行政院所屬機關因公出國人員出國報告書

（出國類別：參訪）

「推動台歐盟環境合作案-赴英國及歐盟參訪活動」與會情形報告

服務機關： 行政院環境保護署

出國人： 職稱： 副署長　副處長　環境技術師

姓名： 張子敬　簡慧貞　邱美璇

出國地點： 英國倫敦及比利時布魯塞爾

出國期間： 100年10月11日至10月15日

報告日期： 100年12月

目錄

「推動台歐盟環境合作案（赴英國及歐盟參訪活動）」與會情形報告

壹、 前言

本案緣起係爲推動第 22 屆台歐盟環境合作中「赴歐交流碳權交易機制設計暨相關能力建構訓練」案，依外交部建議期程，由本署邀集相關執行團隊共赴英國倫敦及比利時布魯塞爾(歐盟總部)進行參訪拜會活動。

我團本次參訪主要任務包括(一)洽談我推動於英國開立與 UNFCCC 及 EU ETS 相互連結之境外碳權管理帳戶，確認我方規劃作法可行性，增進英方瞭解與支持並表達謝意；(二)強化我方與歐盟進行環境合作交流，就溫室氣體排放總量管制及排放交易機制設計等相關議題經驗分享，感謝歐盟長期在氣候變遷議題上對我方之支持；適時宣揚我國因應氣候變遷之努力及成效，包括推動「溫室氣體減量法(草案)」立法工作歷程，建構國內溫室氣體減量能力建構現況及未來展望。

貳、 本團成員任務分工

我國代表團由環保署張副署長子敬率相關執行團隊包括清華大學、財團法人環境資源研究發展基金會及環科顧問有限公司等 7 人，出訪英國及歐盟拜會英國環境署(Environmental Agency(EA)，英國登錄平台 UK Registry 負責單位)及歐盟執委會氣候行動總署(The Directorate-General for Climate Action (DG-CLIMA)，主司歐盟氣候政策)等官方機構與民間研究單位，洽談我國參與國際碳市場與碳權經營策略具體作法之可行性。本團成員任務分工

團員		任務分工
環資會	張長義董事長	隨團指導
清華大學	范建得教授	法律諮詢及探詢國際合作機會 (10/13 晚間先行返台)
臺北大學	李堅明副教授	國內碳交易平台建置說明
本署	簡慧貞副處長	拜會議題主談，並於歐盟執委會氣候行動總署發表本署政策業務簡報
	邱美璇環境技術師	團務處理及參訪資訊彙整
環科工程	余志達資深協理 盧郁青工程師	資訊蒐集及提問

參、 參訪過程紀要

日期	行程
2011 年 10 月 11 日	啓程至英國倫敦
2011 年 10 月 12 日	拜會歐洲氣候交易所(ICE-ECX)、Ecofys、碳揭露專案(Carbon Disclosure Project)、氣候策略網絡組織(Climate Strategy)等四個英國民間企業或智庫。
2011 年 10 月 13 日	會晤英國環境局(Environmental Agency, EA)、碳信託(Carbon Trust)等；傍晚前往比利時布魯塞爾。
2011 年 10 月 14 日	拜會歐盟執委會氣候行動總署(DG CLIMA)、搭機返台
2011 年 10 月 15 日	返程、回到台北

一、 參訪歐洲氣候交易所(ICE-ECX)

(一) 時間：10 月 12 日上午 9 時分至 10 時 30 分

(二) EXC 會晤代表：Mr. George Waldburg-Wolfegg

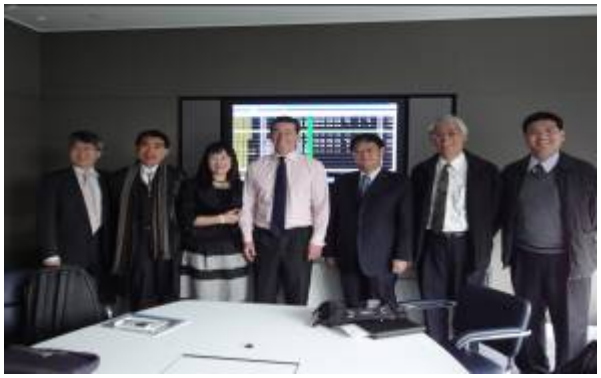
(三) 會晤紀要

W 經理簡報 ECX 運作概況，ECX 在歐洲次級碳交易市場市佔率達 91%，參與者主要係以依歐盟交易指令所納管對象爲主，其中以德國企業爲最大買家，並經其市場供需資料之分析，顯見企業購買減碳額度目的係履行其減碳責任，並非投機套利。

(四) 小結

1.英國政府管理碳交易市場之運作機制係透過跨部會建立運作機制，如英國 DECC 負責定義商品（如 EUA、CER 等），FSA（Financial Service Authority 財政主管機關）負責規範商品交易規則，ECX 則透過與交易會員建立交易契約關係進行交易。

2.我國企業倘需購買次級碳，可透過與 ECX 認可 Clearing Bank(結算銀行)簽訂契約，並經 ECX 規定程序即可購買額度；我方亦可依規劃將此減量額度轉入環資會在英國登錄平台之帳戶，並註銷轉回作爲國內抵換之用。



圖一、參訪 **ICE-ECX 合影**

二、 參訪 ECOFYS

(一) 時間：2011 年 10 月 12 日上午 11 時至 12 時

(二) Ecofy 代表：

Ms. Ann Gardine、Ms. Emelia Holdaway

(三) 會晤紀要

1.標竿值制訂：首先由歐盟官方訂定原則(Criteria)，取同一行業前 10%作爲標竿值。過程爲取得業者資料後，由專家協助判讀資料正確性，經公開意見徵詢後，將成果送交歐盟做最後決定；歐盟完成訂定 15 種行業中 52 種產品標竿值。另，並無針對設備年份進行分類給予不同標準，因其推動標竿值之目的係爲促進企業採用能源效率較佳之設備。

2.該智庫具有標竿值制定方法學及 EU-ETS 核配作法之(Grandfathering、benchmarking、auction)成本效益分析等政策制定經驗，對於我國未來推展總量管制及排放交易制度規劃具有重要參考價值，建議應持續建立雙方交流管道。

圖二、拜會 ECOFYS 合影

三、 會晤碳揭露專案(CDP)

(一) 時間：10 月 12 日下午 14 時 15 分至 15 時 15 分

(二) 地點：駐英代表處會議室

(三) CDP 代表：

政府關係部門主管 Ms. Cassie Chessum、 全球運作部門官員 Ms. Eva Murray

(四) 會晤紀要

1. CDP 積極於全球推動各項碳揭露計畫，協助民間企業、政府機關重視相關減碳議題。藉由成本價值之概念進廣企業自願減碳行動。目前全世界計有 3,050 個企業參與 CDP investor 及 supply chain program。
2. CDP 目前在我國計有三項計畫項目，包含邀集 25 企業參與 CDP investor、華碩及宏碁電腦參與 CDP supply chain、台北市及高雄市參與 CDP 城市碳揭露專案。

圖三、與 CDP 代表會晤討論情形(於駐英代表處)

四、 會晤 Climate Strategies

(一) 時間：10 月 12 日下午 15 時 45 分至 16 時 45 分

(二) 地點：駐英代表處會議室

(三) Climate Strategies 代表：主席 Prof. Michael Grubb

(四) 會晤紀要

1. 渠表示就現階段 UNFCCC 氣候公約之談判情勢觀察，對於 COP17 是否可達成全球共識表示並不樂觀；但渠認爲京都機制應至少會延長至 2015 年，以保障已投入減碳計劃者，此觀察論點與 ICE-ECX Mr. George Waldburg-Wolfegg 持相似看法。

2. 渠認爲不能僅靠碳排放交易制度提供市場誘因，因其碳價格影響因素太多，過於複雜。爲避免無法吸引業者大量投資減碳技術開發之意願，至少應有兩配套作法：一爲建構研發環境，對於產業面臨創新減量技術之研發成本過高問題，倘可透過拍賣機制或訂定碳底價(carbon floor price)，其所獲得收益即可作爲投資低碳技術之研發；二爲提升能源終端使用者有更高意願提升能源效率的誘因，並可結合市場機制或稅制並行。

圖四、與 Climate Strategy Prof. Grubb 討論情形

五、 英國環境署(Environment Agency, EA)

(一) 時間：10 月 13 日上午 11 時 30 分至 14 時 00 分

(二) 地點：EA 辦公室 （位於倫敦北方之 Warrington, 車程約 2.5-3 小時）

(三) EA 代表

碳排放交易部門主管 Jason Bailey、官員 Phil Brookfield 交易支援專員 John Insole、EU ETS 技術經理 Michael Hughes

(四) 我方代表

張副署長子敬、簡副處長慧貞及邱美璇、環資會張長義董事長、清大范建得教授及環科余志達資深協理

(五) 會晤重點

就碳權交易帳戶管理、新排放源保留(NER)、住商部門能源提升計畫(CRC)等相關議題進行意見交換；並確認我規劃於在英國登錄平台(UK registry)開立碳權管理帳戶之作法可行性。

(六) 會晤紀要

1. 我規劃開立英國登錄平台帳戶事宜

(1) 英方表示只要擁有合法之單位(entity)或個人，均可依 UK Registry 開戶申請程序規定，備齊所需規定文件提出申請，約 2-3 星期即可取得帳戶。

(2) Mr. Brookfield 建議非營利財團法人例如環資會，可直接在英國設立非營利公司(Private company by guarantee)，相較於開曼群島設立公司作法，可縮短文件查驗時間，且所成立公司名稱亦無任何限制，僅須該公司地址爲 UN 所認定國家地址即可(亦即公司設立地點須位於 Kyoto Protocol 締約方)

2. 減量額度註銷問題

(1) 只要取得登錄平台帳戶後，帳戶持有者擁有對任何於該帳戶的 CERs 使用管理權利，不論爲賣出或自願註銷，EA 不會干涉其所需用途。

(2) EA 亦爲本團介紹示範該線上操作管理系統，該系統係採電子化作業，管理單位(EA)不另出具書面註銷證明文件，帳戶擁有者可藉由系統查詢，自行製作爲公開報告文件。

(3) UK Registry 及 EUReg REGISTRY 於 2012 年 1 月歐盟各會員國之國家登錄平台將合併爲單一統合登錄系統(Union Registry) ，但帳戶管理規範及帳戶持有者權益不會有改變，英國登錄平台帳戶審核機關仍爲英國 EA。

(4) 對於新設或變更之排放源，英國政府係透過預估可能增加之排放量(採 BAT 前提下)，由英國負責核發許可主管機關依其申請許可順序於 UK 預先保留(set aside) New Entry Reserve (NER)免費額度；惟配合 EU ETS 第三期作法，電力業須經拍賣程序取得。

圖五、與 EA 代表討論情形

圖六、EA 示範登錄平台線上管理系統

六、 參訪碳信託(Carbon Trust)

(一) 時間：10 月 13 日上午 9 時至 10 時

(二) 碳信託代表：Mr. Graham Sinden

我方代表：台北大學李堅明教授及環科公司盧郁青

(三) 會晤紀要

1. 碳信託與世界自然資源組織(WRI)合作，研訂碳足跡證書取得程序：WRI Protocol；兩項程序依據之標準內容差異不大，係由產品之公司自行決定採用何種證書。
2. 碳足跡仍屬企業自發減量之作爲，未來是否成爲強制政策，仍須視歐盟各會員國之決定；現階段係以法國政府最爲積極推動之，英國政府則尚無任何表態。
3. PAS 2050 爲一般性原則，建議我國未來可與碳信託合作，訂定出符合我國國情之部門類別規則(Sector Rule)，作爲各部門排放計算原則參考。

圖七、拜會 Carbon Trust 合影

七、 參訪歐盟氣候行動總署(DG-CLIMA)

(一) 時間：10 月 14 日上午 9 時 15 分至 12 時 30 分

(二) 地點：DG-CLIMA

(三) DG-Clima 代表

歐洲及國際碳市場單位主管 Ms. Mary Veronica Tovsak Pleterski、Ms. Vicky pollard、Ms. Eva Tamme 、Ms. Rasa Sceponaiciute、Mr. Hans Bergman 等 5 人

(四) 會晤紀要

1. DG-Clima 歐洲及國際碳市場單位主管 Ms. Tovsak Pletersk 代表 DG-CLIMA 歡迎我方參訪團，簡要說明歐盟整體氣候政策推動方式，並表達想瞭解我國溫減法及其他氣候政策推動情形。
2. 本署簡副處長慧貞則簡報我推動溫室氣體減量策略規劃：
   (1) 我國自願減量目標及不同情境減量策略，並透過減碳四法分工互補，完備減量法制基礎。
   (2) 本署積極與各界協商以推動「溫室氣體減量法(草案)」立法，納入優先法案，並獲立法院王院長支持。
   (3) 完備溫室氣體管理配套措施之能力建構（含 MRV 制度、EIA 抵換制度及管理平台）。
   (4) 推動於英國登錄平台開立我方境外碳權管理帳戶之目的及進展。
3. DG-CLIMA 與會代表亦分別就歐盟排放交易政策形成經驗、2013 年第三階段(Phase 3)排放交易制度減量額度核配、CERs 抵換限制及航空業納入排放交易制度歷程等進行簡報包括:
   (1) 歐盟排放交易機制歷程與經驗分享
   (2) 歐盟排放交易機制第三期設計

(3) 航空業納入歐盟排放交易機制

(4) 歐盟核配原則、拍賣及標竿值等執行經驗

4. 實施排放交易制度須給予企業長期穩定政策方向，降低投資不確定性。另，依歐盟第三期排放交易指令，CER 仍可繼續使用，期限可使用至 2020 年；惟 2013 年啓動之 CDM 專案，僅限低度開發國家(LDC)，並排除工業製程氣體及土地利用的氧化亞氮氣體。

5. 2012 年後即使歐盟各國登錄系統合併爲單一歐盟登錄系統, 各國仍各自進行其國家登錄平台之作業，即 UK Registry 仍與先前作業相同。

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<td>圖八、Ms. Tovsak Pleterski 接見我代表團</td>
<td>圖九、本署簡副處長慧貞簡報</td>
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圖十、Ms. Eva Tamme 簡報	圖十一、Ms. Vicky pollard 簡報
	
圖十二、Ms. Rasa Sceponiciute 簡報	圖十三、Mr. Hans Bergman 說明
	
圖十二、我團代表提問情形	圖十三、會議討論情形

肆、 與會心得及建議

一、深化與歐盟、英國等國家環保技術交流：

（一）我團此行與英國、歐盟官方單位及民間企業等計 7 個單位進行會晤，就技術層面進行深入討論與交流，具有實質且正面的產出成果，其中歐盟執委會氣候行動總署(DG-CLIMA)，更由其負責歐洲與國際碳市場(European and International Carbon Markets)主管 Ms. Mary Veronica Tovsak Pleterski (Director for European and International Carbon Markets)接見我團，並安排同仁就 EU ETS2013 年第三階段(Phase 3)額度核配、CERs 抵換限制及航空業納入排放交易制度歷程等議題，與我團深入討論及交換意見，顯見歐盟對我代表到訪之重視及善意。

（二）另一方面，英國環境局(EA)代表也協助確認釐清相關平台帳戶申請及英方主政單位管理程序規範，並表示樂意持續與我國在氣候環保政策之執行經驗及技術等，維持良好互動。

（三）綜之，本署此行赴歐與歐盟、英國進行實質交流，不但對我釐清及建置我國碳市場機制設計具有實質助益，更藉機說明我國因應氣候變遷政策及具體作為，與國際分享經驗，廣獲國際專家肯定我國的努力。為此，對於賡續推動與歐盟、英國等環保先進國家之雙邊環保技術合作與交流，建議

持續保持雙方溝通管道之暢通，據以推廣全球碳交易市場發展及連結相關組織之聯繫與交流，推動我國未來與國際接軌認可之實質連結。

二、歐盟 EU ETS 經驗對我國制度建置具體建言:

本次參訪歐盟 DG-CLIMA，該單位與我團分享歐盟 EU ETS 實務經驗，提供歐盟排放交易政策形成過程、法律規範及市場規劃等建議如下:

(一) 歐方建議我排放交易制度設計應避免納入過多抵換機制，應直接採認聯合國 CDM 跟 JI 機制爲宜；同時，也應保持市場彈性，避免過多干預，造成市場僵化，反而不利市場自由化之健全發展。

(二) 實行排放交易制度應有明確法制基礎作爲推動利基，制訂法律時應提供全面且穩定的法制架構，相關規範可階段性修正完備，惟政府主管單位須有明確的規範方向，如此企業才可藉此評估自身投資利益及風險管理，據以提高其投資意願，真正落實減碳成效。

(三) 全球碳市場發展應朝思考減碳需求面及如何擴大國際參與等問題，建立長期且明確的市場機制，藉由提供合理穩定的碳價（carbon price），降低不確定及進行風險管理，據以增進企業投資減碳計畫的意願，促進綠色經濟發展，歐方建議市場價格應有足夠的波動性，不

能將價格固定，否則市場將無法正常運作。

三、建立碳權登錄平台之管理制度交流

(一) 2012 年後歐盟各會員國之登錄系統將合併爲單一歐盟登錄系統（Union Registry），惟歐方及英國相關單位均表示歐盟會員國仍各自進行其國家登錄平台之作業；因此，有關我方擬推動於英國登錄平台開立碳權管理帳戶之相關權益並不會受到影響。

(二) 有鑑於我國持續逐步建構與國際接軌的碳交易平台，並開立境外碳權管理帳戶，以與氣候公約及附件一國家的碳權管理機制接軌，爰此，後續建議可持續透過雙方技術性互訪、或派員赴訓等方式，學習歐盟管理體制之實務作法，完備我碳權管理能力模式。

四、加速完成溫室氣體減量法立法，奠立法制基礎

(一) 我國未來若要彰顯自身減量績效，國內相關減量工作績效宜有明確紀錄與查核機制，以利對外、對內論述，其中最重要的也是其他國家包括歐盟，總會特別關切的就是儘速通過「溫室氣體減量法(草案)」，奠定立法制基礎以利政府相關部門依法行政，逐步建構階段性的溫室氣體減量管理機制，並適時導入市場機制，降低減量成本來維繫產業國際競爭力。

(二) 歐盟表示對於雙邊市場之連結，其主要條件須

同樣屬強制性 Cap-and-trade 措施，且雙方市場規範必須相符。目前我方在溫減法尚未生效且總量管制未實施前，較難討論與歐盟雙邊連結之可能。因此，歐方建議我國初步可採取單邊認可 CER 額度進入歐洲交易市場作法，即單向市場連結方式(oneway linkeage)

(三) 對於持續推動能力建構工作，現階段我國除盤查登錄查證、總量管制及排放交易、先期減量行動等強化因應氣候變遷之能力建構工作外，仍應儘速完備我國溫室氣體減量之法規建置，以強化向國際宣示我減量決心及務實行動之重要立基，歐盟代表認為此亦有助於我正面積極推動成功參與「聯合國氣候變化綱要公約（UNFCCC）」之重要條件。

伍、 附件

- 附件一、歐盟氣候行動總署(DG-CLIMA)組織架構
- 附件二、英國能源與氣候變遷部(DECC)及環境、糧食與鄉村事務部(Defra) 之負責工作任務
- 附件三、歐盟氣候行動總署簡報資料
  - EU ETS : History and Lessons
  - EU ETS design for 2013-2020
  - Aviation in the EU ETS
- 附件四、歐洲氣候交易所 ECX- The Emissions Market 簡報
- 附件五、The Carbon Disclosure Project 簡報
- 附件六、ECOFYS-Introduction to carbon leakage 簡報
- 附件七、Carbon Trust 提供參考資料
  - Guide to PAS 2050
  - Code of Good Practice for Product Greenhouse Gas Emissions and Reduction Claims
  - Business Case for product carbon footprinting Case study: HBOS
  - Business Case for product carbon footprinting Case study: Walkers
  - Business Case for product carbon footprinting Case study: TESCO
  - Business Case for product carbon footprinting Case study: Business Case

附件一、歐盟氣候行動總署(DG-CLIMA)組織架構

DG-CLIMA組織架構

- **DG-CLIMA(氣候環境總署)隸屬於歐盟執委會(European Commission)**
- **成立於2010年2月，主司工作:**
  - 國際和歐盟氣候變化行動政策和戰略之制訂和執行
  - 國際氣候談判
  - 執行歐盟排放交易機制（EU ETS）
  - 監測會員國減量目標執行情況及EU ETS未納入部門的之排放情形
  - 推動低碳和調適技術

- DG-CLIMA與歐盟環境署(EEA)之任務不同，後者主要蒐集、評估及分析歐洲區域之環境資訊，作為各國制定環境政策之決策依據。

資料來源：DG CLIMA網站 (http://ec.europa.eu/dgs/clima/chart/index_en.htm)

附件二、英國能源與氣候變遷部(DECC)及環境、糧食與鄉村事務部(Defra) 之負責工作任務

英國DECC及Defra之 負責工作任務

- 英國政府於2008年10月，將原Defra中的氣候變遷小組與BIS中的能源小組合併成立能源與氣候變遷部(DECC)，主司英國氣候變遷與能源政策之推動。

環境，食品和農村事務部 (Defra)

負責下列領域之政策與法規訂定：
- 自然環境、生物多樣性與動植物
- 可持續發展和綠色經濟
- 食品、農業和漁業
- 動物健康和福利
- 環境保護和污染控制
- 農村社區和問題

氣候變遷小組

能源與氣候變遷部 (Department of Energy and Climate Change)

主要任務：
- 依循綠色新政節約能源並支持弱勢消費者
- 於低碳能源的同時確保能源安全
- 推動英國內外積極對抗氣候變遷行動
- 以負責任與成本有效方式管理能源

經濟、創新與技術部 (Department of Business, \Innovation and Skills

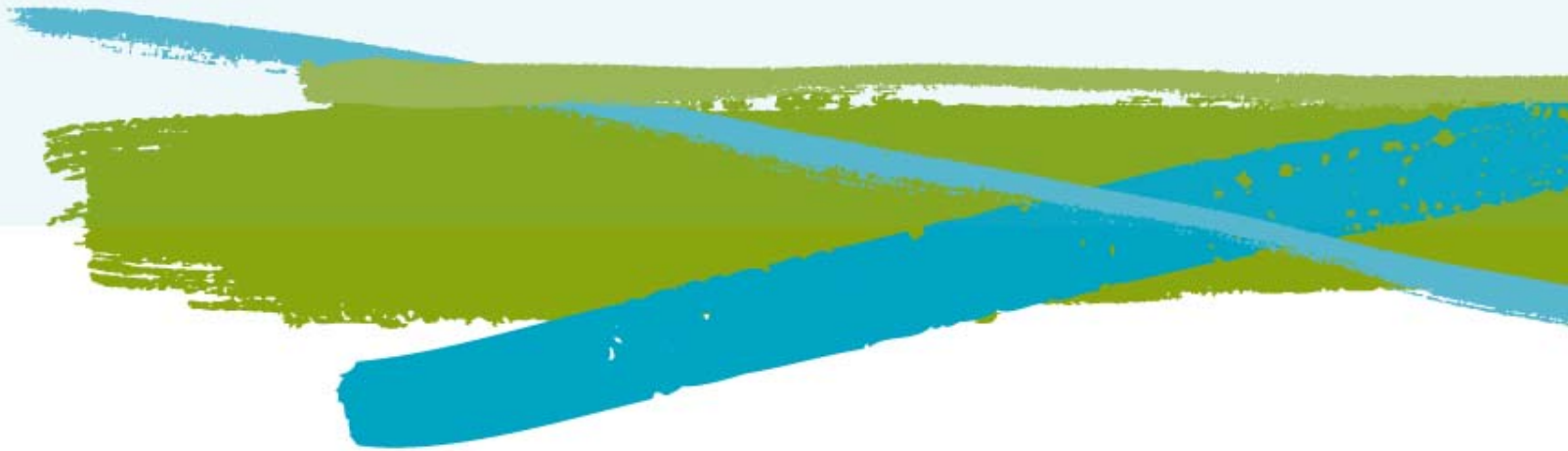
能源小組

附件三、歐盟氣候行動總署簡報資料

14th October 2011

EU ETS : History and Lessons

Vicky Pollard, DG CLIMA



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EU Context

- 27 countries of the European Union + Norway, Iceland and Lichtenstein
- Commission proposes legislation, following extensive stakeholder dialogue
- Legislation agreed by Member State Ministers (Council) and European Parliament
- Member States do direct regulation of companies
- Commission ensures proper implementation, coordinates, runs centralised elements

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EU ETS as part of international carbon market

- More than 80% of the carbon market demand now created outside the negotiations through domestic legislation
- EU ETS and EU Member States have provided the main demand for Clean Development Mechanism (CDM) credits- EU private buyers account for 80% of CDM and JI demand
- New domestic cap and trade systems expected to come on line

Building a robust international carbon market

- Through bottom up linking of cap and trade systems in OECD countries
- Inclusion of advanced developing countries and competitive sectors by 2020?
- Reform of Clean Development Mechanism (CDM), focus CDM on LDCs, replacement over time by a more ambitious sectoral mechanism for advanced developing economies and sectors
- New market mechanisms as a stepping stone to ETS

➢ Provisions in revised EU ETS legislation

Next Steps

- Continued agreement of implementing measures for Phase 3
- January 2012: aviation emissions need to be covered by allowances
- January 2012: Single EU registry
- January 2013: beginning of Phase 3

EU ETS Structure

- Mandatory system
- A collective cap one the number of allowances for all installations covered by the system
- Point of regulation: source of pollution
- Currently caps emissions from ~11,500 energy-intensive installations across EU, covering ~2 billion tonnes CO_2/year (~45% of EU CO_2 emissions)
- Operators must report verified emissions each year & hand in one emission allowance per tonne of CO_2 emitted
- Penalty for non-compliance – €100/ tonne from Phase 2

Scope of application

- Began with partial coverage focussed on large direct emitters of CO2:
  - Power generation and other large combustion installations >20MW
  - Refineries
  - Iron and Steel production
  - Cement
  - Pulp and paper,
  - Lime, Glass, Ceramics
- Expanding to include:
  - From 2008, emissions of N2O from fertiliser production
  - From 2008, Norway, Iceland and Liechtenstein
  - From 2012, covers aviation to/ from EU (with no double-coverage where equivalent measures taken abroad)
  - As from 2013, EU ETS extended to new large industrial emitters (certain chemical sectors and aluminium, emissions of PFCs)

Some figures: Emissions covered by sector in the EU ETS from 2012

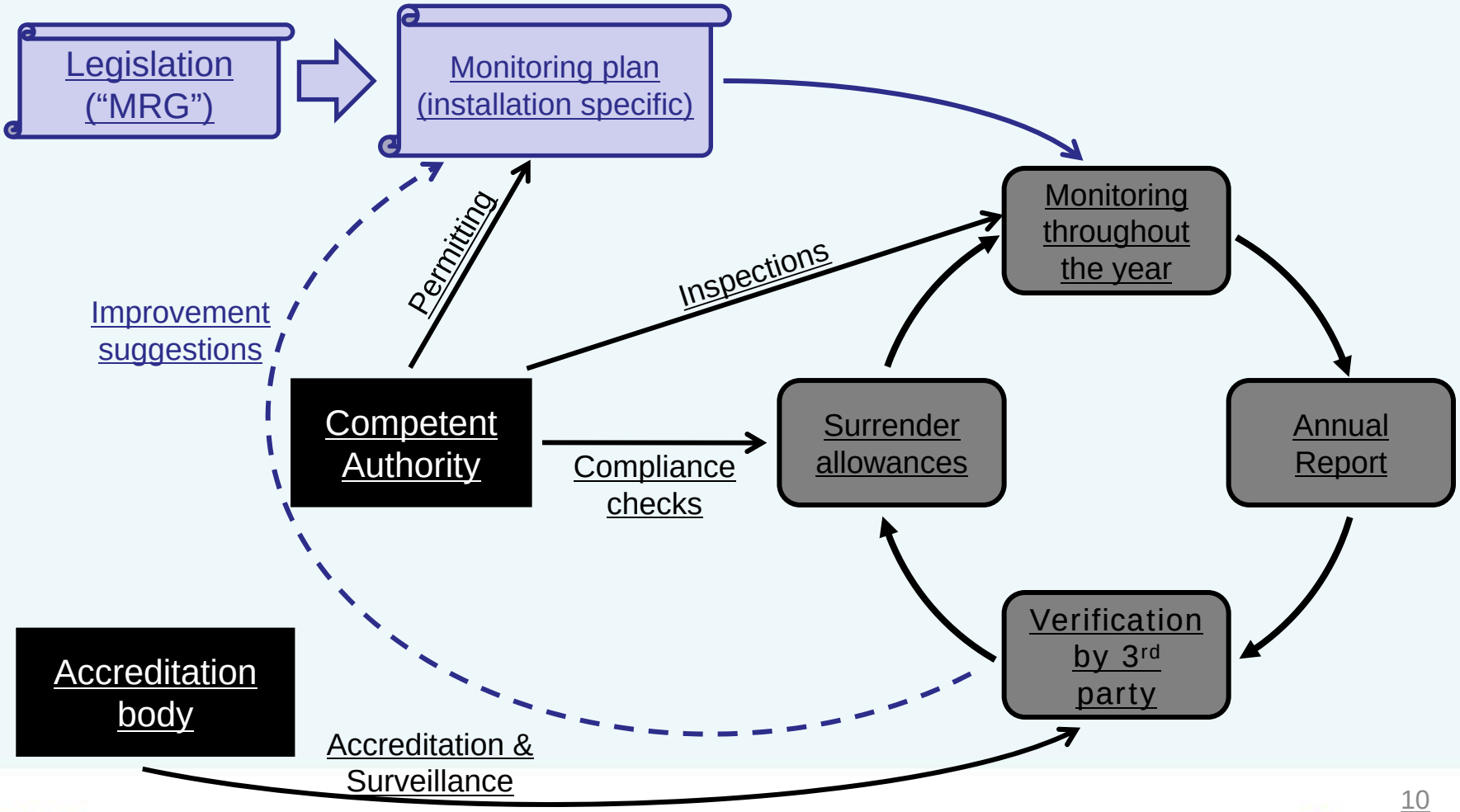
Combustion installations	1491
aviation	~220
Cement and lime	188
Mineral oil refineries	152
Iron or steel	133
Pulp, paper and board	31

Source: Verified 2008 EU-27 emissions for EU ETS installations (m tonnes of CO2 equivalent).

Achievements in phase 1

- The world's largest carbon market gets off the ground and carbon enters the boardroom
- Carbon market infrastructure is established
  - Electronic registry system
  - Installations monitor and report emissions
  - Independent verification of reported emissions
- A liquid market emerges
  - Market intermediaries – brokers and exchanges
- Market is provided with increasingly solid analysis
- Valuable learning for authorities and companies

EU ETS "Compliance Cycle": robust data on installations emissions



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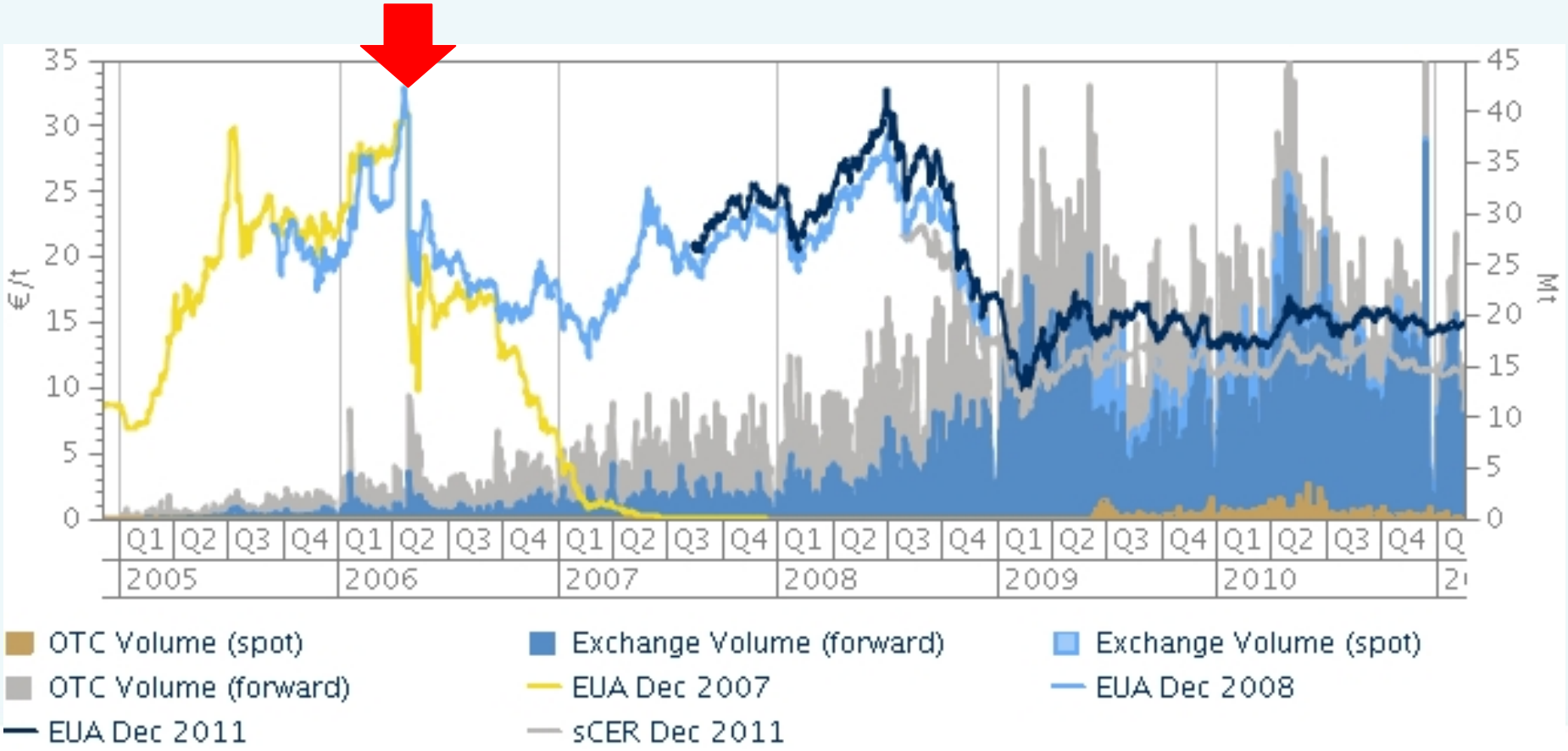
Phase I lessons

- Allocation and cap setting:
  - Lack of good data in government bodies
  - Lobbying on allocation undermined cap
  - Underestimation of abatement potential
- Importance of MRV'd installation emissions data

First and very important lesson: need for verified emissions data from installations



Source Point Carbon

[1] assessment by Ellerman et al, 'Pricing Carbon 2010

[2] verified emissions data, European Commission

Phase 2 lessons

- Robust emissions data- tighter cap with fewer allowances in the market
- More auctioning, but free allocation: windfall profits where costs can be passed on
- Increasingly mature market

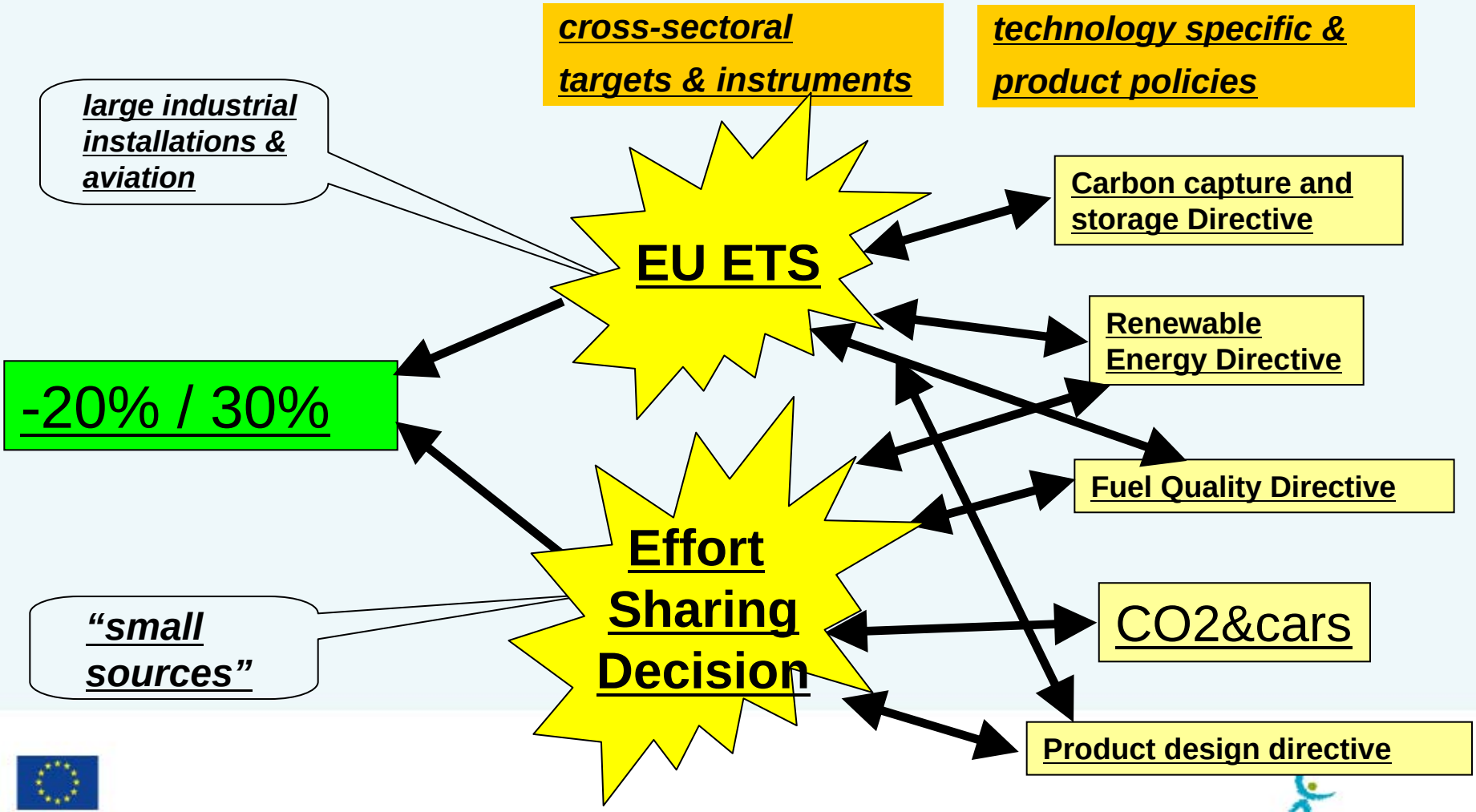
Issues not specific to the carbon market:

- Dealing with criminal activity
- Impacts of the recession

And lessons from Phases 1 & 2

- Wide acceptance of benefits of more harmonisation and centralisation
- Cap-setting and allocation has proven to be the biggest challenge …… because of the significant asset value of the allowances – around € 30-50 billion
- Benefits of separating cap setting and allocation
- Calls for more certainty: long-term emissions reduction path

The EU Climate and Energy Package (agreed 2008)



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GHG Target by 2020:

-20% compared to 1990

-14% compared to 2005

EU ETS

-21% compared to 2005

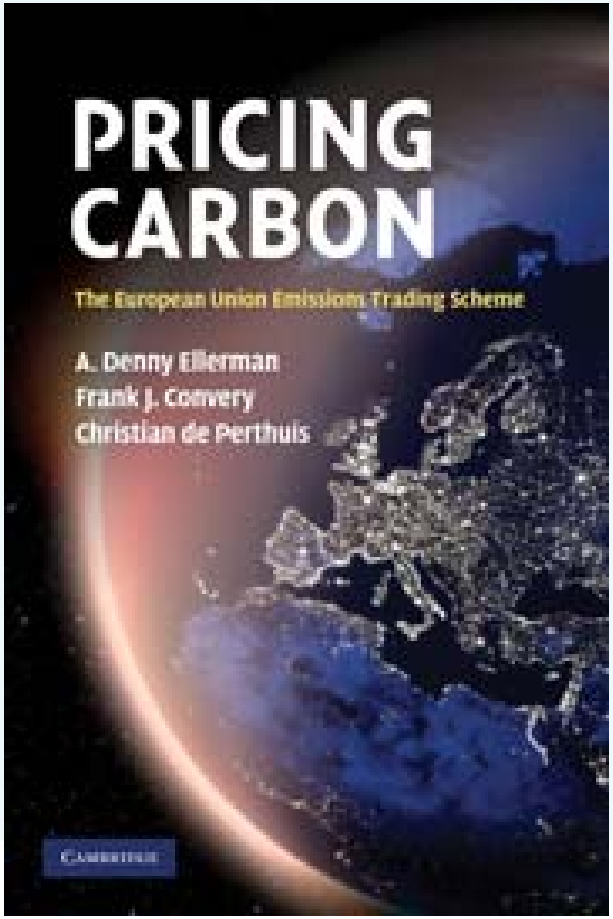
Non ETS sectors

-10% compared to 2005

27 Member State targets, stretching from -20% to +20%

Impact

- 2005-2007 -2% to -5% emissions reductions due to ETS (Ellerman et al)
- -10 % 2007-2010 (verified emissions data)
- Point Carbon Surveys
  - 2005: 5% of participants took future cost of carbon into account for investment
  - By 2006 this had risen to 65%
  - By 2010, 59% say 'EU ETS has already caused emissions reductions in my company'


PRICING
CARBON
The European Union Emissions Trading Scheme
A. Denny Ellerman
Frank J. Convery
Christian de Perthuis

Lessons learnt so far

- Don’t aim for perfection on day one (“*Rome was not built in a day*”)
  - Coverage: Start with partial (downstream) coverage and extend in a stepwise fashion
  - Cap-setting: Make sure you have a good grasp of emissions data when setting the cap
    - If not, set cap for a limited time period / don’t let conservatism creep in / provide for a mechanism to adjust cap (“one-off”) early on
- Keep cap-setting separate from allocation
  - best to set cap up-front in primary legislation

Lessons learnt so far ctd.

- Don’t reinvent the offsets wheel
  - Recognise (selectively) CDM and JI offsets
- Provide for sufficient regulatory stability
  - Regulator should provide clear and stable framework …
  - … but shouldn’t give itself discretion to correct “undesired” market outcomes …
  - … otherwise you may end up with a “political market” or no market at all …
  - … and undue price volatility due to political uncertainty
- Review and mid-term correction is needed, but give the market as much foresight (in particular as regards the cap) as possible

Thank you for your attention

Further information on

- EU ETS:
  http://ec.europa.eu/clima/policies/ets/index_en.htm

EU ETS design for 2013-2020

14 October 2011

Eve.TAMME@ec.europa.eu
European Commission
DG Climate Action
Unit B.3 International Carbon Market, Aviation and Maritime

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Main elements of Phase III 2013-2020

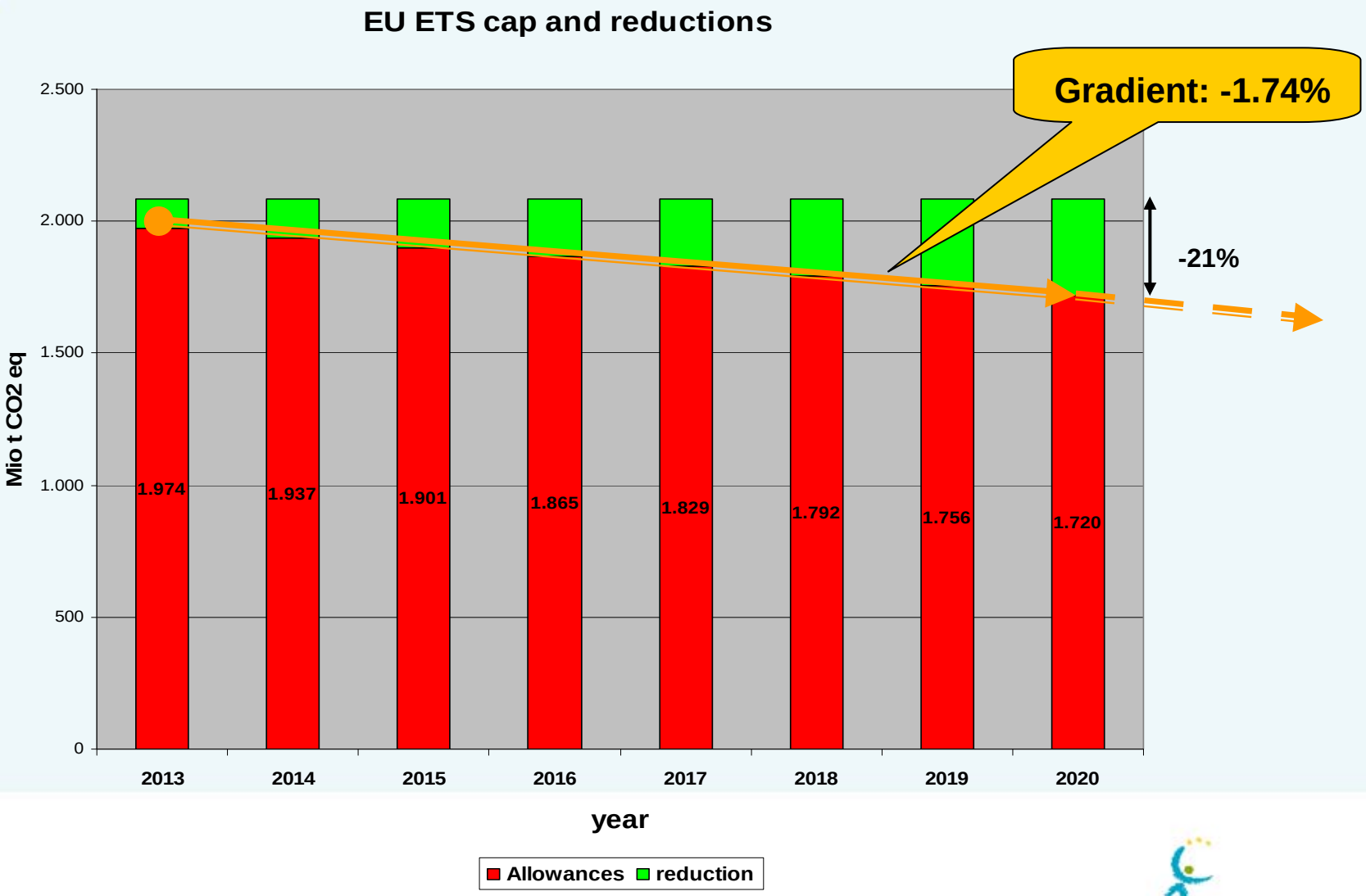
- More predictability: longer trading period and linear reduction trend beyond 2020
- Single EU-wide cap instead of 27 national caps
- Fully harmonised allocation rules
- Strengthened monitoring, reporting and verification
- Increased scope:
  - New sectors: aviation, aluminium, ammonia producers
  - New gases (nitrous oxide and perfluorocarbons)
- Single EU Registry

An EU-wide Phase III cap

- Setting an EU-wide cap up-front in legislation
  - provides for more certainty and predictability for companies and other market participants
  - separates cap-setting from allocation
  - enables fully harmonised free allocation rules

- Cap in 2020 of **1.72 billion** allowances (phase I cap was 2.3 bn, phase II was 2.08 bn tonnes)
  - **21 %** below 2005 verified emissions
  - Trajectory up to and beyond 2020
  - Tightening in case of international agreement

Inducing change: EU ETS puts a limit on emissions to 2020 and beyond



Fully harmonised allocation rules

- Auctioning is default allocation method:
  - From 2013, more than 50% of allowances auctioned, gradually increasing thereafter with aim to reach full auctioning by 2027
  - Regulation (binding rules) adopted
- Phasing out free allocation for sectors not exposed to risk of carbon leakage
  - 2012: **80%** free allocation
  - 2020: **30%** free allocation
- 100% free allocation based on ambitious ex-ante benchmarks for sectors at risk of carbon leakage

Allowance value: to address social and economic objectives

- From 2013, large auctioning revenues. Perhaps € 30 billion per year (depending on price)
- Allows redistribution based on level of development:
  - **88%** of auction rights distributed according to Member States' emission shares
  - **12%** distributed to new Member States for purpose of solidarity and growth

Use of auction revenues

- Member States to determine use of revenues, but at least **50%** should be used tackle climate change and shift to low-emission technologies
- **100%** of aviation auctioning revenues for climate change
- Declaration by Heads of State and Government that revenues would be used for these purposes
- Member States shall report to the European Commission on use of revenues through reports under GHG Monitoring Decision 280/2004/EC

Single EU Registry

- EU Allowances held in accounts in electronic registries set up by Member States, regulated by the European Commission
- The registries system keeps track of the delivery (ownership) of allowances (but not value)
- In 2005-2012, each Member State had its own registry (27 registries linked through the central hub CITL)
- From 2012, there will be a single EU registry
  - IT development and maintenance will be managed by the European Commission and
  - User and Account administration managed by national administrators in Member States

Thank You !

For more information on EU Emissions Trading System:
http://ec.europa.eu/clima/policies/ets/index_en.htm

Aviation in the EU ETS

14 October 2011

Rasa Ščeponavičiūtė
International Carbon Market, Aviation and Maritime
European Commission – DG CLIMA

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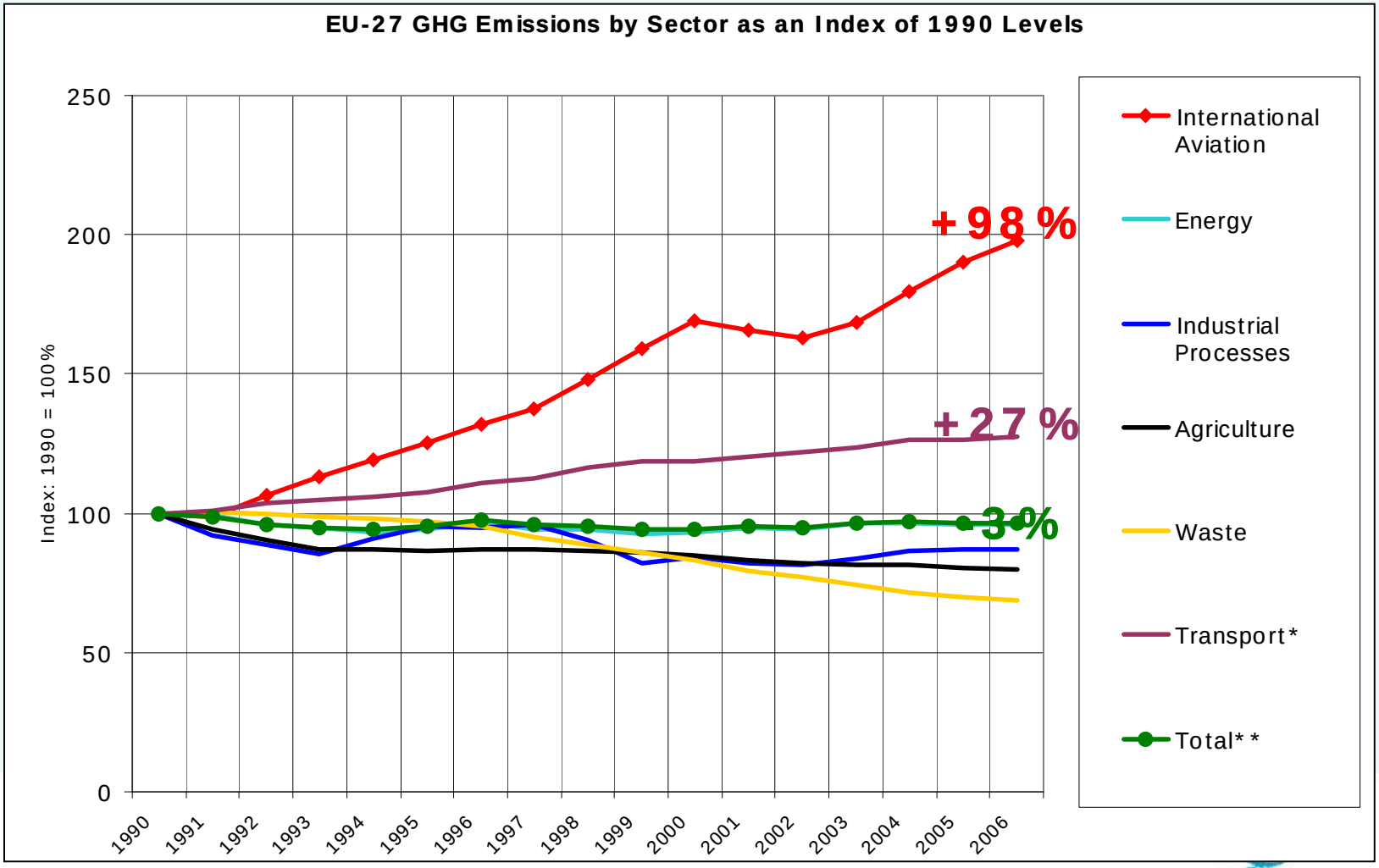
Contents:

- Aviation emissions
- Aviation in EU climate policy
- Functioning of Aviation ETS
- Impacts of Aviation ETS

Growth of aviation emissions in Europe



Source: EU energy and transport in figures - Statistical pocketbook 2009, DG TREN

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Aviation emissions have grown strongly - and are forecast to continue to grow

- In Europe, international aviation emissions have **doubled** since 1990
- ICAO forecasts suggest that by 2050, global aviation emissions could be **3 to 7 times higher** than 2006 levels
- Action is clearly needed if we are to meet our climate goals

The EU has a comprehensive approach to address aviation's climate impacts

- ATM Modernisation
  - Single European Sky
  - SESAR Joint Undertaking
- Research and Development of New Technology
  - Clean Sky Joint Technology Initiative (€1.6 bn over 7 years)
  - Sustainable alternative fuels
- New Standards
  - Through ICAO, e.g. new aircraft CO_2 standard
- Market-Based Measures
  - EU Emissions Trading System
    - Includes direct support for aviation biofuels

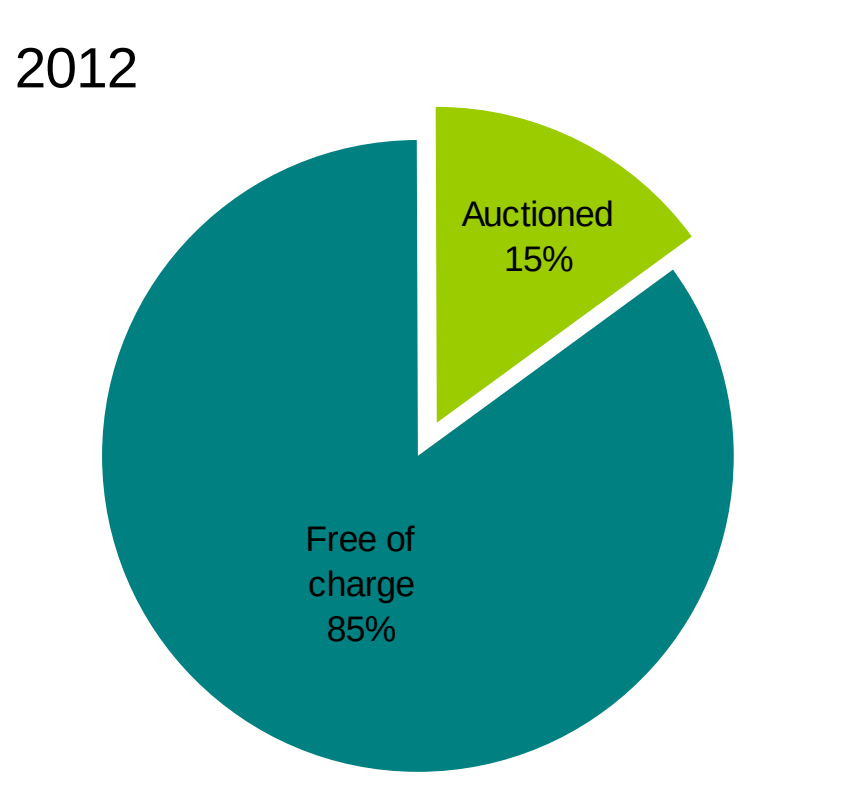
Why did the EU consider emissions trading appropriate for aviation?

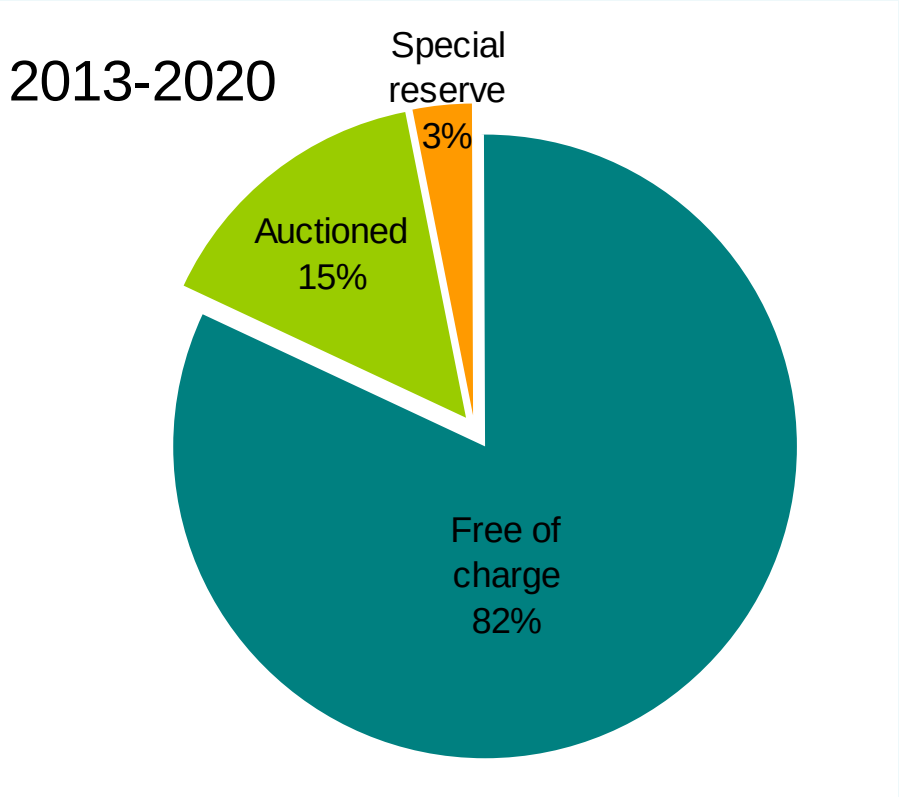
- ETS has well known benefits:
  - Achieves least cost emissions reductions
  - Guaranteed environmental outcome
  - Allows for the growth of the aviation sector
  - Predictability
  - Flexibility for business: to reduce emissions, to acquire reductions from other sectors or auctions

In 2009 EU ETS law expanded to include aviation

- Flights arriving at and departing from EU airports included in EU ETS
- Expands the total EU ETS cap by approximately 10%
- Baseline is average annual emissions of 2004-2006 (221.4 Mt CO_2)
  - 2012 cap = 97% of baseline
  - 2013-2020 cap = 95% of baseline
- Aviation can use allowances from other sectors and international credits for compliance

The majority of the allowances are allocated to airlines for free

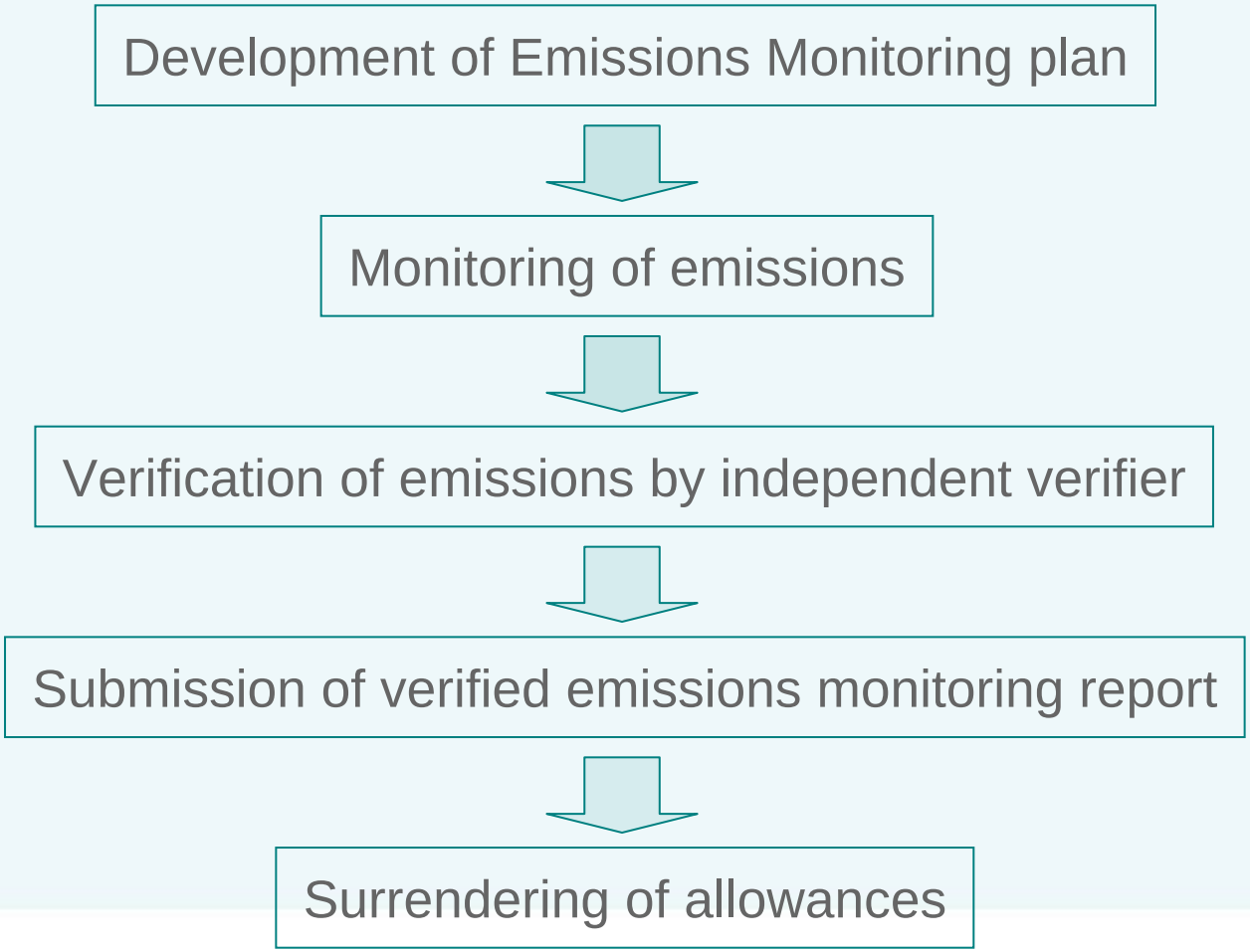




The EU ETS exempts specific flights

- Activity based *de minimis* exempts commercial air transport operators with:
  - Around 2 flights or less per day, or
  - less than 10 000 tonnes of CO_2 / year
- Small aircraft - of less than 5 700 kg
- State, military, rescue, emergency, VFR, training flights

Annual compliance cycle



Implementation of the system is on track

- Legislation in force since 2009
- All EU Member States have adopted national laws implementing it
- All significant commercial aircraft operators in full compliance
- Benchmark adopted on 26 September 2011 for allocation of free allowances to over 900 airlines

Next steps

- **2011**
  - 26 December — Member States publish allocations of allowances to aircraft operators
- **2012**
  - 28 February — Issuing of free allowances for 2012
  - 31 March — Submission by aircraft operators of 2011 verified emissions report
- **2013**
  - 28 February — Issuing of free allowances for 2013
  - 31 March — Submission by aircraft operators of 2012 verified emissions report
  - 30 April — Surrender of allowances equal to the 2012 emissions

Use of auctioning revenues

- The legislation states that auctioning proceeds should be spent in the EU and third countries
- On a range of areas:
  - Reduce emissions
  - Adaptation
  - Global Energy Efficiency and Renewable Energy Fund
  - Reducing deforestation in developing countries
  - Research and development (mitigation and adaptation in aeronautics and air transport)
  - Low emission transport
- EU Member States must report how they use revenues to the European Commission

Impacts of aviation ETS - estimated costs per passenger

Route	CO_2 emissions	Cost Low case	Cost High case
Frankfurt to Moscow	329 kg	€0.60	€2.00
Amsterdam to Johannesburg	683 kg	€1.64	€8.20
London to Taipei	837 kg	€2.01	€10.04

- Calculated per passenger one way
- CO_2 emissions from **ICAO carbon calculator** – reflecting typical aircraft and load factors
- Carbon price = €12
- Assumes growth in aviation from baseline – typical long haul airlines receive around 80% of their required allowances for free

Main benefits

- Has low economic impact on airlines
- Forecasted emissions savings – over 70 million tonnes of CO_2 in 2020
- Incentivises demand for biofuels
  - the proportion of sustainable biofuels counts as zero emissions
- EU ETS foresees €3.6 billion for low carbon technology demonstration projects including biofuels
- Results in investment in developing countries through use of international credits (e.g. CDM)

The EU ETS legislation contains flexibility

- Where another State takes measures to reduce climate change impacts, the European Commission may use “implementing powers” to exclude from the EU ETS flights arriving from that state
- EU ready to engage constructively in consultations

Next steps – internationally

- EU committed to continue working within ICAO for a global agreement
- EU prepares its own action plans, and encourages other States to submit action plans to ICAO, which could include information on any specific assistance needs
- Follow up work on market based measures in ICAO needs to accelerate – EU fully supports this process

Aviation in EU ETS

More information:

http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm

EUROPEAN COMMISSION

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附件四、歐洲氣候交易所

ECX- The Emissions Market 簡報

The Emissions Market

ICE Futures Europe – ECX

Presentation for Taiwan Environmental Protection Agency

Legal disclaimer

Forward-Looking Statements

This presentation may contain “forward-looking statements” made pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. Statements regarding our business that are not historical facts are forward-looking statements that involve risks, uncertainties and assumptions that are difficult to predict. These statements are not guarantees of future performance and actual outcomes and results may differ materially from what is expressed or implied in any forward-looking statement. For a discussion of certain risks and uncertainties that could cause actual results to differ from those contained in the forward-looking statements see our filings with the Securities and Exchange Commission (the "SEC"), including, but not limited to, the "Risk Factors" in our Annual Report on Form 10-K for the year ended December 31, 2008, as filed with the SEC on February 11, 2009. SEC filings are also available in the Investors & Media section of our website. All forward-looking statements in this presentation are based on information known to us on the date hereof, and we undertake no obligation to publicly update any forward-looking statements.

GAAP and Non-GAAP Results

This presentation includes non-GAAP measures that exclude certain charges the company considers non-operating. We believe that the presentation of these measures provides investors with greater transparency and supplemental data relating to our financial condition and results of operations. These non-GAAP measures should be considered in context with our GAAP results. A reconciliation of Adjusted Net Income and Adjusted Earnings Per Common Share to the equivalent GAAP measure and an explanation of why we deem these non-GAAP measures meaningful appears in our earnings press release dated November 3, 2009 and in the appendix to this presentation. The reconciliation of Adjusted EBITDA to the equivalent GAAP results appears in the appendix to this presentation. Our earnings press releases and this presentation are available in the Investors & Media section of our website at www.theice.com. Our earnings press release is also available in our Current Report on Form 8-K filed with the SEC on November 3, 2009.

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ICE Company Overview

ICE Futures acquired European Climate Exchange (ECX) in July 2010

ICE Regulated Futures Exchanges

U.S. & CANADA

AGRICULTURAL

Cocoa
Coffee
Cotton
Sugar
Orange Juice
Barley
Canola Oil

FINANCIAL

FX
US Dollar Index
Russell Equity Indexes

EUROPE ENERGY

Brent Crude
WTI Crude
Sour Crude
Gas Oil/Heating oil
Natural gas
Electricity
Coal
Emissions

ICE OTC

OTC Contracts

OTC Energy
Oil and refined products
Physical/Financial gas
Physical/Financial power
Natural gas liquids

OTC Credit – Creditex
CDS – indexes, single names, structured products

OTC Iron Ore

ICE Data & Services

MARKET DATA

Real-time prices/screens
Indices and end of day reports
Tick-data, time and sales
Market price validations

SERVICES

ICE eConfirm
Coffee & cocoa grading facilities

ICE Clear U.S., ICE Clear Canada

ICE Clear Europe – CDS and Energy

ICE Trust – CDS Clearing

Integrated Markets, Clearing and Technology

ICE ECX Milestones

2011
- ICE/ECX Emissions Open Interest surpasses 1 billion tonnes

2010
- ICE acquires Climate Exchange Group Plc

2009
- 200 new cleared OTC contracts

2008
- ICE Clear Europe launched

2007
- ICE acquires Creditex and the Clearing Corporation as part of the CDS market development
- ICE acquires NYBOT, Winnipeg Commodity Exchange, ChemConnect and Chatham Energy

2005
- 2005 ICE Futures Europe becomes 100% electronic
- European Climate Exchange launched and partnership formed with ICE

2003
- Chicago Climate Exchange launched
- Acquires International Petroleum Exchange

2000
- ICE formed and electronic OTC energy markets launched

The Kyoto Protocol

- Kyoto Protocol adopted in 1997, entered into force in 2005
- Sets binding targets for 39 industrialised countries and the EU for reducing greenhouse gas emissions: 5.2% reduction against 1990 levels over 2008-2012 period
- Countries must meet targets through national measures or via three market-based mechanisms:

	Mechanism		Units	
1.	Emissions Trading	→	AAUs	} 1 tonne of CO2e
2.	Clean Development Mechanism	→	CERs	
3.	Joint Implementation	→	ERUs	

The European Emissions Trading Scheme (EU ETS)

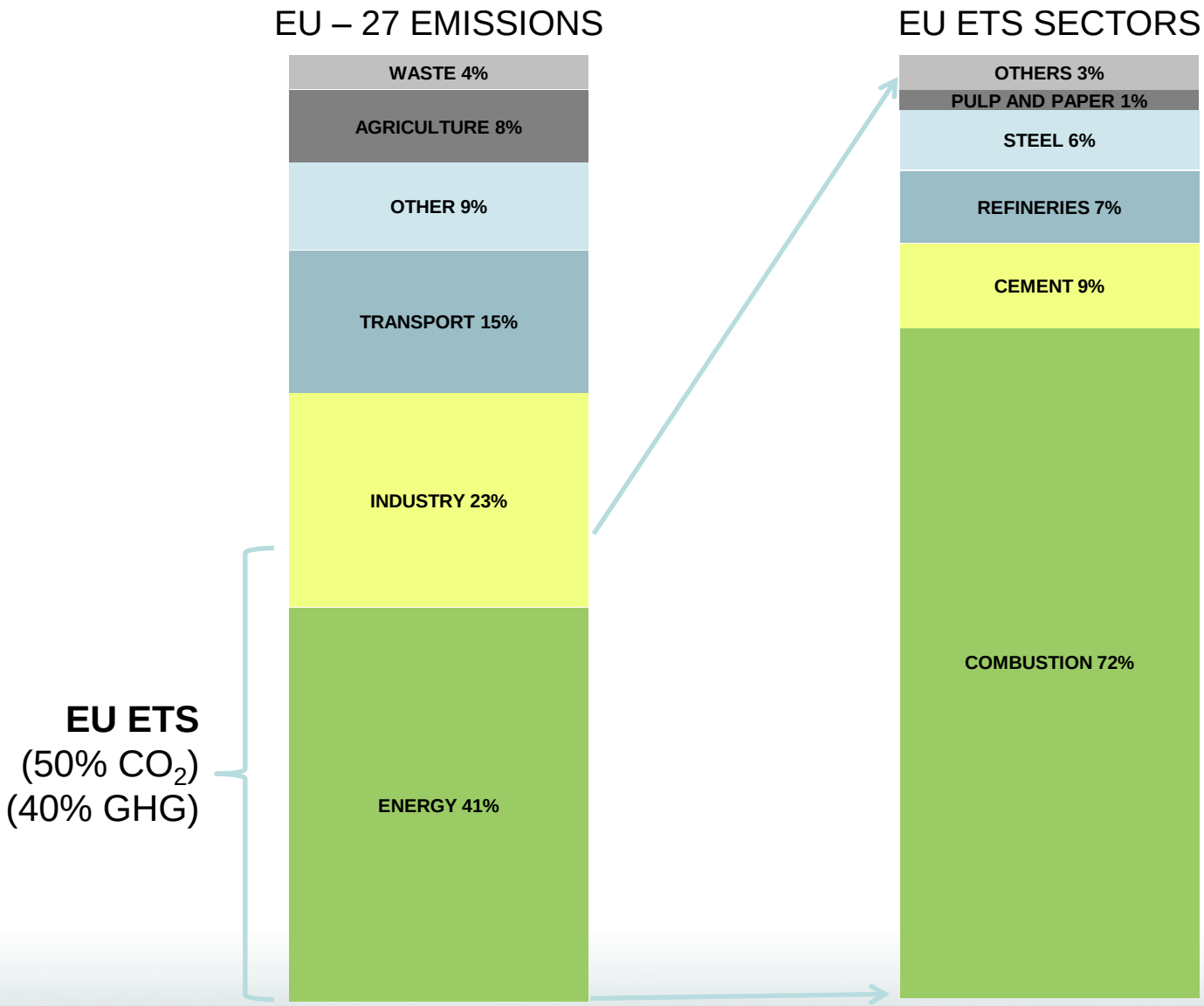
- The largest and most established regional cap-and-trade programme in the world

- The Aim
  - To enable countries to reduce their GHG emissions in a cost-effective way.

- How does it work?
  - By capping the annual CO2 output of approximately 12,000 installations: power generators and heavy industry.
  - National Allocation Plans determine how many allowances each installation in each country receives: 1 EU Allowance (EUA) equals 1 tonne of CO2.
  - Annually, companies must surrender allowances equivalent to their emissions.
  - Companies that produce fewer emissions can sell their excess allowances to those that exceed their targets, creating a carbon price, and allowing emissions to be reduced at least cost.
  - If companies fail to surrender allowances they pay a fine of €100 per tonne
  - Countries allow a portion of target to be met through CERs (13% EU average), generated through the Clean Development Mechanism.

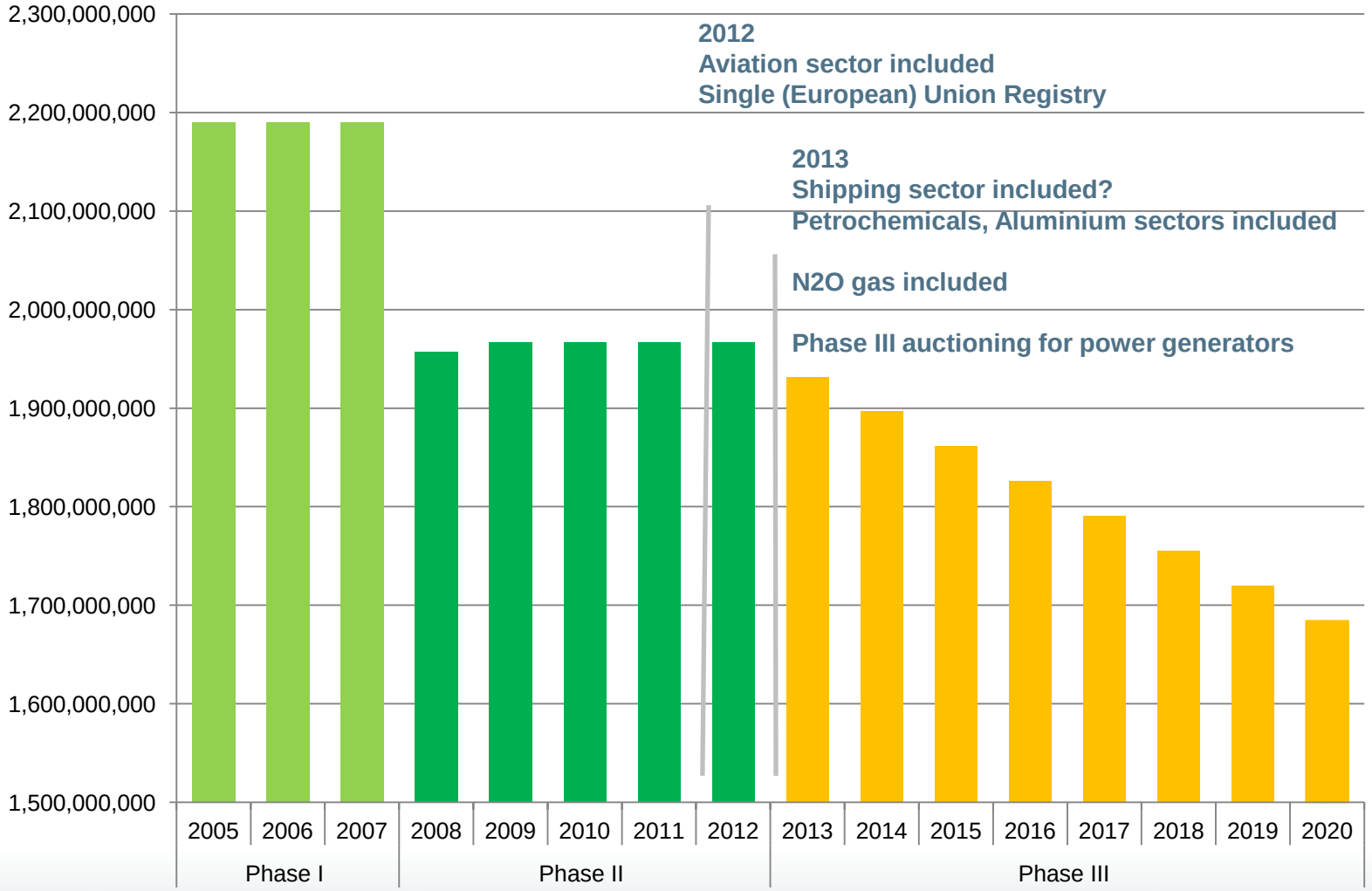
EU ETS

Emissions and sectors



IntercontinentalExchange

EU ETS
3 Phases (2005-2020)



ICE ECX Emissions Products

Futures, Options and Daily Futures (Spot) Contracts

- European Union Allowances (EUAs)

  issued through the EU

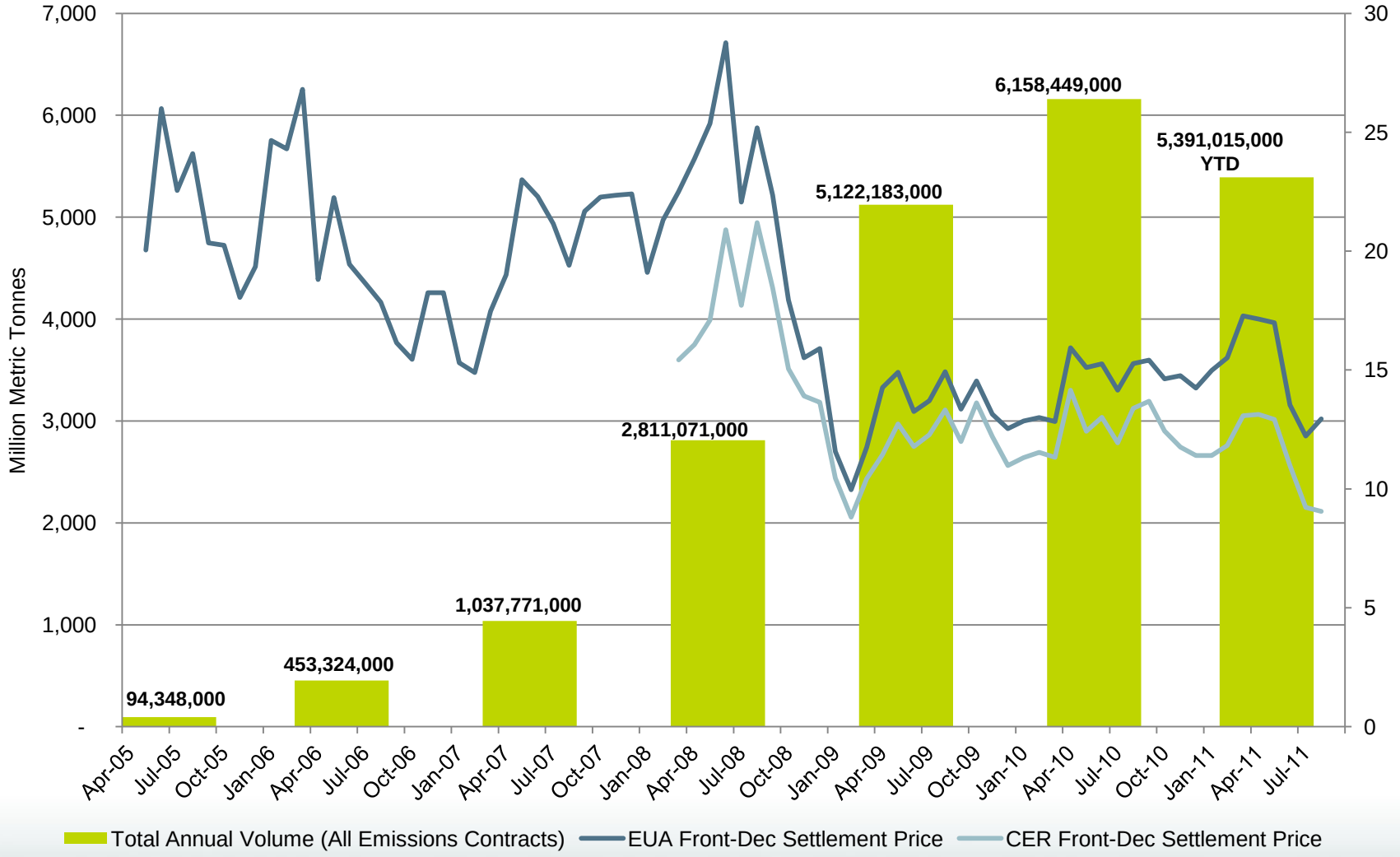
- Certified Emission Reductions (CERs)

  issued through the CDM

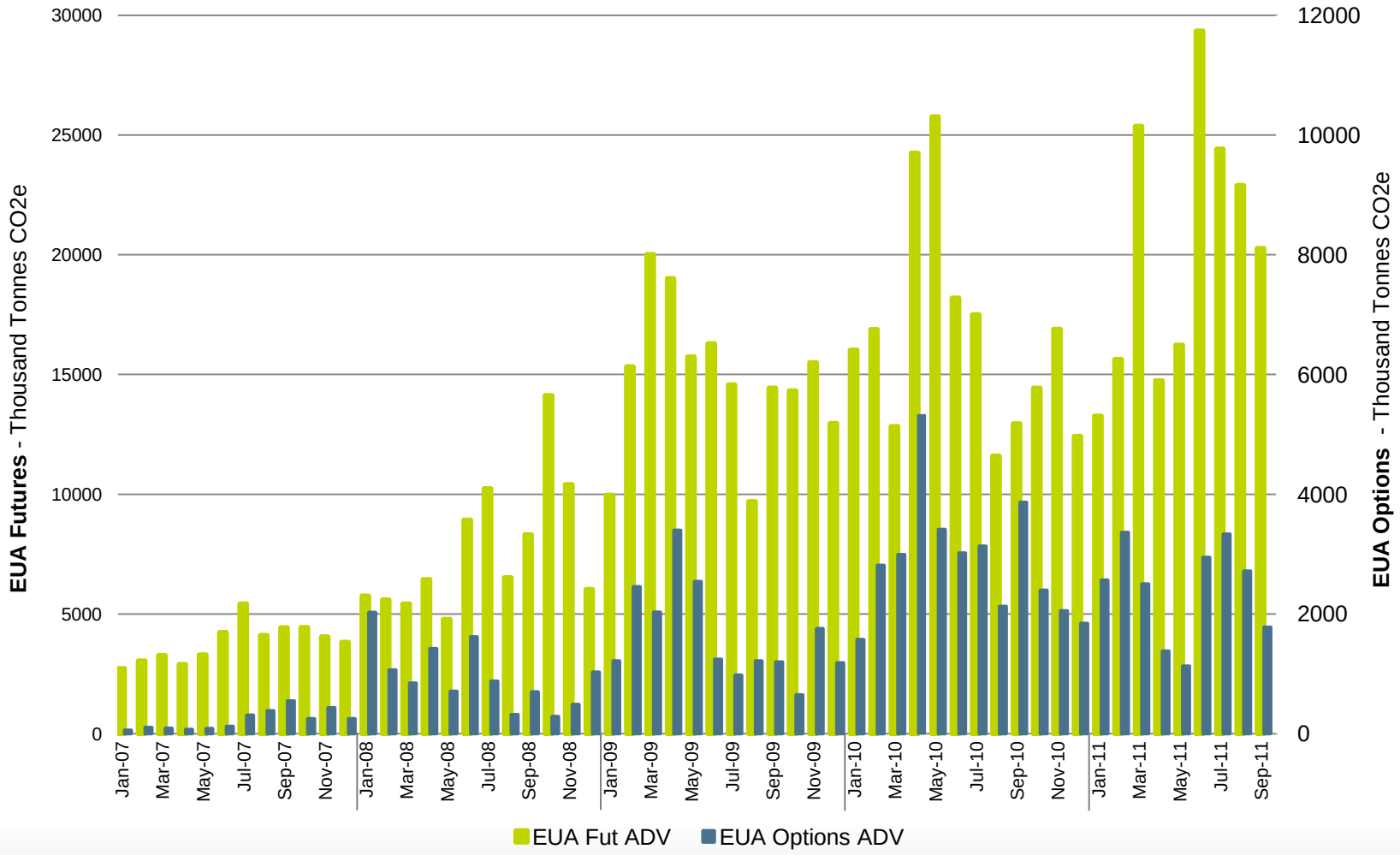
- Emission Reduction Units (ERUs)

  issued through JISC or Track 1 Host Countries
  (Daily Futures to be launched shortly)

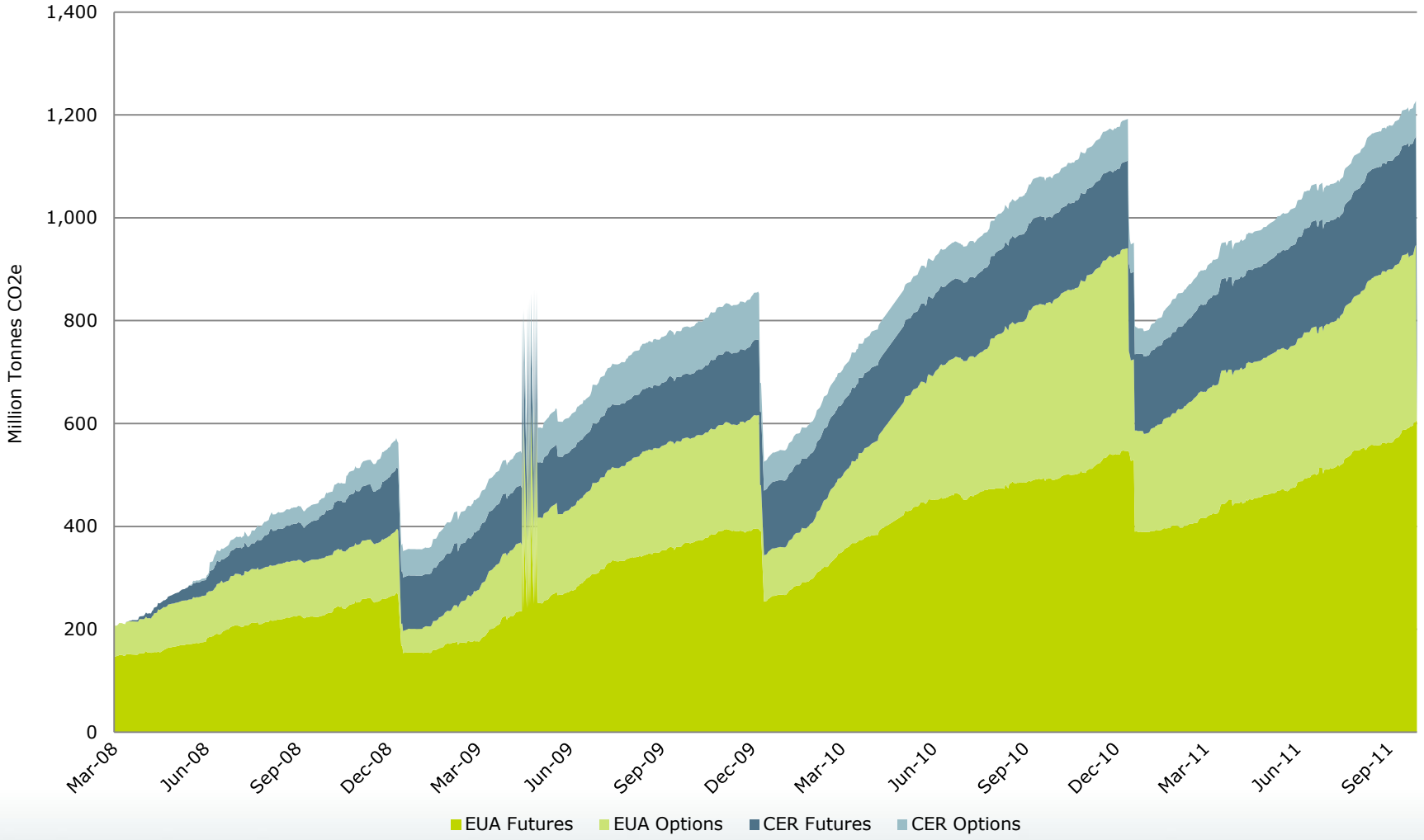
Annual Total Volume & Settlement Price



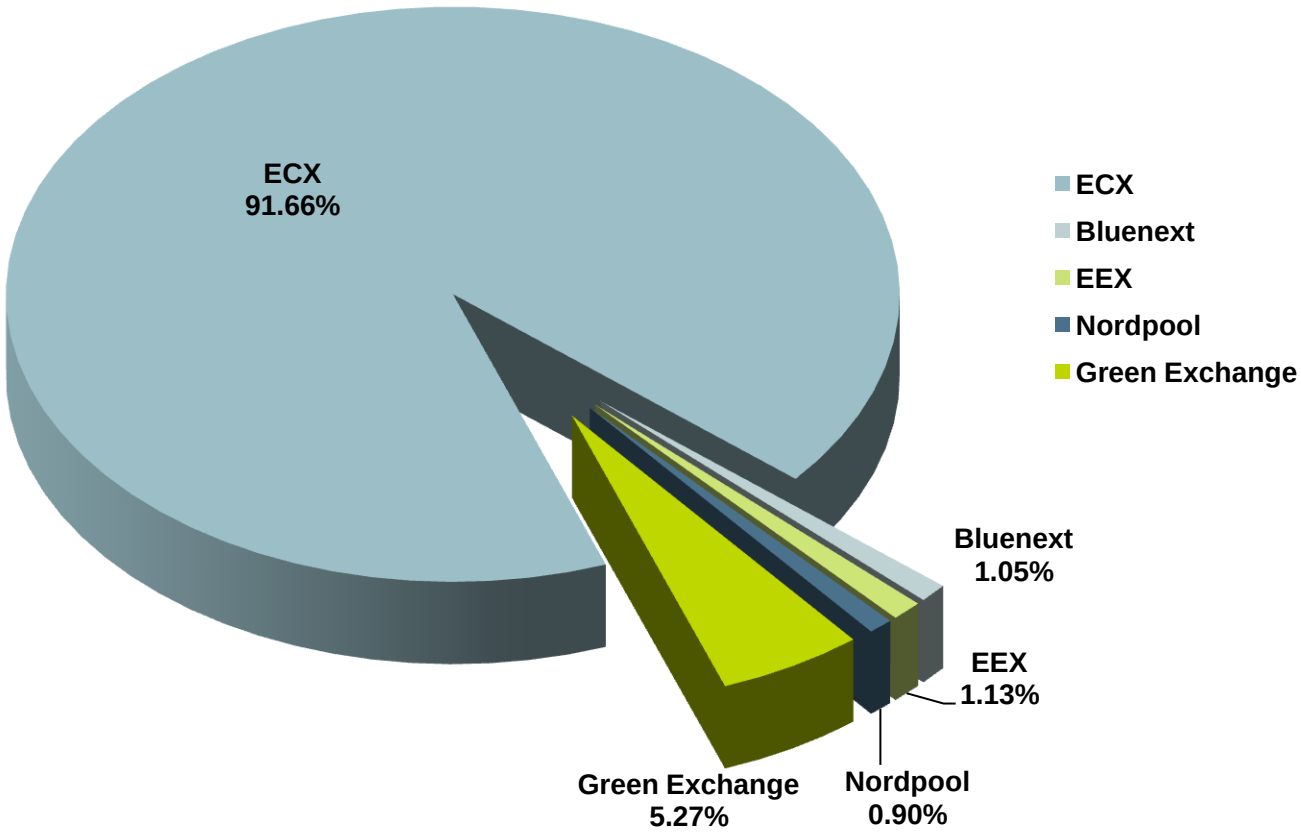
EUA Historic Average Daily Volume



Total Open Interest



Carbon Exchanges Market Shares – September 2011



ICE ECX was awarded leading Exchange in the European Carbon Market Survey in 2005, 2006, 2007, 2008, 2009 & 2010

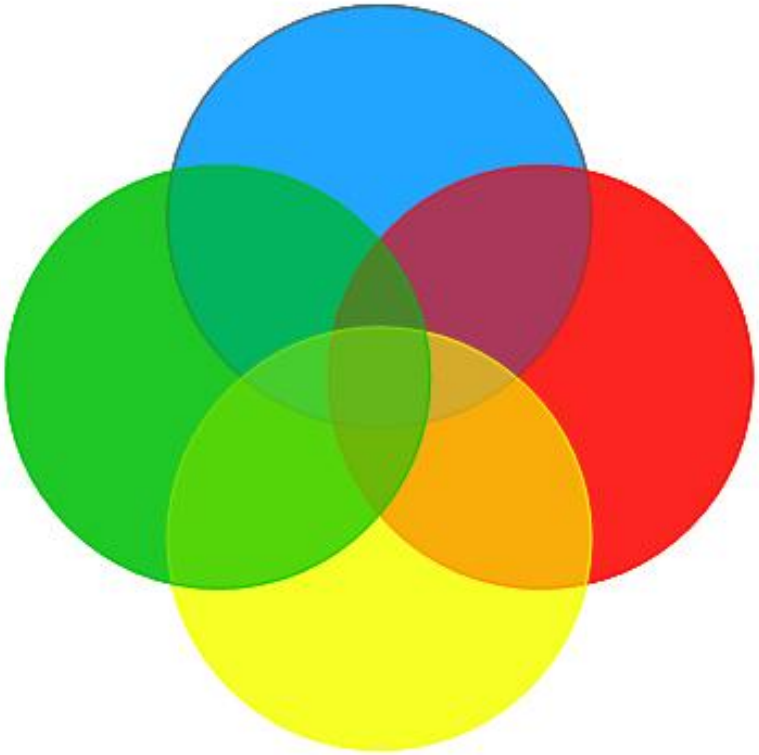
Environmental Finance PUBLICATIONS

BEST EXCHANGE EU ETS

BEST EXCHANGE Kyoto Project Credits (JI & CDM)

Trading Carbon
Carbon Market Participants

Compliance Players
(E.g. Power generators, industry)

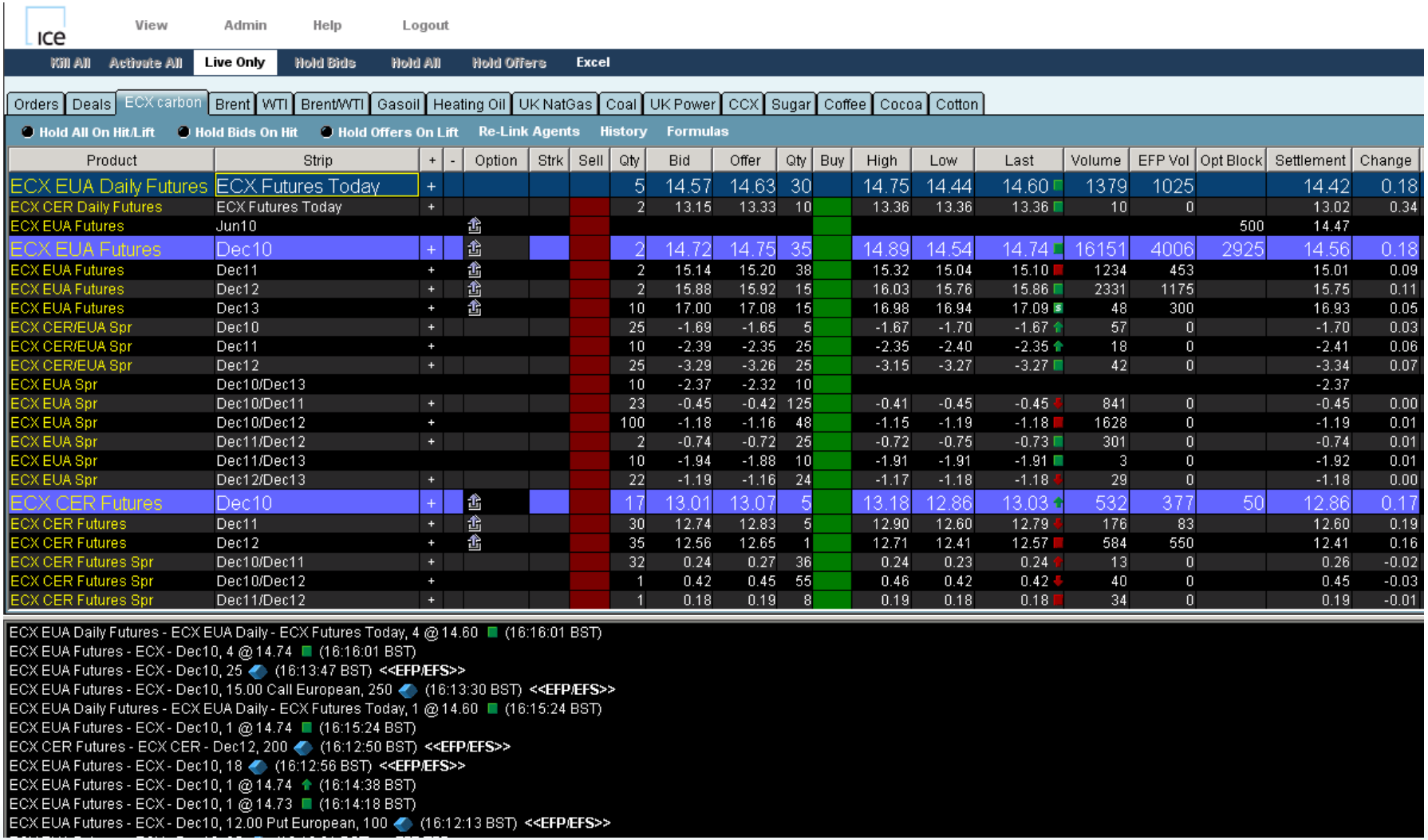


Intermediaries
Investors
(E.g. Brokers, banks)

Liquidity Providers
(E.g. Investment banks, hedge funds)

Project Developers
(E.g. CDM investors, Carbon funds)

WebICE – The ICE Trading Platform



Product	Strip	+	-	Option	Strk	Sell	Qty	Bid	Offer	Qty	Buy	High	Low	Last	Volume	EFP Vol	Opt Block	Settlement	Change
ECX EUA Daily Futures	ECX Futures Today	+					5	14.57	14.63	30		14.75	14.44	14.60	1379	1025		14.42	0.18
ECX CER Daily Futures	ECX Futures Today	+					2	13.15	13.33	10		13.36	13.36	13.36	10	0		13.02	0.34
ECX EUA Futures	Jun10																500	14.47	
ECX EUA Futures	Dec10	+					2	14.72	14.75	35		14.89	14.54	14.74	16151	4006	2925	14.56	0.18
ECX EUA Futures	Dec11	+					2	15.14	15.20	38		15.32	15.04	15.10	1234	453		15.01	0.09
ECX EUA Futures	Dec12	+					2	15.88	15.92	15		16.03	15.76	15.86	2331	1175		15.75	0.11
ECX EUA Futures	Dec13	+					10	17.00	17.08	15		16.98	16.94	17.09	48	300		16.93	0.05
ECX CER/EUA Spr	Dec10	+					25	-1.69	-1.65	5		-1.67	-1.70	-1.67	57	0		-1.70	0.03
ECX CER/EUA Spr	Dec11	+					10	-2.39	-2.35	25		-2.35	-2.40	-2.35	18	0		-2.41	0.06
ECX CER/EUA Spr	Dec12	+					25	-3.29	-3.26	25		-3.15	-3.27	-3.27	42	0		-3.34	0.07
ECX EUA Spr	Dec10/Dec13						10	-2.37	-2.32	10								-2.37	
ECX EUA Spr	Dec10/Dec11	+					23	-0.45	-0.42	125		-0.41	-0.45	-0.45	841	0		-0.45	0.00
ECX EUA Spr	Dec10/Dec12	+					100	-1.18	-1.16	48		-1.15	-1.19	-1.18	1628	0		-1.19	0.01
ECX EUA Spr	Dec11/Dec12	+					2	-0.74	-0.72	25		-0.72	-0.75	-0.73	301	0		-0.74	0.01
ECX EUA Spr	Dec11/Dec13						10	-1.94	-1.88	10		-1.91	-1.91	-1.91	3	0		-1.92	0.01
ECX EUA Spr	Dec12/Dec13	+					22	-1.19	-1.16	24		-1.17	-1.18	-1.18	29	0		-1.18	0.00
ECX CER Futures	Dec10	+					17	13.01	13.07	5		13.18	12.86	13.03	532	377	50	12.86	0.17
ECX CER Futures	Dec11	+					30	12.74	12.83	5		12.90	12.60	12.79	176	83		12.60	0.19
ECX CER Futures	Dec12	+					35	12.56	12.65	1		12.71	12.41	12.57	584	550		12.41	0.16
ECX CER Futures Spr	Dec10/Dec11	+					32	0.24	0.27	36		0.24	0.23	0.24	13	0		0.26	-0.02
ECX CER Futures Spr	Dec10/Dec12	+					1	0.42	0.45	55		0.46	0.42	0.42	40	0		0.45	-0.03
ECX CER Futures Spr	Dec11/Dec12	+					1	0.18	0.19	8		0.19	0.18	0.18	34	0		0.19	-0.01

The Delivery Mechanism

EUAs and CERs are held in dematerialized form in a national registry account.

In the case of physical delivery a registry account will be required.

How to Trade ICE ECX Products

- There are two ways to access the market:

  1. **Order-Route** as a customer of a Clearing Member

  2. **Membership** of ECX/ ICE Futures Europe (again as a customer of a Clearing Member)

- Access route decision will be driven by:
  - Nature of company
  - Type of trading activity
  - Volume of trading activity
  - Regulatory status

- Both Order-routers and Members are given direct screen access to execute orders on the market
- Both require a Clearing Agreement
- Members have discounted trading fees (see later slide)

ICE ECX Clearing Banks

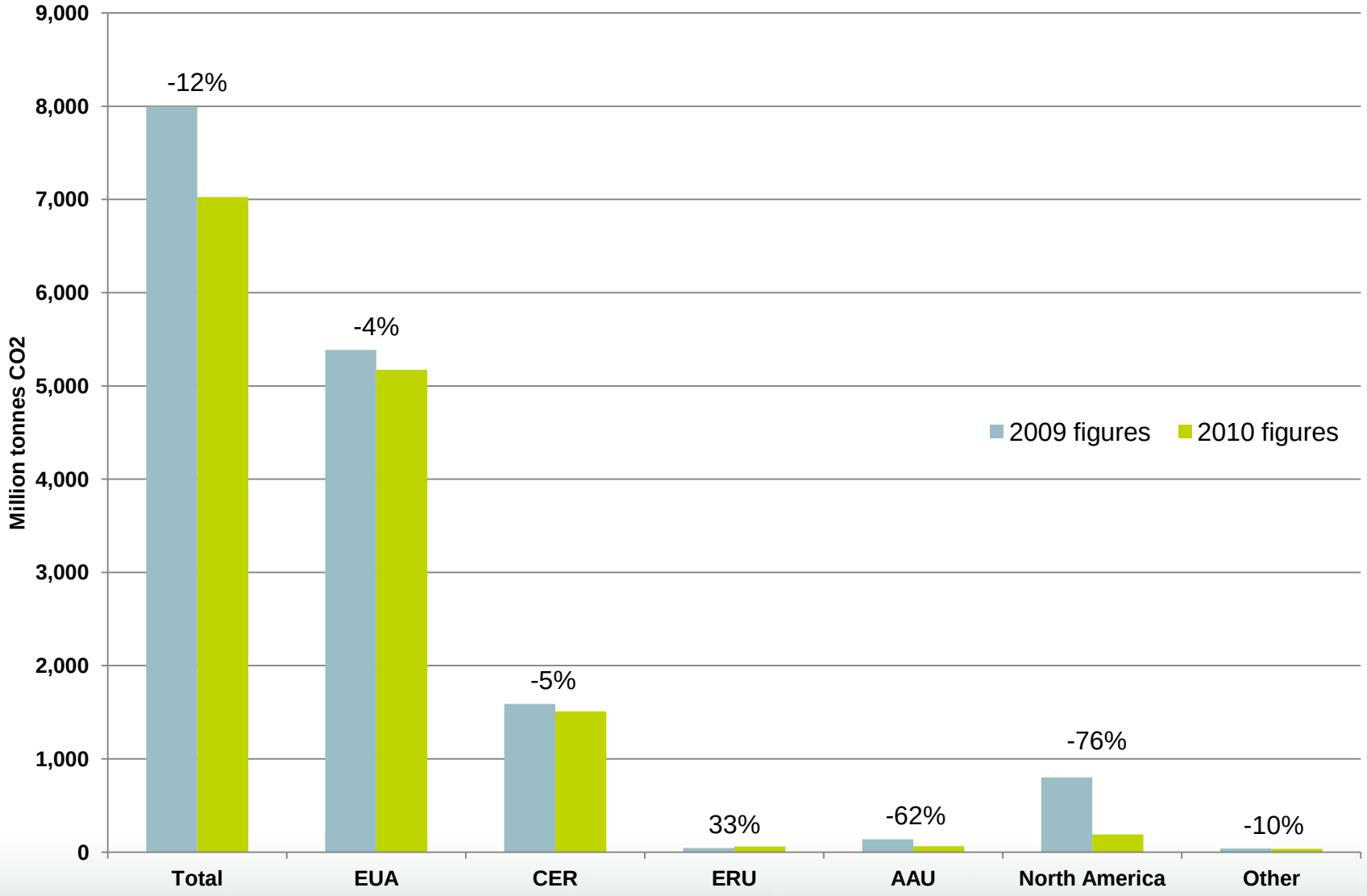
Clearing Members of ICE Futures Europe able to offer clearing and trading services for ECX Contracts to third parties.

ICE ECX Members

ABN Amro Clearing
ADM Investor Services
ADM Investor Services International
Alpiq Swisstrade
Bache Commodities
Banco Santander
Barclays Capital
BG International
BHF Bank
BNP Paribas Commodity Futures
BP Gas Marketing
British Energy Trading and Sales
Carbon Desk Ltd
Centrica Energy
CEZ A.S.
Citadel Derivatives Trading
Citadel Equity Fund
Citigroup Global Markets
Consus France S.A.R.L.
Credit Agricole Corporate & Investment Bank
Credit Suisse Securities
Deutsche Bank AG
E&T Energie
EDF Trading
EDP – Energias de Portugal
EGL Trading AG
EGL Energia Iberia
Electrabel
Endesa Generacion
Energa-Obrót SA
Energie AG
FCStone, LLC
First New York Securities
Five Rings Capital, LLC
Fortnum Power and Heat
Galp Power
Gazprom Marketing & Trading
Gazprom M&T – Singapore
Getco
GFI Securities
GH Financials
Goldman Sachs International
HSBC Bank
ICAP Futures LLC
ICAP Securities
IMC Trading
Infinium Capital Management
Jaypee International
JP Morgan Securities
Jump Trading
KFW Bankengruppe
KI Energy Ceska, S.R.O.
Limestone Trading
Macquarie Bank Limited
Macquarie Futures USA
Marex Financial
Marubeni Corporation
Merrill Lynch Commodities
Merrill Lynch International
MF Global
Mitsui & Co.
Mizuho Securities USA
Morgan Stanley
Natixis Commodity Markets
Newedge Group (UK Branch)
Nomura International plc
Octagon Carbon
Optiver VOF
Orbeo
OTC Europe LLP
Penson GHCO
PetroChina International
Proxima Clearing
R.J. O'Brien & Associates
Rand Financial Services
RBC Capital Markets Corporation
RBC Europe
REN Trading
Rosenthal Collins Group LLC
RWE Supply and Trading
Sagacarbon
Scottish Power Energy
SEB Futures
Shell Int. Trading & Shipping
Smartest Energy
Spectron Energy Services
Stadtwerke Leipzig
Statkraft Energi
Sucden UK
Sunrise Brokers
Susquehanna
TFS Derivatives
The Royal Bank of Scotland
RBS Sempra Energy
ThyssenKrupp
Tibra Trading Europe
Total Global Steel
Tradelink
TRX Futures Limited
Tullett Prebon Securities
UBS
Universal Data
Vattenfal
Verbund
Virtu Financial
Wells Fargo Bank
XR Trading, LLC

www.theice.com/FuturesEuropeMembers.shtml

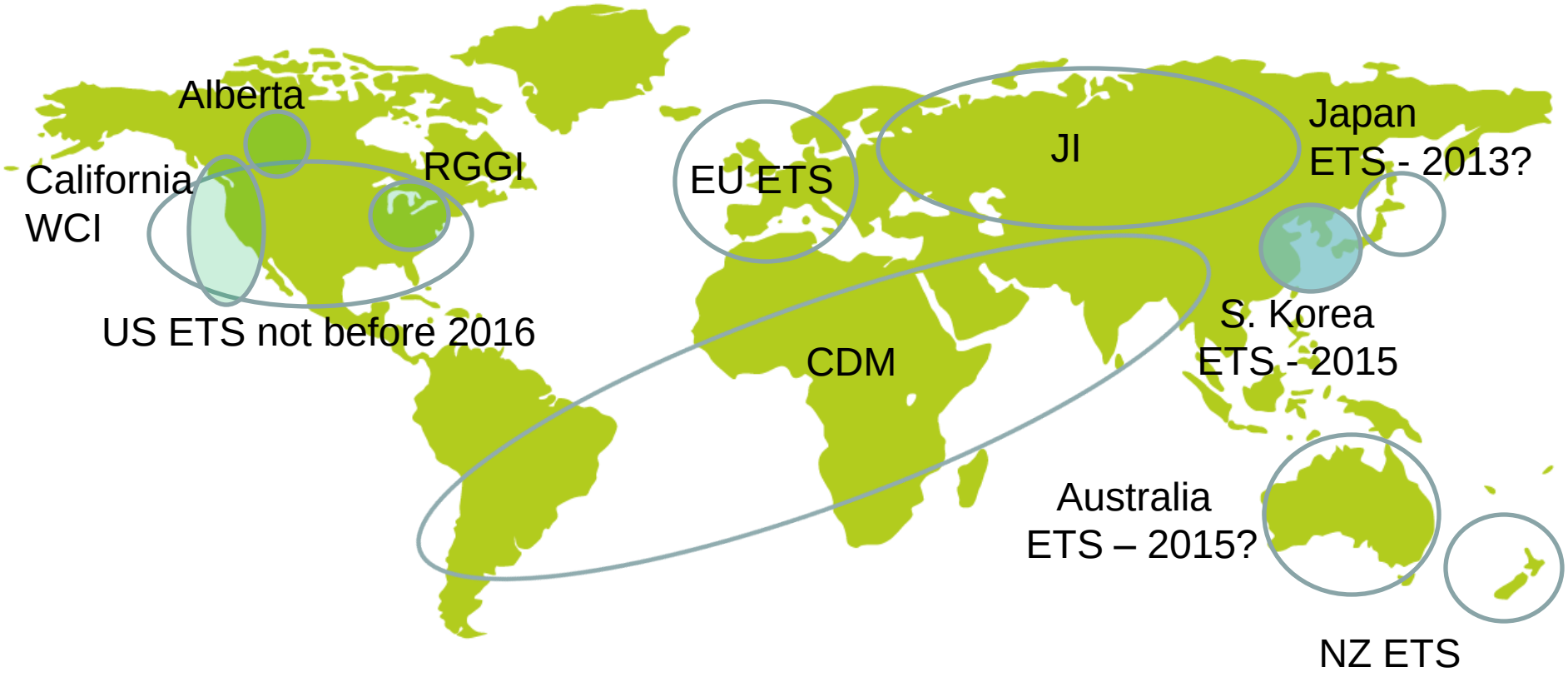
Global Carbon Market Volume



*Source: World Bank, except *Bloomberg New Energy Finance*

Global Carbon Market

Schemes in various stages of development



ICE ECX Contracts Fee Structure

Futures, Options & Daily Futures

Fee Type	EUA & CER Futures	EUA & CER Options	EUA & CER Daily Futures (Spot)
Exchange Fee *(inc Blocks, EFPs and EFSs)*	**Members €2.00** ***or:*** **Order Routers €2.50**	**Members €2.00** ***or:*** **Order Routers €2.50**	**Members €4.00** ***or:*** **Order Routers €5.00**
ICE Clear Europe Clearing Fee *(inc Blocks, EFPs and EFSs)*	**€1.50**	**€1.50**	**€3.00**

- All Exchange and Clearing Fees are charged per lot per side. 1 lot represents 1,000 metric tonnes.
- ECX Options are subject to a €1.50 Exercise Fee

Margin Rates
EUA and CER Contracts

Margin comes in two forms: Initial and Variation Margin

1. **Initial margin** is a returnable good faith deposit required whenever a futures or options position is opened. The money is returned when the position is closed out or expires (goes to delivery).
2. **Variation Margin** represents the profit/ loss in a position each day. ICE Clear Europe calculates the profits/ losses sustained on each position at the end of day.

	ECX EUA Futures Contract (per lot)
Outright Sep 11 to Dec 11 Mar 12 to Dec 14 Dec 15 to Dec 20	 €872 €963 €1,147
Inter-month spread	€350

	ECX CER Futures Contract (per lot)
Outright Sep 11 to Dec 11 Mar 12 to Dec 12 Dec 13 to Dec 20	 €661 €683 €751
Inter-month spread	€200

ECX EUA & CER Daily Futures Contract ('Seller Security')
EUA: 18% CER: 18%
N/A

NB:

- 80% initial margin offset currently applies between EUAs and CERs.
- Inter-month spread applies to EUA or CER spread trades and charged per spread trade, not per leg.
- EUAs & CERs are accepted as collateral for initial margin - a 100% haircut applies.
- Seller Security for Daily Futures is expressed as a percentage of the contract value and is returned after 24 hrs.
- Initial margin for Options is not charged on a "per lot" basis but calculated on the overall risk (delta) of the position.

Margins correct as of 3rd October 2011

Utilities Inter-Commodity Offsets

		Natural Gas				Power	Coal							Emissions		
		NBP	TTF	NCG	GAS	UK Base	RD	RB	NEWC	INDO	CAPP	CSX	PRB	EUA	CER	ERU
Natural Gas	UK NBP		77-89%	85-90%	85-90%	42-60%	42-52%	33-58%	42-57%	-	-	-	-	34-50%	27-44%	-
	Dutch TTF	86-91%		86-91%	86-91%	55-74%	42-58%	45-56%	41-57%	-	-	-	-	47-52%	40-48%	-
	German NCG	85-90%	86-91%		91%	84-89%	60-72%	63-75%	55-63%	-	-	-	-	63%	59%	-
	German GASPOOL	85-90%	86-91%	91%		83-89%	60-72%	63-75%	55-63%	-	-	-	-	63%	59%	-
Power	UK Base	42-60%	55-74%	84-89%	83-89%		30-39%	30-46%	26-37%	-	-	-	-	30%	37-38%	-
Coal	Rotterdam (API2)	42-52%	42-58%	60-72%	60-72%	30-39%		48-78%	50-74%	53-65%	51-61%	40-58%	23-55%	12-20%	15-22%	-
	Richard's Bay (API4)	33-58%	45-56%	63-75%	63-75%	30-46%	48-78%		50-65%	59-65%	55-65%	40-59%	23-48%	14-20%	18-23%	-
	Newcastle	42-57%	41-57%	55-63%	55-63%	26-37%	50-74%	50-65%		50-65%	40-70%	40-65%	30-48%	30-45%	30-40%	-
	Indo. Sub-Bit	-	-	-	-	-	53-65%	59-65%	50-65%		45-55%	30-46%	29-37%	26-32%	24-37%	-
	Central App.	-	-	-	-	-	51-61%	55-65%	40-70%	45-55%		30-57%	24-39%	40-48%	41-46%	-
	CSX	-	-	-	-	-	40-58%	40-59%	40-65%	30-46%	30-57%		24-38%	40-45%	35-40%	-
	Powder River Basin	-	-	-	-	-	23-55%	23-48%	30-48%	29-37%	24-39%	24-38%		30-37%	26-32%	-
Emissions	EUA	34-50%	47-52%	63%	63%	30%	12-22%	14-20%	30-45%	26-32%	40-48%	40-45%	30-37%		80%	80%
	CER	27-44%	40-48%	59%	59%	37-38%	15-22%	18-23%	30-40%	24-37%	41-46%	35-40%	26-32%	80%		90%
	ERU	-	-	-	-	-	-	-	-	-	-	-	-	80%	90%	

Maximum Possible Offset < 25%
Maximum Possible Offset 25% - 50%
Maximum Possible Offset 50% - 75%
Maximum Possible Offset > 75%

Offsets correct as of 22 Sep 2011

Utilities Inter-Commodity Offsets

		Natural Gas				Power	Coal							Emissions		
		NBP	TTF	NCG	GAS	UK Base	RD	RB	NEWC	INDO	CAPP	CSX	PRB	EUA	CER	ERU
Oil	Brent	40%	43-45%	40%	30%	20-22%	25-35%	19-33%	18-35%	10-17%	6-14%	9-15%	10-19%	47-58%	44-46%	-
	WTI	35-45%	42-45%	40-45%	35%	22-27%	25-35%	19-33%	18-35%	11-17%	9-15%	9-15%	10-19%	40-50%	40-45%	-
	Gasoil	60%	60%	55-60%	55%	30-47%	30-44%	24-45%	26-46%	20-32%	10-25%	12-22%	12-16%	48-51%	40-41%	-
OTC	Henry Hub	42-50%	36-51%	62-63%	62-63%	40-56%	28-50%	19-55%	30%	44-63%	42-60%	30-46%	20-33%	22-25%	20-21%	-
	Dry Freight	-	-	-	-	-	24-63%	30-63%	26-75%	-	-	-	-	-	-	-
	Iron Ore	-	-	-	-	-	31-47%	31-45%	30-40%	31-42%	26-37%	27-40%	32-42%	22-33%	24-30%	
	Brent 1st Line Swap	40-50%	45-55%	-	-	-	14-23%	16-22%	13-23%	-	-	-	-	42-54%	38-44%	-
	Dated Brent vs. Brent 1st Line Swap	30%	35%	-	-	-	20-40%	20-40%	20-40%	-	-	-	-	16-27%	18-25%	-
	1% NWE FOB Cargoes	-	-	-	-	-	45-63%	38-63%	43-63%	-	-	-	-	20-24%	20-26%	-
	3.5% RDAM FOB Barges	-	-	-	-	-	39-59%	36-59%	40-59%	-	-	-	-	20-21%	23-54%	-
	180 CST Singapore Fueloil	-	-	-	-	-	43-61%	38-61%	42-60%	-	-	-	-	18-20%	20-23%	-
	Brent 1st Line vs. Gasoil 1st Line	40-55%	40-55%	-	-	-	-	-	-	-	-	-	-	-	-	-

Maximum Possible Offset < 25%
Maximum Possible Offset 25% - 50%
Maximum Possible Offset 50% - 75%
Maximum Possible Offset > 75%

Offsets correct as of 22 Sep 2011

Contract Specifications: EUA Futures

Contracts are for physical delivery through the transfer of EUAs between National Registry Accounts. Capitalised terms which are not otherwise defined below have the meanings ascribed to them in the ICE Futures Europe Regulations

Units of Trading	One lot of 1,000 CO2 EU Allowances. Each EU Allowance being an entitlement to emit one tonne of carbon dioxide equivalent gas. EUAs may be delivered under the Contracts such that EUAs are eligible, at the time of delivery to the Clearing House, to be surrendered to a Competent Authority for compliance purposes under the Directive at the compliance obligation date subsequent to such delivery. Neither the Clearing House nor the Exchange makes any representation or warranty whatsoever as to whether any EUA delivered pursuant to a EUA Contract are or are not eligible in this regard. Aviation Allowances (EUAAs), as defined within the Aviation Directive, shall not be eligible for delivery under the EUA contract.		
Minimum Trading Size	1 lot.		
Quotation	Euro (€) and Euro cent (c) per metric tonne.	**Minimum Price Flux**	0.01 euro per tonne
Tick Size	€0.01 per tonne (i.e. €10.00 per lot).	**Maximum Price Flux**	There are no limits.
Trading Hours	Open 07:00, Close 17:00 (London local time) Open 08:00, Close 18:00 (Central European Time).		
Contract Months	Contracts are listed on a quarterly expiry cycle such that March, June, September and December contract months are listed up to June 2013 and annual contracts with December expiries for 2013 up to 2020. Two additional calendar month contracts are listed, which combined with the existing quarterly month contracts, means that there are always at least three consecutive near calendar month futures contracts available for trading.		
Expiration Date	Last Monday of the Contract month. However, if the last Monday is a Non-Business Day or there is a Non-Business Day in the 4 days following the last Monday, the last day of trading will be the penultimate Monday of the delivery month. Where the penultimate Monday of the delivery month falls on a Non-Business Day, or there is a Non-Business Day in the 4 days immediately following the penultimate Monday, the last day of trading shall be the antepenultimate Monday of the delivery month. The Exchange shall from time to time confirm, in respect of each contract month, the date upon which trading is expected to cease.		
Trading System	Trading will occur on the ICE Futures electronic trading platform known as the ICE Platform accessible via Web ICE or through a conformed Independent Software Vendor.		
Settlement Price	Trade weighted average during the daily closing period (16:50:00 - 16:59:59 UK Local Time) with Quoted Settlement Prices if low liquidity. *Rule Z1		
VAT & Taxes	UK's HM Revenue and Customs have confirmed that the trading of the ICE ECX EUA Futures Contract on the Exchange between the Member and ICE Clear Europe has been granted interim approval to be zero-rated for VAT purposes under the terms of the Terminal Markets Order.		
Delivery Methods	The contracts are physically deliverable by the transfer of EUAs from the Person Holding Account of the Selling Clearing Member at a Registry to the Person Holding Account of ICE Clear Europe at a Registry and from the Person Holding Account of ICE Clear Europe at that Registry to the Person Holding Account of the Buying Clearing Member at a Registry. Delivery is between Clearing Members and ICE Clear Europe during a Delivery Period. The Delivery Period is the period beginning at 19:00 hours on the Business Day following the last trading day and ending at 19:30 hours on the third Business Day following that last trading day. There is provision for 'Late' and 'Failed' delivery within the contract Rules. Members' attention is drawn to the additional delivery terms outlined in Circular 11/038: https://www.theice.com/publicdocs/circulars/11038.pdf		
Clearing	ICE Clear Europe will act as central counterparty to all trades and guarantees the financial performance of the ICE Futures Europe contracts registered in the name of its Members.		
Margin	Variation and initial margin will be charged in the usual manner by ICE Clear Europe.		

Contract Specifications: CER Futures

Contracts are for physical delivery through the transfer of CERs between National Registry Accounts. Capitalised terms which are not otherwise defined below have the meanings ascribed to them in the ICE Futures Europe Regulations

Units of Trading	One lot of one thousand (1,000) Certified Emission Reduction units (CER) only to the extent such CERs are eligible, as of the time of delivery to the Clearing House, to be surrendered to a Competent Authority in exchange for an equal number of EUAs under the Directive or the Linking Directive. Neither the Clearing House nor the Exchange makes any representation or warranty whatsoever as to whether any CERs delivered pursuant to a CER Contract are or are not eligible in this regard.. For contracts up to and including the March 2013 contract, CER Types not eligible for delivery include those generated by hydroelectric projects with a generating capacity exceeding 20MW, LULUCF activities and nuclear facilities.		
Minimum Trading Size	1 lot.		
Quotation	Euro (€) and Euro cent (c) per metric tonne.	**Minimum Price Flux**	0.01 euro per tonne.
Tick Size	€0.01 per tonne (i.e. €10.00 per lot).	**Maximum Price Flux**	There are no limits.
Trading Hours	Open 07:00, Close 17:00 (London local time) Open 08:00, Close 18:00 (Central European Time).		
Contract Months	Contracts are listed on a quarterly expiry cycle such that March, June, September and December contract months are listed up to March 2013 and annual contracts with December expiries for 2013 up to 2020. Two additional calendar month contracts are listed, which combined with the existing quarterly month contracts, means that there are always at least three consecutive near calendar month futures contracts available for trading.		
Expiration Date	Last Monday of the Contract month. However, if the last Monday is a Non-Business Day or there is a Non-Business Day in the 4 days following the last Monday, the last day of trading will be the penultimate Monday of the delivery month. Where the penultimate Monday of the delivery month falls on a Non-Business Day, or there is a Non-Business Day in the 4 days immediately following the penultimate Monday, the last day of trading shall be the antepenultimate Monday of the delivery month. The Exchange shall from time to time confirm, in respect of each contract month, the date upon which trading is expected to cease		
Trading System	Trading will occur on the ICE Futures electronic trading platform known as the ICE Platform accessible via Web ICE or through a conformed Independent Software Vendor.		
Settlement Price	Trade weighted average during the daily closing period (16:50:00 - 16:59:59 UK Local Time) with Quoted Settlement Prices if low liquidity. *Rule Z1		
VAT & Taxes	UK's HM Revenue and Customs have confirmed that the trading of the ICE ECX CER Futures Contract on the Exchange between the Member and ICE Clear Europe has been granted interim approval to be zero-rated for VAT purposes under the terms of the Terminal Markets Order.		
Delivery Methods	The contracts are physically deliverable by the transfer of CERs from the Person Holding Account of the Selling Clearing Member at a Registry to the Person Holding Account of ICE Clear Europe at a Registry and from the Person Holding Account of ICE Clear Europe at that Registry to the Person Holding Account of the Buying Clearing Member at a Registry. Delivery is between Clearing Members and ICE Clear Europe during a Delivery Period. The Delivery Period is the period beginning at 19:00 hours on the Business Day following the last trading day and ending at 19:30 hours on the third Business Day following that last trading day. There is provision for 'Late' and 'Failed' delivery within the contract Rules. Members' attention is drawn to the additional delivery terms outlined in Circular 11/038: https://www.theice.com/publicdocs/circulars/11038.pdf		
Clearing	ICE Clear Europe will act as central counterparty to all trades and guarantees the financial performance of the ICE Futures Europe contracts registered in the name of its Members.		
Margin	Variation and initial margin will be charged in the usual manner by ICE Clear Europe.		

Contract Specifications: ERU Futures

Contracts are for physical delivery through the transfer of ERUs between National Registry Accounts. Capitalised terms which are not otherwise defined below have the meanings ascribed to them in the ICE Futures Europe Regulations

Units of Trading	One lot of one thousand (1,000) Emission Reduction Units (ERUs) only to the extent such ERUs are eligible, as of the time of delivery to the Clearing House, to be surrendered to a Competent Authority in exchange for an equal number of EUAs under the Directive or the Linking Directive. Neither the Clearing House nor the Exchange makes any representation or warranty whatsoever as to whether any ERUs delivered pursuant to a ERU Contract are or are not eligible in this regard. For contracts up to and including the March 2013 contract, ERU types not eligible for delivery include those generated by hydroelectric projects with a generating capacity exceeding 20MW, LULUCF activities and nuclear facilities.		
Minimum Trading Size	1 lot.		
Quotation	Euro (€) and Euro cent (c) per metric tonne.	**Minimum Price Flux**	0.01 euro per tonne.
Tick Size	€0.01 per tonne (i.e. €10.00 per lot).	**Maximum Price Flux**	There are no limits.
Trading Hours	Open 07:00, Close 17:00 (London local time) Open 08:00, Close 18:00 (Central European Time).		
Contract Months	Contracts are listed on a quarterly expiry cycle such that March, June, September and December contract months are listed up to March 2013 and annual contracts with December expiries for 2013 up to 2020. Two additional calendar month contracts are listed, which combined with the existing quarterly month contracts, means that there are always at least three consecutive near calendar month futures contracts available for trading.		
Expiration Date	Last Monday of the Contract month. However, if the last Monday is a Non-Business Day or there is a Non-Business Day in the 4 days following the last Monday, the last day of trading will be the penultimate Monday of the delivery month. Where the penultimate Monday of the delivery month falls on a Non-Business Day, or there is a Non-Business Day in the 4 days immediately following the penultimate Monday, the last day of trading shall be the antepenultimate Monday of the delivery month. The Exchange shall from time to time confirm, in respect of each contract month, the date upon which trading is expected to cease		
Trading System	Trading will occur on the ICE Futures electronic trading platform known as the ICE Platform accessible via Web ICE or through a conformed Independent Software Vendor.		
Settlement Price	Trade weighted average during the daily closing period (16:50:00 - 16:59:59 UK Local Time) with Quoted Settlement Prices if low liquidity. *Rule Z1		
VAT & Taxes	UK's HM Revenue and Customs have confirmed that the trading of the ICE ECX ERU Futures Contract on the Exchange between the Member and ICE Clear Europe has been granted interim approval to be zero-rated for VAT purposes under the terms of the Terminal Markets Order.		
Delivery Methods	The contracts are physically deliverable by the transfer of ERUs from the Person Holding Account of the Selling Clearing Member at a Registry to the Person Holding Account of ICE Clear Europe at a Registry and from the Person Holding Account of ICE Clear Europe at that Registry to the Person Holding Account of the Buying Clearing Member at a Registry. Delivery is between Clearing Members and ICE Clear Europe during a Delivery Period. The Delivery Period is the period beginning at 19:00 hours on the Business Day following the last trading day and ending at 19:30 hours on the third Business Day following that last trading day. There is provision for 'Late' and 'Failed' delivery within the contract Rules. Members' attention is drawn to the additional delivery terms outlined in Circular 11/038: https://www.theice.com/publicdocs/circulars/11038.pdf		
Clearing	ICE Clear Europe will act as central counterparty to all trades and guarantees the financial performance of the ICE Futures Europe contracts registered in the name of its Members.		
Margin	Variation and initial margin will be charged in the usual manner by ICE Clear Europe.		

Contacts

George Waldburg
Director, Emissions Markets
ICE Futures Europe - ECX
+44 (0) 20 7065 7755
george.waldburg@theice.com

Sam Johnson-Hill
Business Development Manager
ICE Futures Europe - ECX
+44 (0) 20 7065 7617
sam.johnson-hill@theice.com

Emissions Desk
+44 (0) 20 7065 7796

www.theice.com/emissions

附件五、The Carbon Disclosure Project 簡報

CARBON DISCLOSURE PROJECT

The Carbon Disclosure Project

Agenda

- CDP Background
- CDP Programmes
- CDP Government Engagement
- CDP Global Operations
- CDP 2011 Global 500 Results
- CDP's work in Taiwan

Cassie Chessum

Senior Partnerships Manager –

Governments & Corporations

Carbon Disclosure Project (CDP)

CDP

- Charity – Founded in 2000
- Aim: To accelerate solutions to climate change and water management by putting relevant information at the heart of business, policy and investment decisions
- CDP programmes and initiatives:
  - Investor CDP
  - CDP Supply Chain
  - CDP Water Disclosure
  - CDP Carbon Action
  - CDP Cities

Investor CDP

• Investor CDP is the largest collaboration of investors in the world.
• It gathers essential information on climate change adaptation and mitigation to help inform investment decision-making.

- Climate change governance and strategy - including targets and achievements
- Risks and opportunities
- Emissions Breakdown – including direct / indirect emissions and carbon trading

• In 2011, over 551 institutional investors with assets of US$71 trillion were signatories to Investor CDP.

"Analysis of objective measures of performance on a comparable basis is vital to assessment of company's management of ESG issues. CDP provides a valuable tool for analysis of climate change related aspects of environmental performance."
Andrew Howard, Goldman Sachs

Investor CDP: 551 Signatories - $71 trillion in assets

Carbon Trading

- Investor CDP captures information from companies about the emission trading schemes in which they participate or plan to do so in the next 2 years.
- Question 14: Investor CDP
- Reviewing questionnaire in early 2012
- Area for potential research
  - Company strategy – How is it affecting company behaviour?
  - Sector analysis - How is it affecting different sectors?
  - Geographical – How do companies from different countries / regions compare?
  - Emissions reduction: Is it helping to deliver actual emissions reductions?

14. Emissions Trading (CDP 2010 Q21)

14.1 Do you participate in any emissions trading schemes?

If yes: 14.1a Please complete the following table for each of the emission trading schemes in which you participate

Scheme name	Period for which data is supplied	Allowances allocated	Allowances purchased	Verified emissions in metric tonnes CO2e	Details of ownership

And if "yes" or "we don't currently, but we anticipate doing so within the next 2 years":

14.1b What is your strategy for complying with the schemes in which you participate or anticipate participating?

14.2 Has your company originated any project-based carbon credits or purchased any within the reporting period?

If yes: 14.2a Please complete the following table

Credit origination or credit purchase	Project type	Project identification	Verified to which standard	Number of credits (metric tonnes CO2e)	Number of credits (metric tonnes CO2e): Risk adjusted volume	Credits retired	Purpose, e.g. compliance

CDP Supply Chain

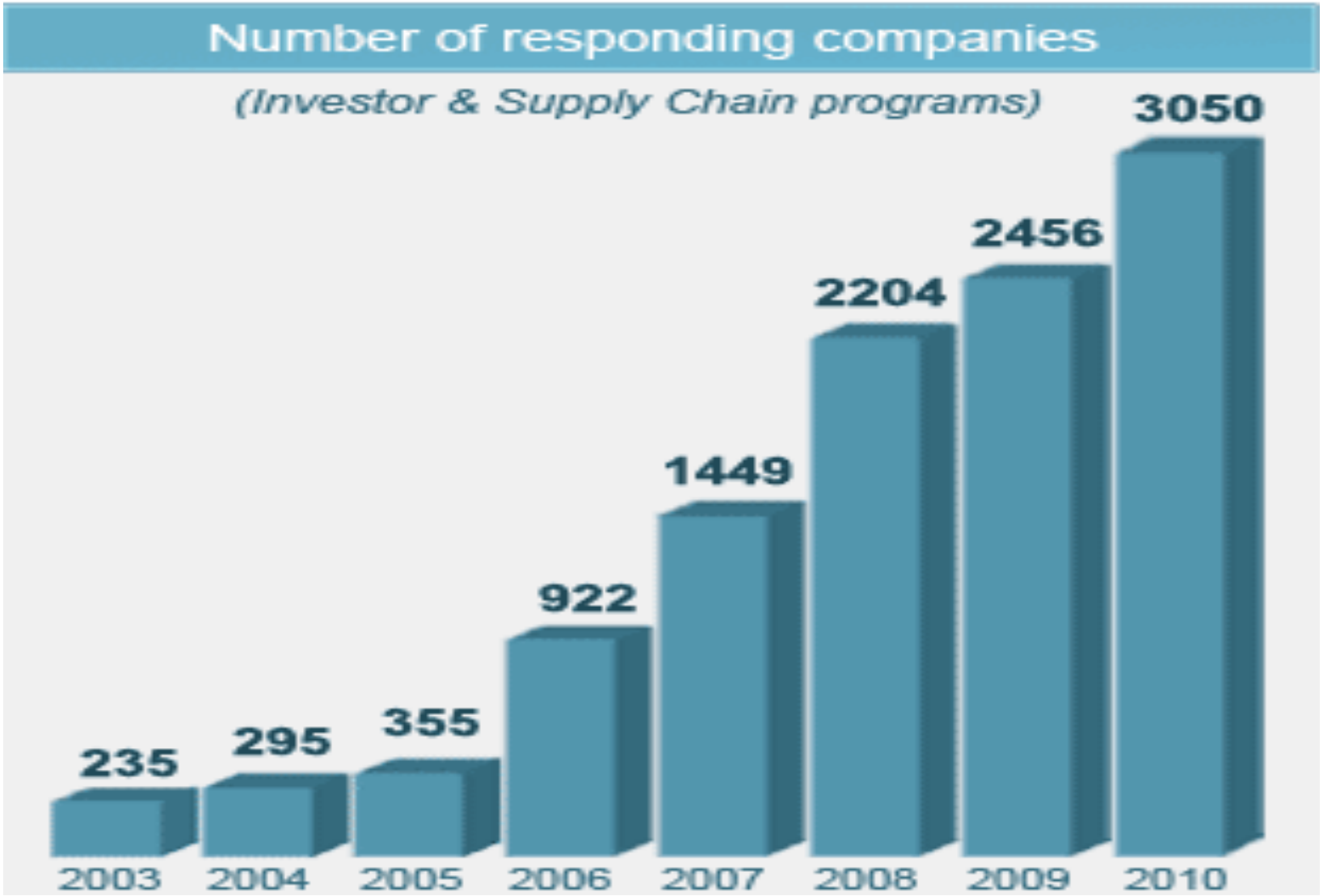
• CDP Supply Chain harnesses the collective purchasing power of global corporations who encourage suppliers to measure and disclose climate change information, set reduction targets and make performance improvements.

•Over 50 purchasing corporations are members of CDP Supply Chain, including Acer.

"As a founding member of CDP, Unilever believes that CDP's standardised approach to emissions reporting can provide real benefits. In 2010, we will expect an increase in the number of our suppliers engaged through CDP. Unilever will continue to drive emissions reduction activities across the supply chain and we expect real progress in suppliers emission reduction".
Marc Engel, Group Chief Procurement Officer, Unilever

CDP Supply Chain

CARBON DISCLOSURE PROJECT


Number of responding companies
(Investor & Supply Chain programs)
235
295
355
922
1449
2204
2456
3050
2003
2004
2005
2006
2007
2008
2009
2010

CDP Water Disclosure

• CDP Water Disclosure uses the Investor CDP model to generate critical water-related data from the world's largest corporations for investment decision-making.

• In 2011, 354 institutional investors with assets of US $43 trillion were signatories to CDP Water Disclosure.

"With the drive to increase resource efficiency it is encouraging to see that water issues are becoming increasingly important to business and investors. With the increased expectations around water management and reporting, CDP Water Disclosure is a valuable tool, and an opportunity, for business to take action to ensure sustainable water use, and ensure their own long term performance."
Lord Henley, Former Parliamentary Under-Secretary of State, DEFRA

CDP Carbon Action

• CDP Carbon Action harnesses the power of investors to request specific climate mitigation actions from the world's largest companies.

- Set and publicly disclose an emissions reduction target (if they do not do so already)
- Make year-on-year emissions reductions
- Identify and implement investment in greenhouse gas emissions reduction initiatives which have a satisfactory payback period

• The initiative is supported by 35 institutional investors with assets of more than $7 trillion.

"This initiative focuses on cases where companies do not need to make a choice between emissions reductions or higher financial returns. Efficient management of energy offers a huge win-win: lower carbon emissions, higher returns for shareholders."

Craig Mackenzie, Head of Sustainability, Scottish Widows Investment Partnership

CDP Cities

• CDP Cities assists city governments in publicly disclosing their GHG emissions data together with analysis of climate change risks / opportunities.

• In 2010, CDP worked with the C40 and in 2011-12, CDP is requesting disclosure from the world's largest 150 cities.

•*"Ever since 2008, we have appropriated budgeted for energy saving and carbon reduction projects, and for the expenses of increasing or replacing energy saving equipment in government agencies and schools."*
City of Taipei

CDP's Government Engagement

- CDP has good relationships with various governments and institutions

- CDP has various statements of support from the Ministers of the Governments of Australia, Canada, EU, France, Japan, Korea, South Africa, Sweden and Switzerland

"The work of the Carbon Disclosure Project is crucial to the success of business in the 21st century... helping persuade companies throughout the world to measure, manage, disclose and ultimately reduce their *use* *gas emissions. No other organization is gathering this type of* *e* *climate change data and providing it to the marketplace."*

Ban Ki-moon, Secretary General of United Nations

"The increasing participation of developing country companies in CDP positive and essential development in our quest to curb global emissions. The World Bank Group wants to lead by example. In 2009, we began to report our own global corporate emissions to the CDP."

Robert Zoellick, President of the World Bank Group

Case Study: CDP's work with UK government

- CDP has an excellent relationship with the UK government, including Defra and DECC
- The UK government has provided funding to CDP for several years
- CDP works with the UK government in various ways

Research:

- Conducted a review (with PWC) for Defra on the costs and benefits of reporting GHG emissions – published in November 2010.

Data:

- Provided CDP data to help with the impact assessment on whether the UK government should mandate corporate environmental reporting

Policy:

- Helping Defra / DECC to develop guidance on how to measure and report GHG emissions – which has evolved in parallel to the CDP questionnaire.

Eva Murray

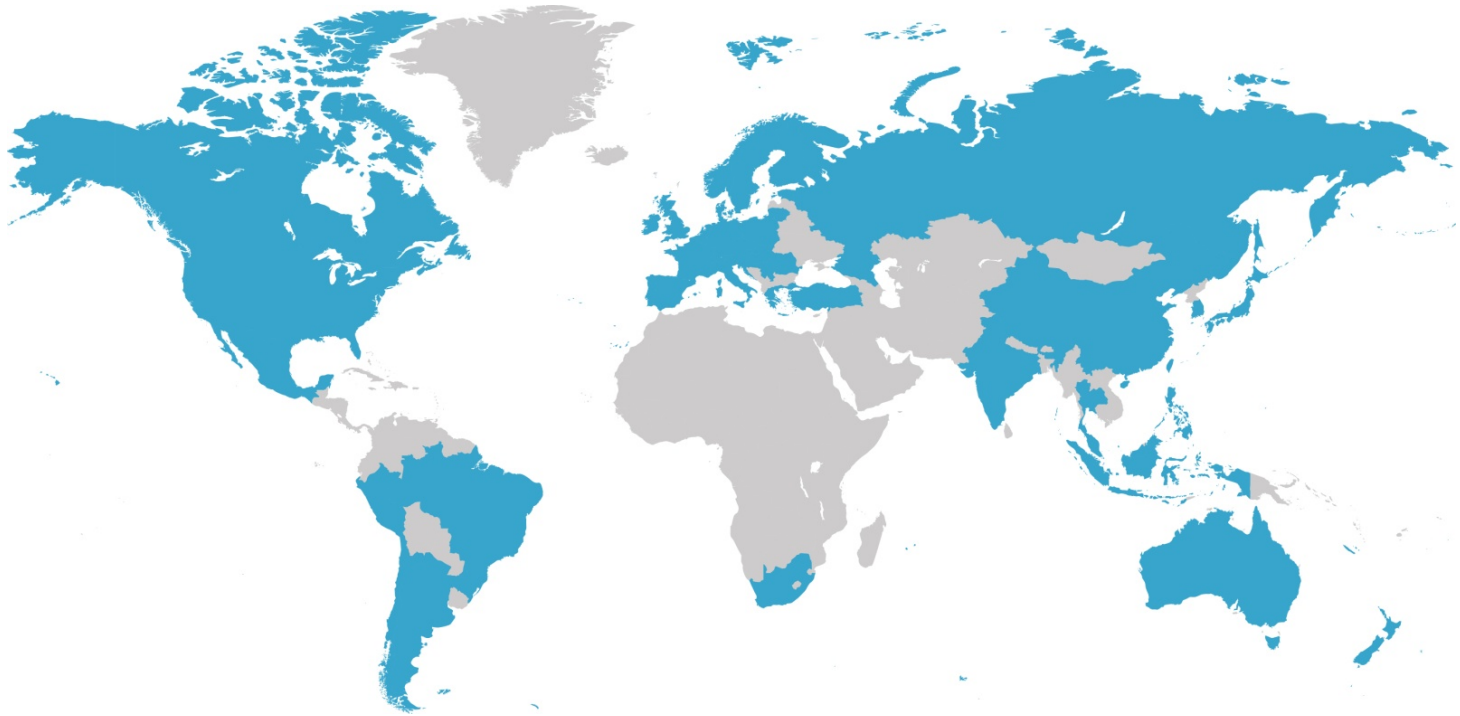
Senior Partnerships Manager - Global Operations

Carbon Disclosure Project (CDP)

CDP's Global Operations

•Climate change is a global problem. CDP was therefore established as an international initiative

•CDP operates in most of the world's major economies. Our global reach continues to expand



Key Findings – Global 500

- 85% of Global 500 see significant opportunities from climate change

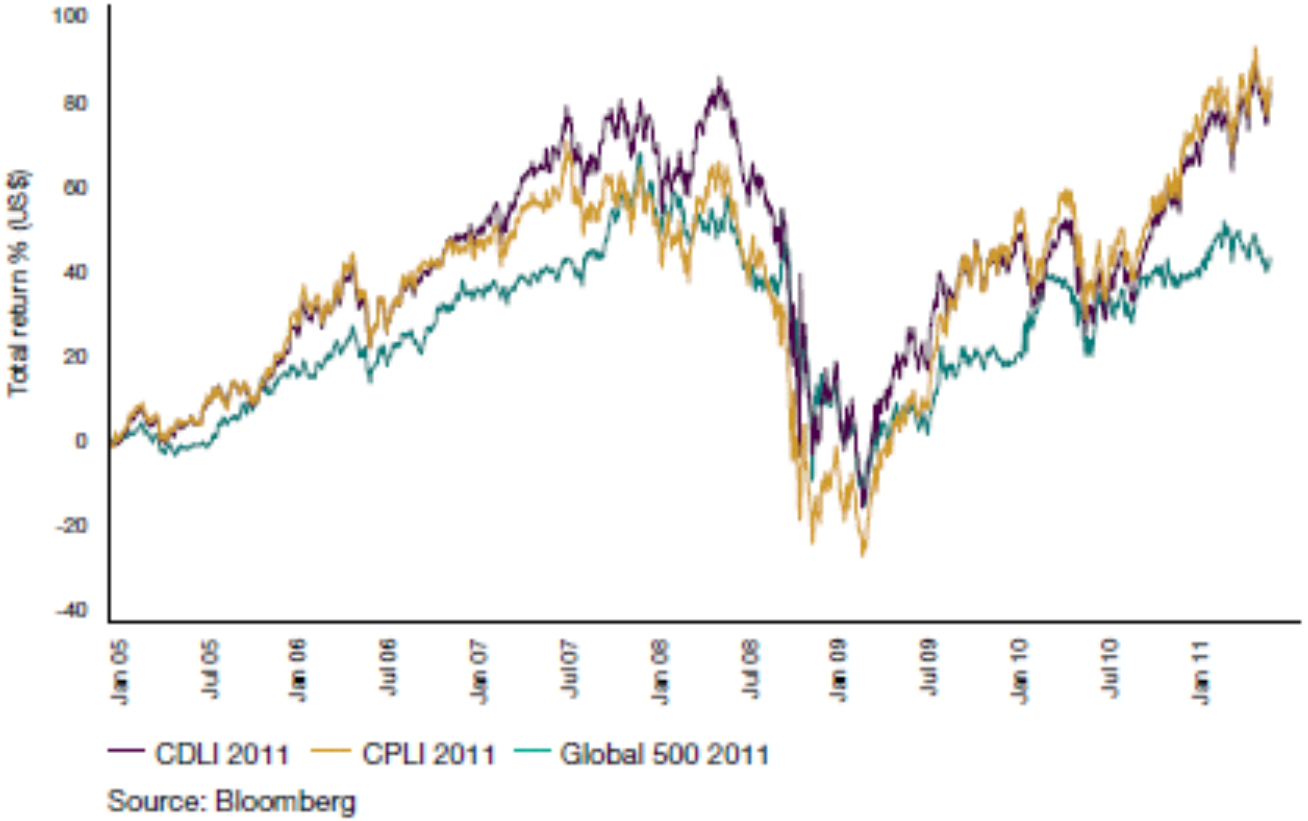
- 93% have board or executive level responsibility for climate change today

- 68% are embedding carbon management into overall business strategy (compared to 48% in 2010)

- 97% of Global 500 respondents report a total of 1,780 emissions reductions activities, of which 59% have a payback within 3 years

- **Top performing Global 500 companies provided approximately double the average financial return of the Global 500 benchmark**

Figure 8: Total return % (US$)



Source: Bloomberg

CDP's work in Taiwan

Investor CDP:

- Since 2006, partnership with ASrIA (Association for Sustainable and Responsible Investment in Asia) to implement the Investor CDP in the Asian region

- Taiwan is covered through ASrIA member BCSD- Taiwan (Business Council for Sustainable Development in Taiwan) promoting CDP and engaging with the 25 Taiwanese companies in the Asia ex-JICK 170 sample

CDP Supply Chain:

- Supply Chain Members: Acer Inc. and ASUSTeK Computer

CDP Cities:

- Taipei & Kaohsiung – voluntary disclosers in 2011

- **Investor CDP – 2011 Preliminary Results:**

– 25 Taiwanese companies invited to respond via Asia ex-JICK 170 sample (Asia excluding Japan, China, India, Korea – so covering 10 other Asian countries)

  - 6 companies responded – **60% response rate** for Taiwan
  - Taiwanese companies among leaders in disclosure and performance scoring (6 out of 22 disclosure leaders, 2 out of 11 performance leaders in Asia ex-Japan 400)

– A further 91 Taiwanese companies invited to respond through CDP's Emerging Markets 800 sample, in 2011: 23 responses

– Voluntary responders – 5 Taiwanese companies

– Overall – **44 Investor CDP responses from Taiwan**

- **CDP Supply Chain:**

– 77 Taiwanese suppliers invited to respond – **58 responded**

Business Benefits of Reporting

- Measuring Carbon Costs and Reductions
- Optimizing Reduction Plan
- Satisfying Buyers
- Engaging in the Carbon Market
- Preparing for Future Compliance
- Encouraging Business Innovation
- Enhancing Business Reputation
- Shaping a Green Culture

Conclusion

• Increasing numbers of Taiwanese companies are seeing commercial opportunities from climate change.

Q&A

• How can the CDP process help you achieve your policy aims?

• What are your views about reporting on greenhouse gas emissions and climate change?

附件六、ECOFYS

Introduction to carbon leakage 簡報

Introduction to carbon leakage

Emelia Holdaway

12th October 2011

Introduction to Carbon Leakage

- A sector or sub-sector is "deemed to be exposed to a significant risk of carbon leakage if:

  - the extent to which the sum of direct and indirect additional **costs induced** by the implementation of this directive would lead to a substantial increase of production cost, calculated as a proportion of the Gross Value Added, of at least **5%; and**
  - the **Non-EU Trade intensity** defined as the ratio between total of value of exports to non EU + value of imports from non-EU and the total market size for the Community (annual turnover plus total imports) is above **10%;**
  - **or** if either one of these individually exceeds **30%.**

Induced CO2 cost ratio

- Induced CO2 cost ratio =

$$\frac{(\text{Direct emissions} \times 0{,}75 + \text{indirect emissions}) \times 30\ €/t}{\text{Gross Value Added}}$$

Trade intensity

- Trade intensity =

$$\frac{\text{Export to non-EU27} + \text{Import from non-EU27}}{\text{Annual turnover} + \text{Import from non-EU27}}$$

By default, EC assesses at NACE4 activity level

NACE (Rev. 1.1) code	Description
11.20	Service activities incidental to oil and gas extraction, excluding surveying
12.00	Mining of uranium and thorium ores
15.52	Manufacture of ice cream
15.61	Manufacture of grain mill products
17.72	Manufacture of knitted and crocheted pullovers, cardigans and similar articles
18.10	Manufacture of leather clothes
21.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
21.22	Manufacture of household and sanitary goods and of toilet requisites
23.10	Manufacture of coke oven products
23.20	Manufacture of refined petroleum products
24.51	Manufacture of soap and detergents, cleaning and polishing preparations
25.23	Manufacture of builders' ware of plastic
26.51	Manufacture of cement
27.31	Cold drawing
27.53	Casting of light metals
29.42	Manufacture of other metalworking machine tools
29.43	Manufacture of other machine tools n.e.c.
31.30	Manufacture of insulated wire and cable
35.50	Manufacture of other transport equipment n.e.c.
40.21	Manufacture of gas
45.44	Painting and glazing

Paragraph 15

A sector or sub-sector shall be deemed to be exposed to a significant risk of carbon leakage if:

Induced CO2 cost > **5%**

AND

Trade intensity > **10%**

Example of sector that meets Paragraph 15 criteria AND

Induced cost ratio	Total GHG emissions	3 Mtonne/y		
	Carbon price	30 Euro/tonne		
	Induced cost for emissions	**90 MEuro/y**		
			=	11%
	GVA EU27	**800 MEuro/y**		>5%
Trade exposure ratio	Export value	110 MEuro/y		
	Import value	180 MEuro/y		
	Turnover	1930 MEuro/y		
	Export+Import	**290 MEuro/y**		
			=	14%
	Turnover+Import	**2110 MEuro/y**		>10%

Paragraph 16

Notwithstanding paragraph 15, a sector or sub-sector is also deemed to be exposed to a significant risk of carbon leakage if:

Induced CO2 cost > **30%**

OR

Trade intensity > **30%**

Example of sector that meets Paragraph 16 criteria OR

Induced cost ratio	Total GHG emissions	5 Mtonne/y		
	Carbon price	30 Euro/tonne		
	Induced cost for emissions	**150 MEuro/y**		
			=	38%
	GVA EU27	**400 MEuro/y**		>30%
Trade exposure ratio	Export value	30 MEuro/y		
	Import value	50 MEuro/y		
	Turnover	1400 MEuro/y		
	Export+Import	**80 MEuro/y**		
			=	6%
	Turnover+Import	**1450 MEuro/y**		<30%

Quantitative criteria

- Evaluated at 30 Euro/tonne CO_2
- Assessment carried out at NACE4 rev. 1.1 aggregation
- Carbon costs transferred from utilities are included (emission costs to generate steam, electricity).
- Data used for trade and emission is historical
- Full carbon costs would only occur by 2027 (full auctioning)
  - Calculation would grant CL for 2013-2014
  - The actual initial 'induced cost' would be only 20% in 2013 – the actual risk to carbon leakage would occur somewhere during the period

Beyond NACE4… some sectors are evaluated at a further deaggregation

- 6 groups of products meet the combined trade intensity and CO2 cost thresholds
  - Manufacture of Glass Fibres (Reinforced Glass Fibres).
  - Manufacture of other non-metallic mineral products (Expanded Clay).
  - Manufacture of other non-metallic mineral products (Graphite).
  - Manufacture of paints, varnishes and similar products (Frits).
  - Manufacture of Glues and Gelatines (Gelatines).
  - Processing and preservation of food products (Concentrated tomato)
- 1 group of products meets the CO2 cost 30% threshold
  - Industrial Gases (Hydrogen, Nitrogen and Oxygen).
- 2 groups of products meet the Trade Intensity 30% threshold
  - Operation of dairies and cheese making (Milk powder, casein and lactose)
  - Other food products (dry bakers yeast)

Paragraph 17

The list referred to in paragraph 13 may be supplemented after completion of a **qualitative assessment**, taking into account, where the relevant data are available, the following criteria:

- Techno-economic potential to decrease direct and indirect emissions
- Current and projected market characteristics
- Profit margins

Commission's approach for Paragraph 17

The commission carried out a qualitative analysis based on 4 criteria:

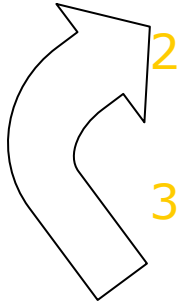
- Border line case
- Absence of statistics
- Quality of statistics
- Sectoral specificities

- Analysis on limited amount of sectors,
- Some details have been communicated: impact assessments
- Full details not available

Activities that received qualitative assessment (September 2009)

From the qualitative assessment, three cases occur:

1. Sectors for which there is evidence that they would be deemed to be at risk of carbon leakage
   - finishing of textile, wood-based panels, plastics
2. Sectors requiring further analysis
   - casting of iron, casting of steel and casting of light metals
3. Sector for which there is no evidence that the sector would be deemed to be at risk of carbon leakage
   - bricks, roof tiles and construction products
   - **but now in 2011: added to list after industry action**



Future of Carbon Leakage 2015 - 2019

- The current CL exposure list applies for the years 2013-2014
- The list will be revised for the years 2015-2019
- DG Clima is assessing how the assessment for these years will take place
  - *Build on existing methodologies and learn from difficulties in previous quantitative assessment*
  - *Preparatory work expected to take one year*
- The new assessment will take into account
  - *Transition from NACE 1.1 to NACE 2*
  - *Risk of double counting of CHP emissions*
  - *Different levels of aggregation (Prodcom 6 and 8)*
  - *The most suitable data sources*
  - *Reassessment of starting points (e.g. electricity emissions factor, carbon price)*

Revision of CL list 2015-2019

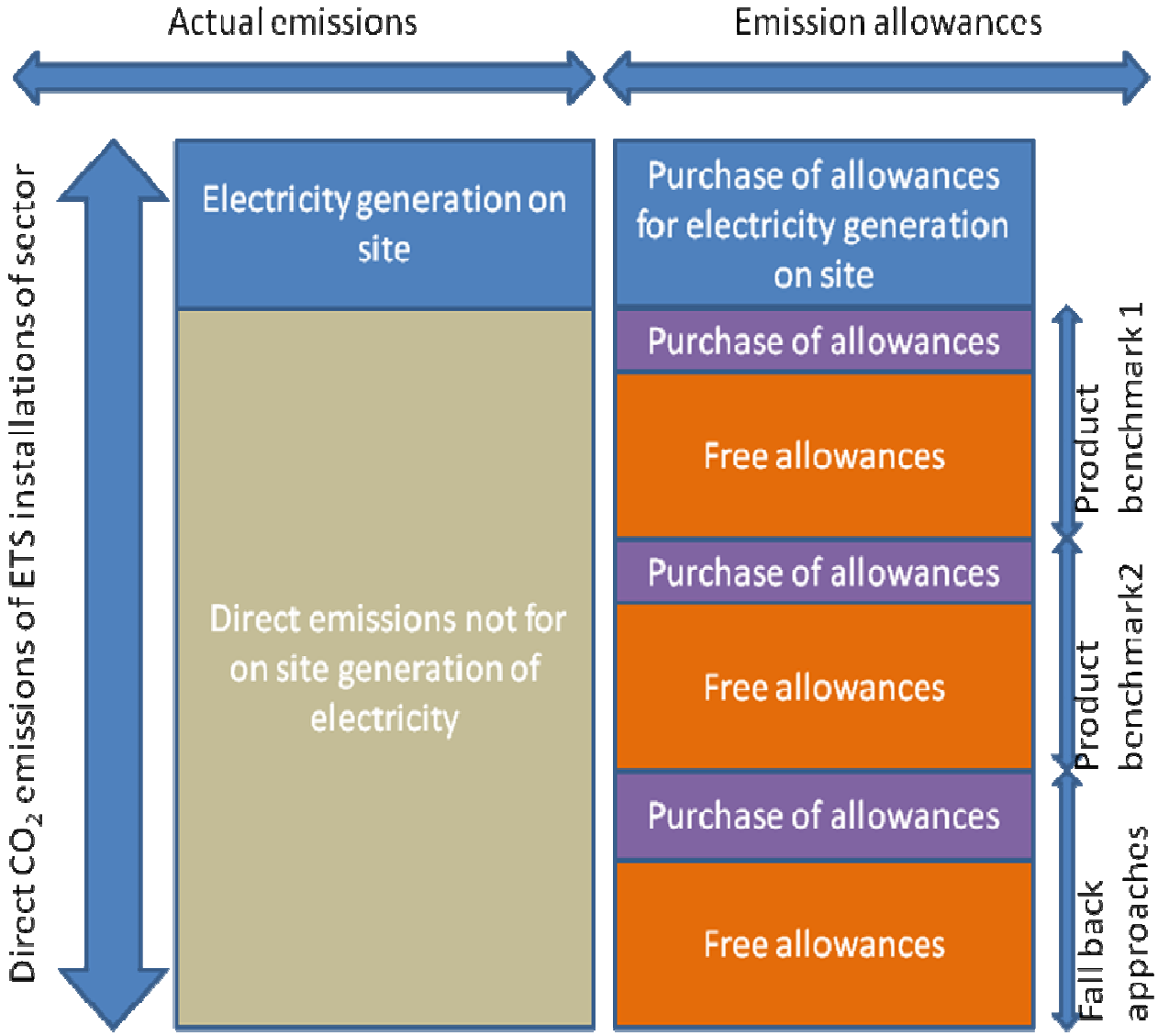
The revised assessment has the following objectives:

1. Establish a general methodology as well as data sources and their availability necessary for the determination of the list based on the quantitative assessment.

2. Establish a methodology to estimate an average share of allowances that a sector would be required to purchase if not deemed to be exposed

   – *Estimated in previous assessment (75%). Next assessment will take into account benchmarks and other rules for free allocation now in place*

Revision of CL list 2015-2019



Graph represents Ecofys proposal for methodology, and not DG-CLMA approach

Revision of CL list 2015-2019

3. Establish a harmonised framework for qualitative assessments

Criteria will include:

- Extent to which it is possible for individual installations in the sector or sub-sector concerned to reduce emission levels and electricity consumption
- Current and projected market characteristics
  - *Transport cost, export and import duties, subsidies, production trends*
- Profit margins

Revision of CL list 2015-2019

One approach could be a scorecard to show weighting of these factors

Qualititative Carbon Leakage Scorecard

Indicator:	Score:	Weighting factor:
Indicator 1		++
Indicator 2		+++
Indicator 3		+
Indicator 4		++
Indicator 5		+++
Indicator 6		+
Indicator 7		+
Indicator 8		+++
Indicator 9		+
Indicator 10		++

Graph represents Ecofys proposal for methodology, and not DG-CLMA approach

Revision of CL list 2015-2019

4. Analysis of international considerations

- The extent to which 3rd countries, representing a decisive share of global production of products in sectors deemed to be exposed, firmly commit to reducing GHGs
  - Will include degree to which pledges under Copenhagen Accord have been implemented
  - Will assess any agreements made outside UNFCCC process too

- The extent to which the GHG-efficiency of installations located in these countries is comparable to that of the Community

- A carbon price differential will be established as an indicator

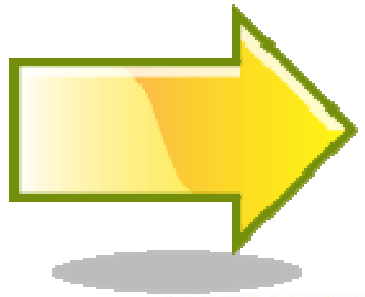
Ecofys conclusion of future of CL assessment

From the EC request for support for setting up the 2015-2019 assessment methodology, Ecofys draws several conclusions:

Induced cost and trade intensity ratios will remain core of carbon leakage criteria, including 5/10/30% quantitative thresholds.

Three most recent years will be used for the assessment. Assessment to be done in 2012-2013, likely that 2010-11-12 be used by EC assessment. (Later appeals can likely use later reference years)

Assessment will be done at Revision 2.0 i/o 1.1



ECOFYS

Ecofys conclusion of future of CL assessment

Qualitative assessment will be better prescribed, with clear criteria to address

Assessment will be done based at Prodcom6/8 and NACE4 level to test for trade intensity >30%. Induced cost will be tested only at NACE4 level.

- (Need for proactive formal application again for 5%/10%?)

Sector specific 'auctioning factor' will be developed.

- 75% general ratio will no longer be used
- Will reflect actual ratio of free allowances/total emissions per sector.
- This new feature will put a downward pressure on induced cost ratio

附件七、Carbon Trust 參考資料

Guide to PAS 2050

How to assess the carbon footprint of goods and services

CARBON TRUST

defra
Department for Environment Food and Rural Affairs

BSi
British Standards

Guide to PAS 2050

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Contents

Introduction

Climate change and product carbon footprints

'Carbon footprint' is a term used to describe the amount of greenhouse gas (GHG) emissions caused by a particular activity or entity, and thus a way for organisations and individuals to assess their contribution to climate change. Understanding these emissions, and where they come from, is necessary in order to reduce them. In the past, companies wanting to measure their carbon footprints have focused on their own emissions, but now they are increasingly concerned with emissions across their entire supply chain.

Supply chain GHG emissions, which include those associated with processes not controlled by the company itself, can be measured at either the company level or the level of an individual product. There are benefits to both company- and product-level supply chain emissions assessment; however, PAS 2050 and this guide focus on product-level emissions only.

This guide uses 'product' to refer to both physical products (i.e. goods) and service products (i.e. services) throughout; any differences related to services are highlighted in the text. Appendix II describes two examples of service carbon footprint assessments.

Measuring the carbon footprint of products across their full life cycle is a powerful way for companies to collect the information they need to:

- Reduce GHG emissions
- Identify cost savings opportunities
- Incorporate emissions impact into decision making on suppliers, materials, product design, manufacturing processes, etc.
- Demonstrate environmental/corporate responsibility leadership
- Meet customer demands for information on product carbon footprints
- Differentiate and meet demands from 'green' consumers

This guide explains how to assess GHG emissions of an individual product, either a good or a service, across its entire life cycle – from raw materials through all stages of production (or service provision), distribution, use and disposal/recycling – in accordance with the method specified in the BSI Publicly Available Specification 2050:2008, or 'PAS 2050'.

PAS 2050 background

PAS 2050 is a publicly available specification for assessing product life cycle GHG emissions, prepared by BSI British Standards and co-sponsored by the Carbon Trust and the Department for Environment, Food and Rural Affairs (Defra). PAS 2050 is an independent standard, developed with significant input from international stakeholders and experts across academia, business, government and non-governmental organisations (NGOs) through two formal consultations and multiple technical working groups. The assessment method has been tested with companies across a diverse set of product types, covering a wide range of sectors including:

- Goods and services
- Manufacturers, retailers and traders
- Business-to-business (B2B) and business-to-consumer (B2C)
- UK and international supply chains

PAS 2050 can deliver the following benefits:

- For companies, it can provide:
  - Internal assessment of product life cycle GHG emissions
  - Evaluation of alternative product configurations, operational and sourcing options, etc. on the basis of their impact on product GHG emissions
  - A benchmark for measuring and communicating emission reductions
  - Support for comparison of product GHG emissions using a common, recognised and standardised approach
  - Support for corporate responsibility reporting
- For customers (if companies choose to communicate their product footprints), it provides:
  - Confidence that the life cycle GHG emissions being reported for products are based on a standardised, robust method
  - Greater understanding of how their purchasing decisions impact GHG emissions

The term 'product carbon footprint' refers to the GHG emissions of a product across its life cycle, from raw materials through production (or service provision), distribution, consumer use and disposal/recycling. It includes the greenhouse gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), together with families of gases including hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).[1)]

Guide objectives, scope and structure

While PAS 2050 provides a standard method for assessing a product carbon footprint, this guide will help businesses to implement the standard by offering specific and practical guidance. It is not a replacement for PAS 2050 and should always be used alongside PAS 2050.

This guide aims to:

- Enable companies of all sizes, and from all industries, to assess the life cycle carbon footprint of their products and to identify emission reduction opportunities
- Share best practices, tools and frameworks for calculating product-level GHG emissions and prioritising opportunities to reduce emissions

PAS 2050 and this guide focus exclusively on GHG emissions created during a product's life cycle. They do not consider any other potential environmental,

[1)] See the IPCC (Intergovernmental Panel on Climate Change) publication, *Climate Change 2007: The Physical Science Basis* and PAS 2050 Annex A for a full list of gases.

social and economic impacts (e.g. biodiversity, water use, labour standards and other product impacts).

The method described in PAS 2050 can be used to assess the life cycle GHG emissions of any type of product:

- Business-to-consumer (B2C) goods, where the customer is the end user;
- Business-to-business (B2B) goods, where the customer is another business using the product as an input to its own activities; and
- Services that can be either B2C or B2B

This guide explains how to apply PAS 2050 in each of these circumstances but focuses on a typical consumer good. Any differences between this B2C application of PAS 2050 and B2B goods or services is highlighted in the text. A summary of the differences can be found in Appendix I.

This guide is structured in the following sections:

Section 1
Start-up

This section covers the important initial steps that ensure PAS 2050 implementation is fast, effective and that its results support decision making.

Setting objectives

The usual aim of product carbon footprinting is to reduce GHG emissions; however, organisations may have specific goals within that overall aim. Defining and agreeing the specific objectives for the product-level GHG assessment up-front creates the foundation for an efficient and effective process by:

- Enabling effective product selection to generate more useful findings at the end of the assessment,
- Providing direction on the scope, boundaries and data to be used in calculating the footprint, and
- Informing the choice of verification method which may be needed.

PAS 2050 can be applied with different levels of rigour, depending on how the footprint will be used. At a high level, PAS 2050 can be used to guide an internal assessment, such as identifying emissions 'hot spots', i.e. where to focus action to reduce GHG emissions across a product's life cycle. However, this approach does not result in carbon footprint information that can stand up to third-party verification and is not appropriate for external claims. If the goal is to certify and communicate the product footprint to customers, then it will require more precise analysis. Comparisons across product carbon footprints – or the same product over time – can only be achieved by using consistent data sources, boundary conditions and other assumptions across products and having the footprint results independently verified.

Verification is important to consider when the product carbon footprint is communicated either:

- internally within the company (e.g. different subsidiaries reporting to corporate level in a consistent way to assess carbon performance); or
- externally, to business customers or consumers, to inform purchasing, portfolio choice or other decisions

During the objective-setting process, and the footprinting process in general, it is helpful to include people across different areas within the company. The individuals selected will depend on the size of your organisation; see overleaf for an example of particular functions that could be involved. Smaller organisations may not have individual representatives for each area but should ensure that these perspectives are recognised during the start-up phase.

Who should be involved?

In a larger organisation internal participants could include, where applicable, representatives from:

- Senior management
- Environment/corporate social responsibility (CSR)
- Marketing/communications
- Production
- Procurement/supply chain
- Logistics
- Energy
- Finance/performance management
- Analysts[1] who will lead the carbon footprint calculations

[1] Many companies hire third-party consultants to perform the product carbon footprinting analysis. The decision depends on weighing internal resource availability and expertise against the costs of an external provider.

Product carbon footprinting does not require a full-time commitment from all stakeholders, but rather:

- initial agreement on the objectives,
- input throughout the process (e.g. help with data collection), and
- discussion of results and next steps

The level of commitment depends on the individual's role and the complexity and/or number of products selected for carbon footprinting.

Agreeing the objectives will help determine the size of the ongoing project team. If the goal is to test the method on one product but eventually roll it out to others, then it may be more effective to involve a wider set of people across the organisation – and supply chain – from the beginning. Similarly, if more than one product is to be tested this may impact on how the data is collected and formatted. It could be prudent to standardise your data collection methods and analysis in order to allow consistency in the way you present results.

It is useful to assemble this team for a series of introductory and scoping workshops to discuss these and other start-up issues as described below.

Key considerations during start-up phase

- Why product carbon footprinting? What are the objectives and expected outcomes?
- Based on these objectives, what criteria should be set for product selection?
- What products could meet those criteria?
- Who are the key supplier contacts?
- What resources and budget can be given to the project?
  - e.g. external consultants vs. in-house resources and expertise
- What governance/decision making structure will guide the project?
- How long will it take?
- Who is responsible for what, and what will they deliver?

Choosing products

When choosing products to footprint, it helps to set overarching criteria based on goals for the project, and then to identify which products best meet those criteria. Product selection criteria should fall directly from the objectives agreed at the beginning of the project, and are a key component of defining the scope – how many products, types of product, different sizes of product, etc.

Key questions to consider when selecting products include:

- Which products are likely to yield the largest emission reduction opportunities?
- Which comparisons are most relevant to the company's GHG reduction strategy? For example, comparisons across:
  - Product specifications
  - Manufacturing processes

  - Packaging options
  - Distribution methods
- Which products are most important from a differentiation or competitive perspective?
- Which brands/products are most aligned with potential emission reductions and marketing opportunities?
- How willing and/or able are suppliers to engage?
- What impact could the footprint analysis have on key stakeholders?
- How much time and resource can be committed to the footprinting analysis?

Once the product is chosen, the next step is to specify the functional unit (see PAS 2050 Section 5.8[2)]). A functional unit reflects the way in which the product is actually consumed by the end user (e.g. 250 ml of a soft drink, 1,000 hours of light from a light bulb, one night's hotel stay), or used as an input by a B2B customer (e.g. 1 kg sugar).

Defining the functional unit is a very important step in calculating a carbon footprint. The functional unit can be thought of as a meaningful amount of a particular product used for calculation purposes.

The functional unit is important since it provides the basis for comparison and, if desired, communication of results. It may be easier to do the actual analysis using a larger unit (e.g. a sheet of aluminium vs. a soft drink can). This is possible as long as the relationship between this unit of analysis and the functional unit is clearly understood, so that it can be converted back to the functional unit at the end of the analysis.

When choosing a functional unit there may be no single right answer, however it should be a unit that is easily understood and can be used by others. Often industry-specific guidance already exists in other standards, such as the functional units for nutritional information on food products.

[2)] Throughout this guide where specific sections of PAS 2050 are referenced, these refer to the 2008 version of PAS 2050.

Services note: Defining the functional unit is particularly important when calculating the carbon footprint of services.

- What do customers believe they are purchasing?
- What quantity of service is representative?
- What does the company want to compare the footprint against?
- What might customers want to compare against?

Engaging suppliers

Engaging with suppliers is critical to understanding the product's life cycle and for gathering data. Typically, companies know their own production processes thoroughly; however, beyond the boundaries of the company, knowledge of the processes, materials, energy requirements and waste tends to vary considerably.

As part of the initial internal discussions, it is useful to think through the following:

- Who are the key suppliers, retailers, waste management companies, etc.?
- What information can they provide?
- How willing and/or able are they to support the project, e.g. are there any commercial sensitivities with the information they are being asked to provide?
- Who will take responsibility for the relationships?

Consider drawing up a supplier engagement plan that includes the following:

- How to get suppliers interested in carbon footprinting, including goals of the analysis and potential benefits to suppliers, e.g. the opportunity to:
  - Identify carbon/cost savings opportunities
  - Declare that they are collaborating to manage carbon
  - Create joint emissions targets
  - Improve relationships/credentials with business customers, etc.
- Information they will need to provide, including potential site visits and key contacts
- Estimated meetings/workshops required
- How to address confidentiality concerns – legal/confidentiality issues must be overcome early in order to get access to necessary data

Supplier engagement should be built into the overall project work plan, with roles, responsibilities and milestones clearly defined and understood.

In summary, getting off to the right start will help to ensure the product footprinting process is cost-effective and delivers the full range of possible benefits.

Section II

Calculating product carbon footprints

PAS 2050 takes a process life cycle assessment (LCA) approach to evaluating the GHG emissions associated with goods or services, enabling companies to identify ways to minimise emissions across the entire product system.

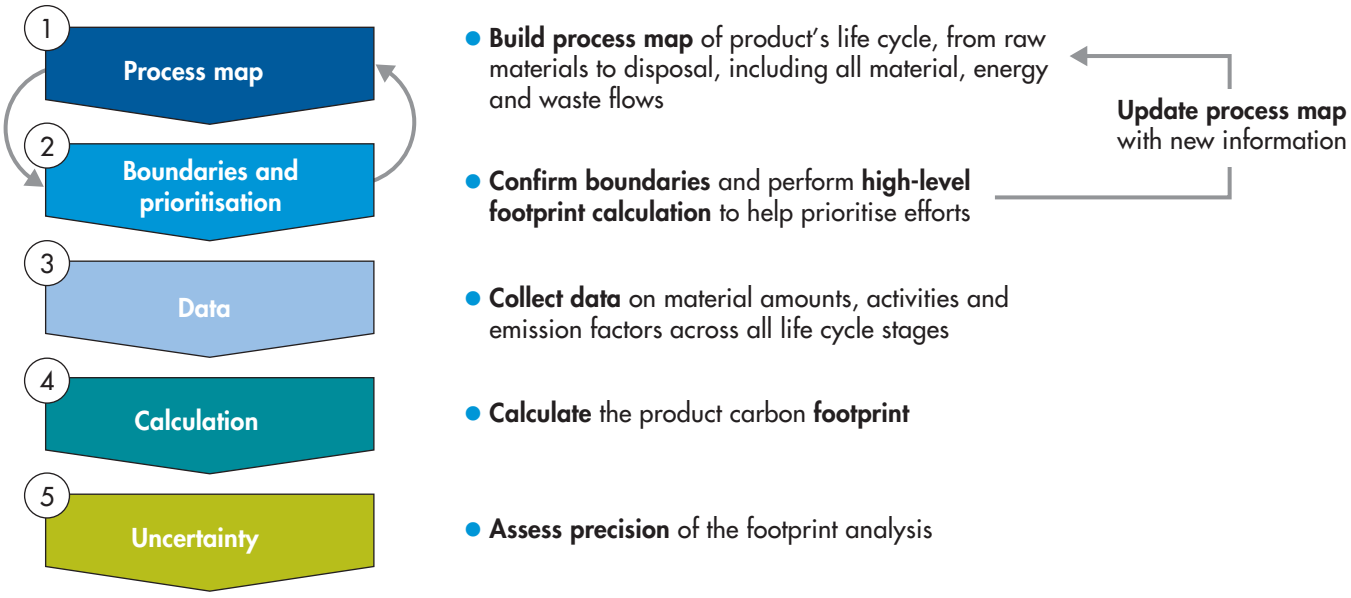
PAS 2050 is anchored in the guiding principles listed in the box below (see PAS 2050 Section 4.2).

There are five basic steps to calculating the carbon footprint of any good or service:

- Building a process map (flow chart)
- Checking boundaries and prioritisation
- Collecting data
- Calculating the footprint
- Checking uncertainty (optional)

Relevance	Select sources, data and methods appropriate to assessing the chosen product's life cycle GHG emissions
Completeness	Include all GHG emissions and storage that provide a 'material' contribution to a product's life cycle emissions
Consistency	Enable meaningful comparisons in GHG-related information
Accuracy	Reduce bias and uncertainty as much as is practical
Transparency	When communicating, disclose enough information to allow third parties to make decisions

'Uncertainty' is a statistical term used to define the accuracy and precision of an input or calculation. For more information, see *Step 5: Checking uncertainty*, in this guide.



Five steps to calculating the carbon footprint

Step 1: Building a process map

The goal of this step is to identify all materials, activities and processes that contribute to the chosen product's life cycle. Initial brainstorming helps to build a high-level process map that can then be refined through desktop research and supply chain interviews. The process map serves as a valuable tool throughout the footprinting exercise, providing a starting point for interviews and a graphical reference to guide both data collection and the footprint calculation.

To develop a product process map, start by breaking down the selected product's functional unit into its constituent parts (e.g. raw materials, packaging) by mass using internal expertise and available data or desktop research. A product specification or bill-of-materials is a good starting point. Focus on the most significant inputs first, and identify their respective inputs, manufacturing processes, storage conditions and transport requirements.

In practice there are considerable benefits to repeating the process map step (Step 1 above) as understanding of the life cycle improves, allowing greater prioritisation and focus. For example, in Step 2 a high-level footprint can be calculated with estimates and readily available data before fully investing in data collection. This approach enables prioritisation based on highest impact emission sources rather than spending time on small or 'immaterial' (less than 1% of overall life cycle emissions) contributors.

Process map steps

Business-to-consumer (B2C)

When calculating the carbon footprint of B2C goods, typical process map steps include those illustrated opposite. From raw materials, through manufacture, distribution and retail, to consumer use and finally disposal and/or recycling.

Business-to-business (B2B)

Business-to-business carbon footprints stop at the point at which the product is delivered to another manufacturer, consistent with the 'cradle-to-gate' approach described in BS EN ISO 14040[3]. The B2B

[3] BS EN ISO 14040, *Environmental mamagement — Life cycle assessment — Principles and framework.*

Process map steps for business-to-consumer goods

Process map steps for business-to-business goods

life cycle therefore captures raw materials through production up to the point where the product arrives at a new organisation, including distribution and transport to the customer's site. It excludes additional manufacturing steps, final product distribution, retail, consumer use and disposal/recycling.

This is because B2B goods can be used as inputs to multiple final products with widely divergent use and disposal characteristics (e.g. aluminium can be used in drinks cans or aeroplanes). See PAS 2050 Section 6.2 for more information.

Services

Process maps for services will vary depending on the service chosen. An 'activity-based assessment' is used when considering the life cycle of services, and is derived from the combined activities required to provide the service which may or may not result in a physical output.

A service 'life cycle' therefore involves more than just inputs, outputs and processes: the process map will include all stages and potential emission sources from any activity that contributes to the delivery or use of the service. When mapping the service life cycle, try to define it in a way that would be most useful both for internal use and for others using the footprint, i.e. make it:

- Easily comparable to other services internally or from competitors;
- Likely to generate actionable opportunities to reduce emissions; and
- Relatively easy to describe the supply chain

See Appendix II for examples of how to develop the process map for two different services.

Product carbon footprinting in action – croissants example

Croissants are used as a rolling example throughout this guide to demonstrate how to use PAS 2050 to calculate a product carbon footprint. This simplified example is designed to be a representation not a complete or exhaustive description of the croissants' life cycle. All figures are purely illustrative.

Building a process map for croissants involves the following brainstorming stages.

1. Define the functional unit – the appropriate functional unit is driven by how the product is typically consumed (e.g. one 100 g croissant); however, it may be easier to collect data and calculate the footprint using a larger unit, such as one tonne of croissants
2. List the ingredients and proportions
   - Flour (wheat) – 60%
   - Water – 20%
   - Butter – 15%
   - Other (e.g. yeast) – 5%
   - Packaging material (film and secondary packaging)
3. List the activities involved in producing and consuming croissants
   - Produce and transport raw materials
     - Grow and transport wheat; mill into flour
     - Supply water
     - Produce milk; manufacture butter
     - Produce other ingredients
     - Produce film packaging
   - Manufacture and package croissants
   - Distribute finished product
   - Retail
   - Use (eat)
   - Dispose of waste
4. Reflect on what might have been missed
   - Have all raw materials been traced back to their origin, including intermediate processes?
     - Include the GHG impact of grazing and cows to the butter process; add wheat drying as an intermediate process
   - Were any by-products created during manufacturing?
     - Milling produces wheat germ and animal feed as well as flour
   - Have all waste streams and emissions been accounted for?
     - In flour milling, baking, retailing and consumer use; in transport, waste treatment and decomposition
   - Has the transport of waste been accounted for?
     - Need to include transport at every stage where waste is created
   - Have multiple distribution stages been accounted for, including all transport links and storage conditions?
     - Add in regional distribution centre
   - Was energy consumed during the consumer use phase?
     - Consumers may freeze and heat before eating

Continue to update the process map until all inputs have been traced back to their original sources, and all outputs have been tracked until they stop emitting GHGs attributable to the product. This process typically takes multiple attempts with management, suppliers, distributors and customers. The process map should be exhaustive and include all possible drivers of emissions; however, the footprint calculation focuses on the more significant contributors.

Once a full picture of the steps in the product's life cycle has been built, the next step is to confirm boundaries and prioritise.

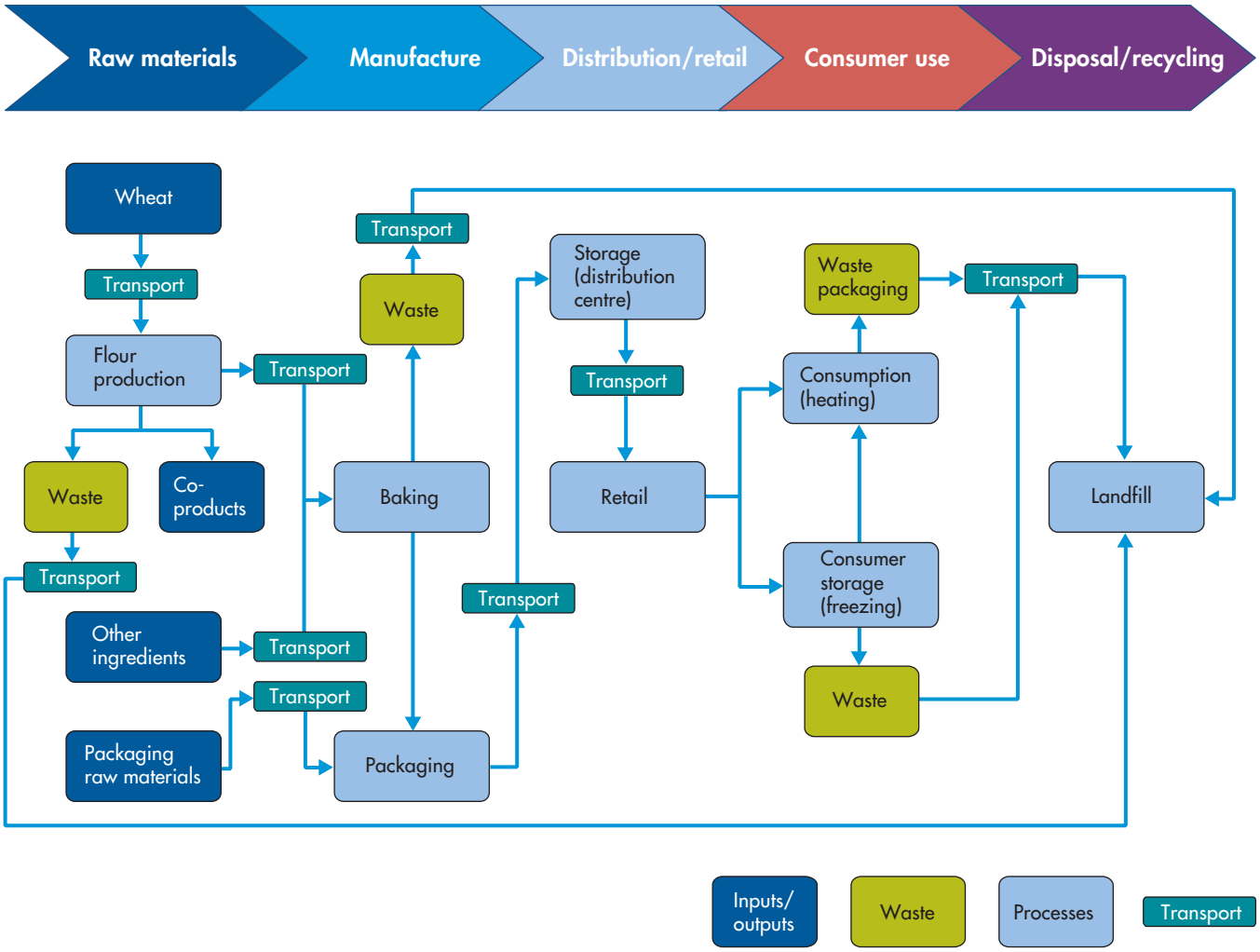
Step 2: Checking boundaries and prioritisation

Boundaries

The system boundary defines the scope for the product carbon footprint, i.e. which life cycle stages, inputs and outputs should be included in the assessment.

Once a high-level process map has been developed (see example opposite), the relevant boundaries for the carbon footprint analysis must be determined. For conformity to PAS 2050 the product life cycle system boundaries should be consistent with a Product Category Rule (PCR), where available, as outlined in BS ISO 14025[4].

[4] BS ISO 14025, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures.*



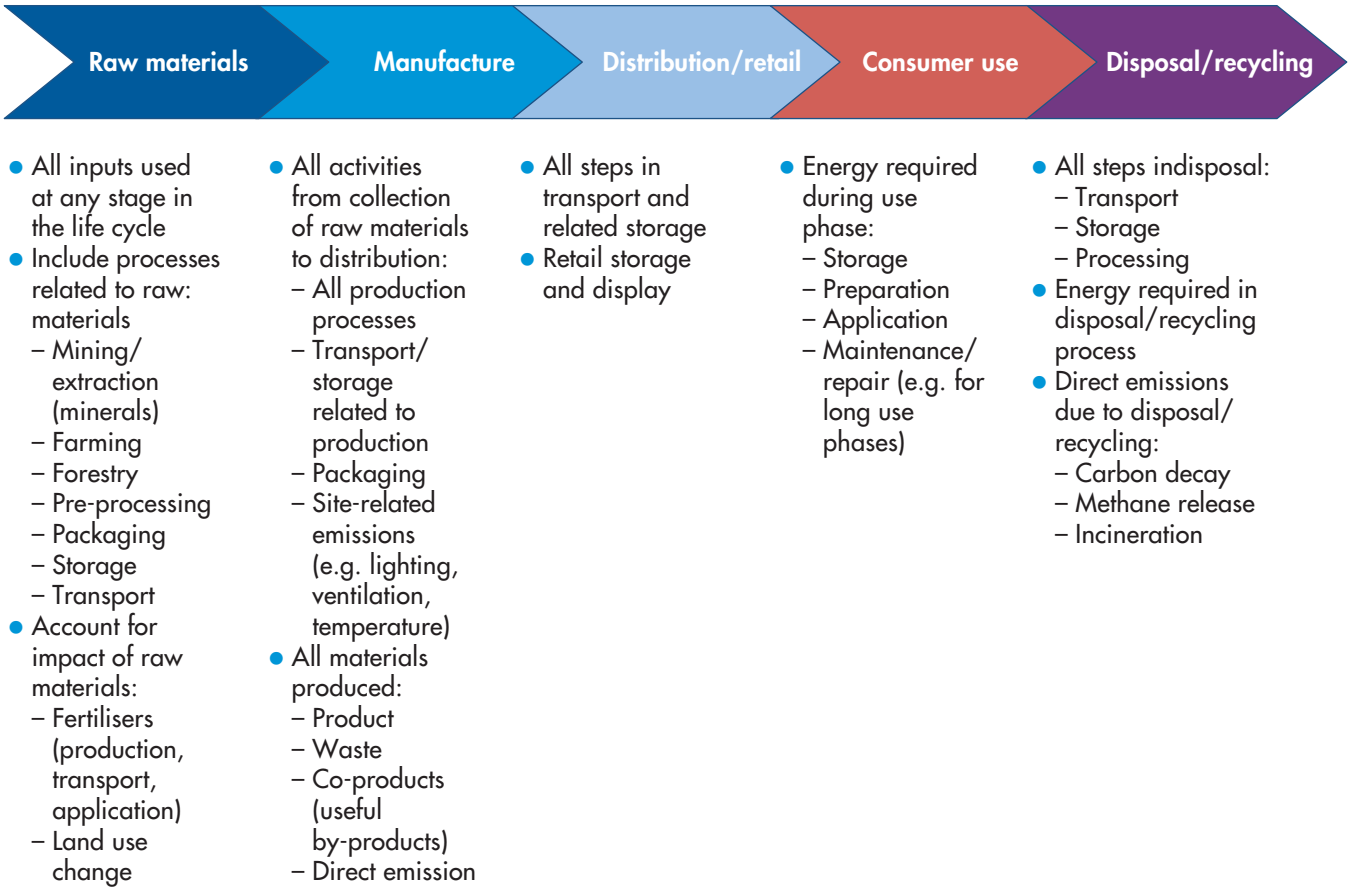
In this simplified example, a reliable and representative emission factor for wheat is assumed to exist, and therefore wheat production is not decomposed into its upstream activities (e.g. fertiliser production, transport and use; impact of land use change). Similarly, other ingredients and packaging are assumed to have reliable and representative emission data available. Although butter would be an important contributor to the product's overall footprint, for simplicity it is not included in detail in the calculations.

Process map: croissants example

If a PCR is not available for the product, the system boundary should be clearly defined. System boundaries apply primarily to goods and need to be adapted to consider a service. See PAS 2050 Sections 6.1, 6.4 and 6.5 for more information and specific guidelines.

See PAS 2050 Section 5.3 for more detail on potential sources of GHG emissions to include in the process map.

Product category rules (PCRs) are a set of specific rules, requirements and guidelines for developing environmental declarations for one or more groups of products that can fulfil equivalent functions. PCRs offer a consistent, internationally-accepted approach to defining a product's life cycle. They are emerging but still cover a limited number of products. To check whether the product being footprinted is covered by a PCR, refer to the PCR section of *www.environdec.com*.



Common materials/activities to include within a product's life cycle boundary

The key principle for system boundaries is to include all 'material' emissions generated as a direct or indirect result of the chosen good or service being produced, used and disposed of or recycled.

A material contribution is a contribution from any one source resulting in more than 1% of the total anticipated life cycle emissions of the product.

PAS 2050 allows immaterial emissions to be excluded – any single source resulting in less than 1% of total emissions. However, the total proportion of immaterial emission sources cannot exceed 5% of the full product carbon footprint. Detailed specifications of the boundaries are described in PAS 2050 Section 6.

For further detail on inclusions and exclusions, see *Step 4: Calculating the footprint*.

Boundaries: what not to include

- Immaterial emissions sources (less than 1% of total footprint)
- Human inputs to processes
- Transport of consumers to retail outlets
- Animals providing transport (e.g. farm animals used in agriculture or mining in developing countries)

Materiality and prioritisation

To decide whether an emission source is likely to be material, it helps at this point to do a high-level footprint analysis using estimates and readily accessible data (see *Step 3: Collecting data* for guidance on potential sources). This analysis includes

the full life cycle of the product but relies on estimates and generic data to build a high-level footprint. Significant sources of emissions can then be replaced by more specific and better quality data.

For example, the high-level analysis of the life cycle carbon footprint of croissants shown in the table below could be built from a desktop internet search of published academic work, other LCA studies of similar products, industry association published data and selected use of standard LCA databases. A list of datasets can also be found at *http://lca.jrc.ec.europa.eu/lcainfohub/databaseList.vm*.

The results shown in Table 1 suggest that data collection efforts should begin with raw material production and transport, particularly wheat. The initial assessment also suggests that three steps in the process flow may be immaterial: water supply, storage and retail. These steps are unlikely to produce substantial GHG emissions, so collecting data for these areas should be given a lower priority.

A range of data may be available for each material, but the data should be sufficient to allow for prioritisation of further data collection.

Armed with a better sense of where – and where not – to focus, the next step is to collect more detailed data specific to the product being footprinted. For a high-level analysis it may be sufficient to stop here and use this carbon footprint figure to identify emissions 'hot spots'; however, this would not be rigorous enough to achieve full compliance with and certification against PAS 2050, for external claims or for most product or process comparisons.

Step 3: Collecting data

Guided by the initial calculations in Step 2, begin collecting more specific data following the requirements and recommendations of PAS 2050, which will enable assessment of the carbon footprint in more detail.

All data used in a PAS 2050-compliant carbon footprint assessment must meet the Data Quality Rules (see PAS 2050 Section 7.2). This assures accurate, reproducible and more readily comparable carbon footprints. Good quality data helps to build a footprint that represents a 'typical' product's life cycle, over a defined time period, recognising variations in geography, distance and materials.

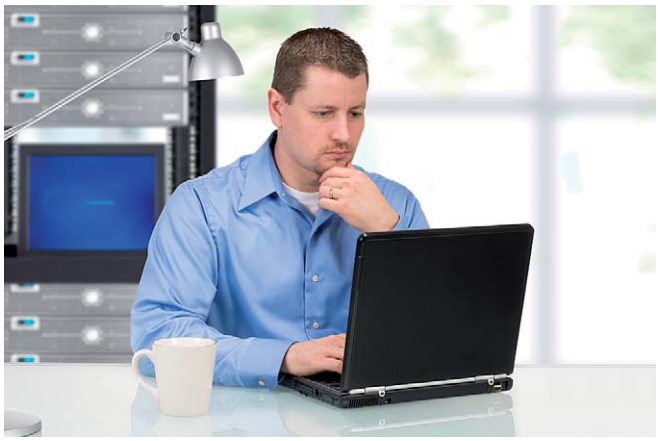


Table 1: High-level footprint analysis (croissants example)

Raw materials (including transport)		Manufacturing		Distribution/ retail		Consumer use		Disposal/ recycling		Total
Wheat agriculture	500	Plant A	200	Transport	30	Freezing	50	Transport	50	
Flour milling	50			Storage	0	Toasting	40	Decay	100	
Water supply	0			Retail	0					
Other ingredients	100									
Film packaging	20									
Total	**670**		**200**		**30**		**90**		**150**	**1140**

All figures are in grams CO_2e per tonne croissants, and are for illustration purposes only.

In order to comply with the requirements of PAS 2050, data quality should be judged according to the rules described in PAS 2050 Section 7.2.

- How specific is it to the declared reporting period? (Ideally the data would cover the exact time period)
- How specific is it to the product's relevant geography?
- How specific is it to the product's relevant technologies and processes?
- How accurate is the information used (e.g. data, models and assumptions)?
- How precise is the information? i.e. measure the variability of the data values (see *Step 5: Checking uncertainty*)
- How complete is it? i.e. is the sample size sufficiently large and representative of all potential sub-categories of the product? What percent of the data used was actually measured vs. taken from a general database?
- How consistent is it?
- How reproducible is it? i.e. what is the extent to which an independent practitioner could reproduce the results?
- What sources are used?

These rules are subjective; however, their application will allow companies to identify the most appropriate data for their circumstances.

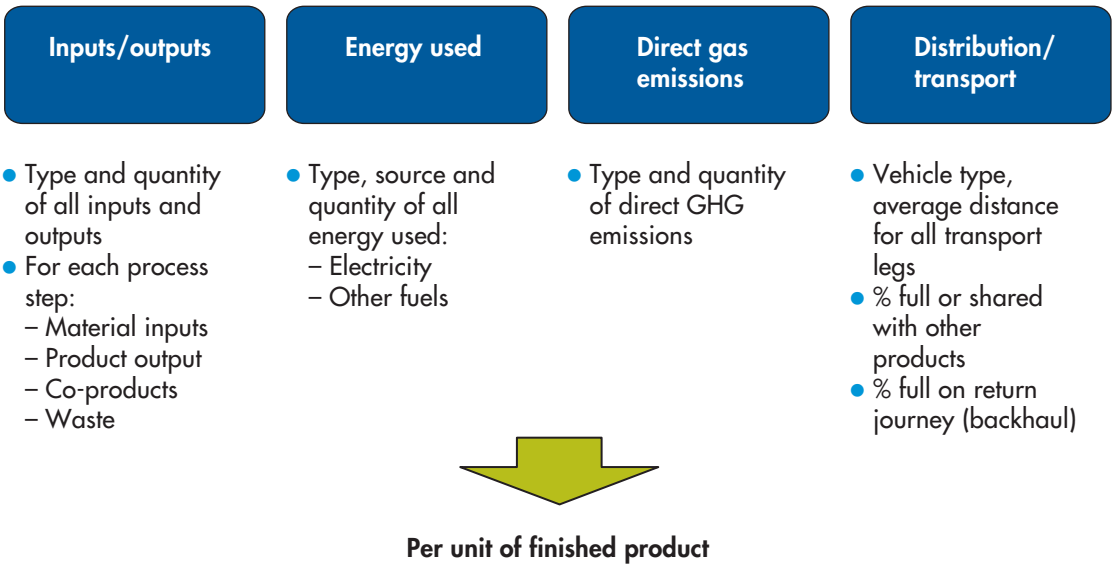
Data types

Two types of data are necessary to calculate a carbon footprint: **activity data** and **emission factors**. Activity data refers to all the material and energy amounts involved in the product's life cycle (material inputs and outputs, energy used, transport, etc.) – see below.

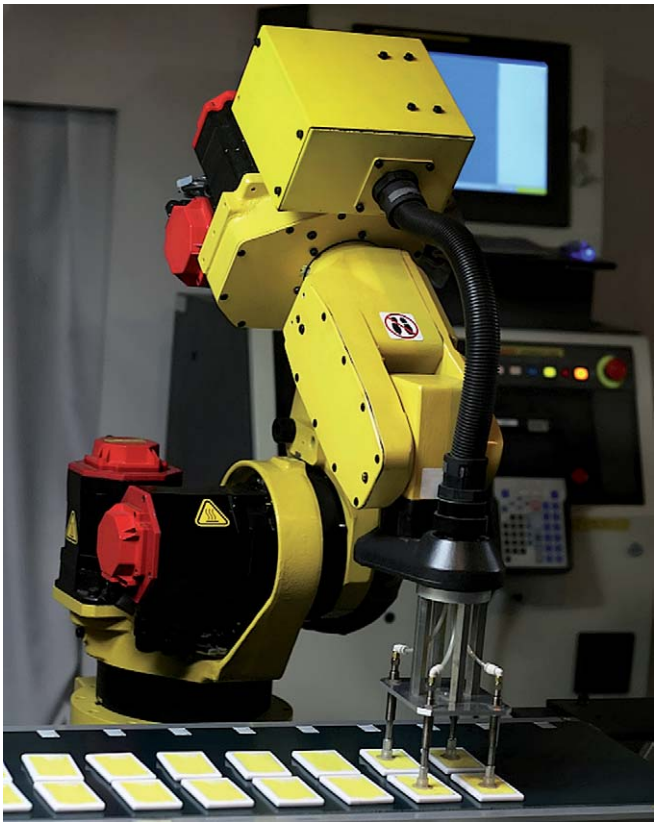
Emission factors provide the link that converts these quantities into the resulting GHG emissions: the amount of greenhouse gases emitted per 'unit' of activity data (e.g. kg GHGs per kg input or per kWh energy used).

Activity data and emissions factors can come from either primary or secondary sources:

- Primary data refers to direct measurements made internally or by someone else in the supply chain about the specific product's life cycle
- Secondary data refers to external measurements that are not specific to the product, but rather represent an average or general measurement of similar processes or materials (e.g. industry reports or aggregated data from a trade association)



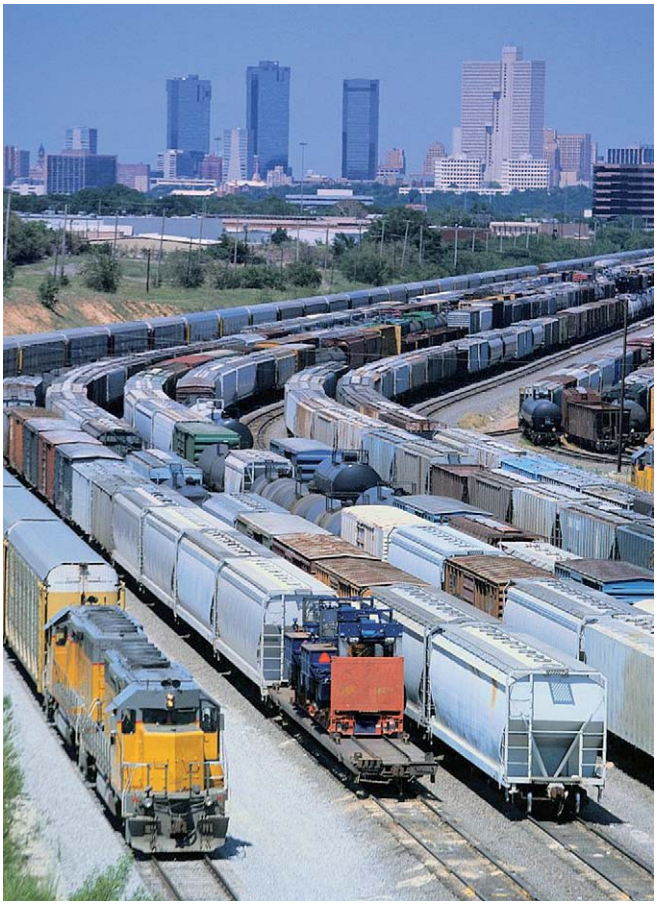
Common activity data



Primary activity data

PAS 2050 requires that primary activity data be used for all processes and materials owned, operated or controlled by the footprinting organisation (see PAS 2050 Section 7.3). For retailers or other organisations that do not contribute a significant amount to the product's emissions, primary activity data is required for the processes and materials controlled by the first (closest) upstream supplier. These data should be relatively easy to measure, and are necessary to ensure the carbon footprint result is specific to the chosen product. Primary activity data is not required for downstream sources of GHG emissions (e.g. consumer use, disposal).

In general, use as much primary activity data as possible, since it allows for better understanding of the actual emissions and helps identify real opportunities to improve efficiency.



Primary activity data should be representative, reflecting the conditions normally encountered by the product being assessed. For more guidance on gathering primary activity data in variable supply chains, see PAS 2050 Section 7.6

Primary activity data can be collected across the supply chain either by an internal team or by a third party (e.g. consultants). In practice, it helps to speak to at least one person in each part of the supply chain to ensure the process map is correct and that sufficient data is collected. The data may already exist within the organisation, or it may require new analysis. In some cases, gathering primary activity data may require installing new ways to collect data, such as measurement meters and sub-meters.

Data collection templates may be a useful method of formalising the data collection process, helping to:

- Structure an interview with a supplier
- Ensure completeness, thereby minimising the number of interviews required
- Prioritise the likeliest/largest carbon reduction opportunities

For example, when collecting data on flour milling, a spreadsheet such as that shown in Table 2 may be useful to capture key pieces of primary activity data. For more complex processes, more information on the technology and sub-process steps would be required (such as source of wheat, fertiliser used, etc.).

Secondary data

Where primary activity data is not available, or is of questionable quality (e.g. when appropriate measurement meters are not available), it is necessary to use secondary data derived from sources other than direct measurement.

In some cases, secondary data may be preferable to enable consistency and, where possible, comparability:

- Global warming potential of greenhouse gases
- Electricity emissions (in kg CO_2e per kWh) from various energy sources
- Fertiliser/pesticide emissions per kg
- Fuel emissions per litre
- Transport emissions per km per vehicle type
- Waste emissions per kg
- Agriculture emissions from livestock and/or soils

Global warming potential (GWP) is a term used to describe the impact over 100 years of one unit of a greenhouse gas relative to an equivalent unit of carbon dioxide.

Table 2: Example of a data collection template

Data collection example: flour supplier interview	Notes
T flour / T croissants	0.6
Wheat production breakdown (1 T wheat yields):	
% flour	80%
% wheat germ	10%
% animal feed	5%
% waste	5%
kWh to produce 1 T wheat milled	100
Electricity source	UK grid average
On-site storage?	Ambient
On-site transport?	None
Transport to croissant factory:	
Vehicle type	Articulated truck
Distance between supplier and factory	200 km
Fuel consumed per trip	80 L
# of trips per tonne flour	0.3
% of vehicle dedicated to flour	100%
% of return journey filled with other goods	0%

CO_2e stands for 'carbon dioxide equivalent', a unit used to measure the global warming potential for all greenhouse gases.

Data sources

Relevant databases are continually being developed and updated, so it is not possible to provide a definitive list in this document. However, guidance is included below to help in finding potential sources and assessing their quality.

For secondary data, PAS 2050 recommends the use of verified PAS data from other sources where available (e.g. a supplier who has completed a PAS 2050-compliant product carbon footprint). Otherwise, use data from peer-reviewed publications, together with data from other competent sources (e.g. national government, official UN publications and publications by UN-supported organisations).

Types of databases that have been used to calculate product carbon footprints are:

- Multi-sector life cycle databases, either commercial or publicly available (note some of these datasets can also be accessed through commercial LCA software programmes)
- Industry-specific databases
- Country-specific data sources, e.g. government agencies such as Defra in the UK

A list of LCA databases provided by the EU can be found at *http://lca.jrc.ec.europa.eu/lcainfohub/databaseList.vm*. Some databases are free, whereas some charge a licence fee. Over time, more databases may become available, such as the International Reference Life Cycle Data System (ILCD), which will contain life cycle inventory datasets for selected materials and processes. It is important to confirm that sources are as representative as possible of the time period being analysed. In any case, data chosen from any database should be assessed against the quality criteria defined in PAS 2050 Section 7.2, which are consistent with existing BS EN ISO 14044[5)] data quality criteria.

Understanding exactly what is included in – or missing from – any secondary data is important. For example, when using secondary sources for agricultural product emissions, have land use change and emissions from nitrous oxide been included, or will these need to be calculated separately? (See PAS 2050 Sections 5.5 and 7.5.) Also watch out for other situations that can be more complicated (see *Treatment of specific emission drivers*).

Consumer use emissions

Data describing how consumers use products (the 'use profile') can be particularly difficult to find. PAS 2050 offers a hierarchy of sources for use profile data (see PAS 2050 Section 6.4.8.2):

1. Product Category Rules (PCRs)
2. Published international standards (e.g. Energy Star database *www.eu-energystar.org/en/en_database.htm*)
3. Published national guidelines (e.g. Market Transformation Programme energy in use data *http://whatif.mtprog.com*)
4. Published industry guidelines

Each source should be considered only if it specifies a use phase for the product being footprinted. If no public information is available, check with all relevant industry associations or other potential sources of expertise.

Use phase and Use profile

'Use phase' describes the activities and energy consumed when the product is used by the end consumer. This could include energy associated with storage, e.g. refrigeration, or application, e.g. electricity for a light bulb.

'Use profile' describes the average behaviours of the end consumer, e.g. the average percentage of food products that go to waste.

[5)] BS EN ISO 14044, *Environmental management — Life cycle assessment — Requirements and guidelines.*

For full compliance with PAS 2050, it is necessary to disclose the basis of any use phase calculation (data sources, assumptions, etc.) – see PAS 2050 Section 6.4.8.

Records

PAS 2050 requires that detailed records be kept of all data sources and any assumptions that are used to carry out the emissions assessment. To communicate the footprint externally, details of boundaries, use profile and all data sources should be disclosed to ease transparency.

Armed with sufficient data, now it is time to put it all together and calculate the carbon footprint of the product (see *Communicating the footprint and claiming reductions*).

Step 4: Calculating the footprint

The equation for product carbon footprinting is the sum of all materials, energy and waste across all activities in a product's life cycle multiplied by their emission factors. The calculation itself simply involves multiplying the activity data by the appropriate emission factors.

Carbon footprint of a given activity = Activity data (mass/volume/kWh/km) × Emission factor (CO_2e per unit)

Once GHG emissions are calculated for each activity, convert to CO_2e using the relevant global warming potential (GWP) factors described in PAS 2050 Table A.1

Calculating the carbon footprint normally requires a 'mass balance' to ensure all input, output and waste streams are accounted for.

Mass balance

The quantification of the total amount of all materials into and out of a process is referred to as 'mass balance'. The mass balance step provides confirmation that all materials have been fully accounted for and no streams are missing.

The fundamental concept is that total mass flowing into a process should equal total mass flowing out. In practice, it is a useful way to identify previously hidden waste streams: if the mass coming out of a process is less than the combined mass of the inputs, then some other stream – most likely waste – must be leaving the process too. Note that for some complex natural systems, like agriculture, mass balance may not be practical or relevant.

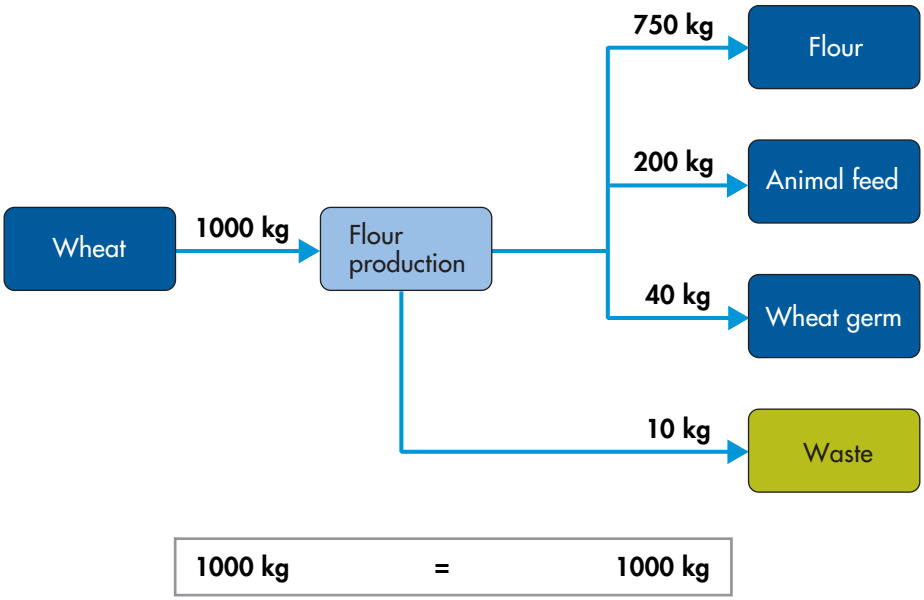
Services note: The services equivalent of a mass balance calculation is called an activity-based assessment. For a given activity, all processes and materials flowing into and out of that activity stage must be analysed for their GHG emissions.

For example, a mass balance check on the flour production stage for croissants would be as shown opposite.

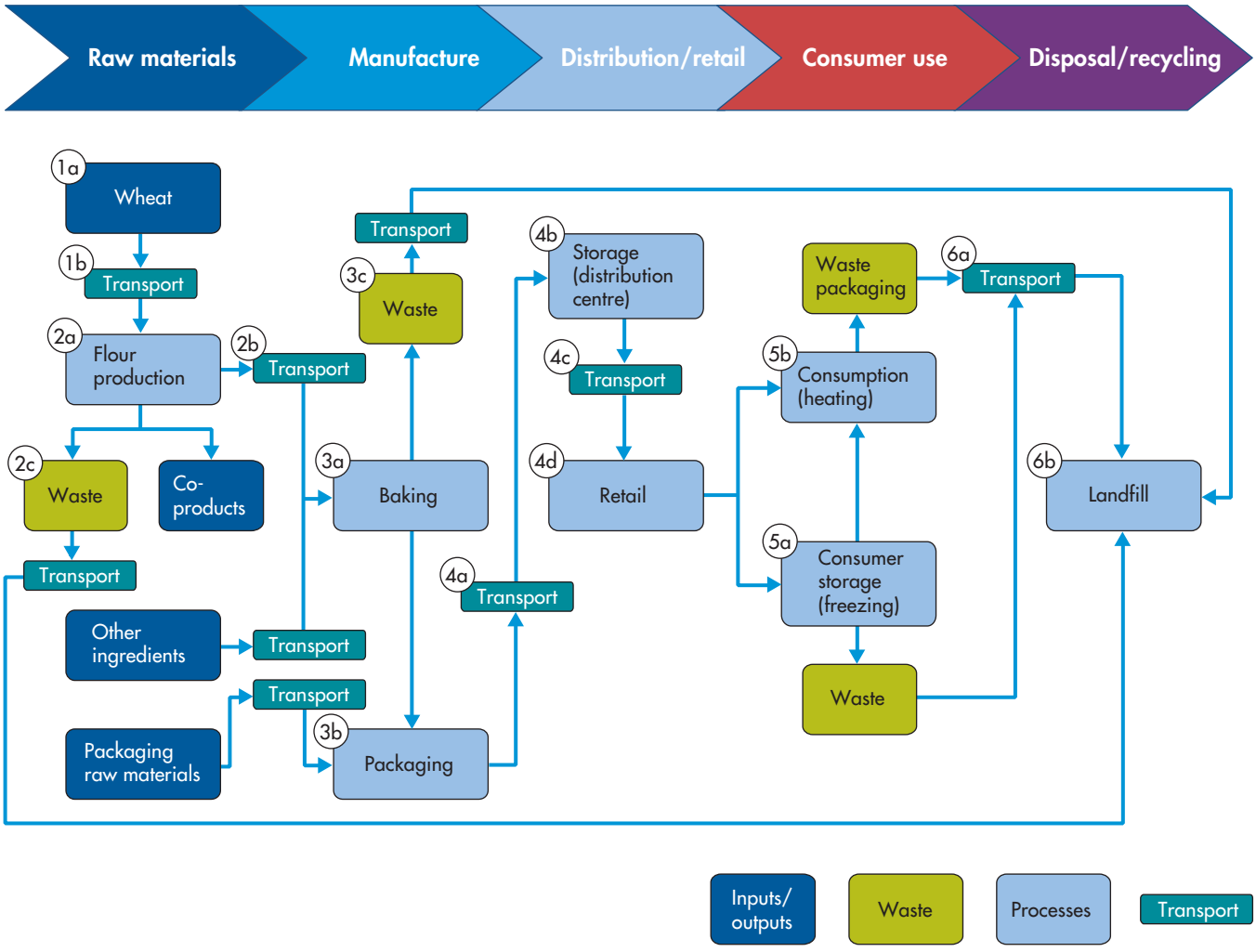
It is easiest to calculate mass balances while the data is being collected. First work backwards from the point of purchase: all materials, energy and direct emissions to produce a unit should be included, and all the mass accounted for. Then use a similar process to ensure the full mass of the product is captured in the use and disposal phases.

Footprint calculation

The actual calculation involves multiple steps, which are shown in the croissants example. For reference, each step is numbered in the process map opposite and corresponds to a discrete part of the detailed calculation diagram (pages 22–26) and the worked example in Appendix III.



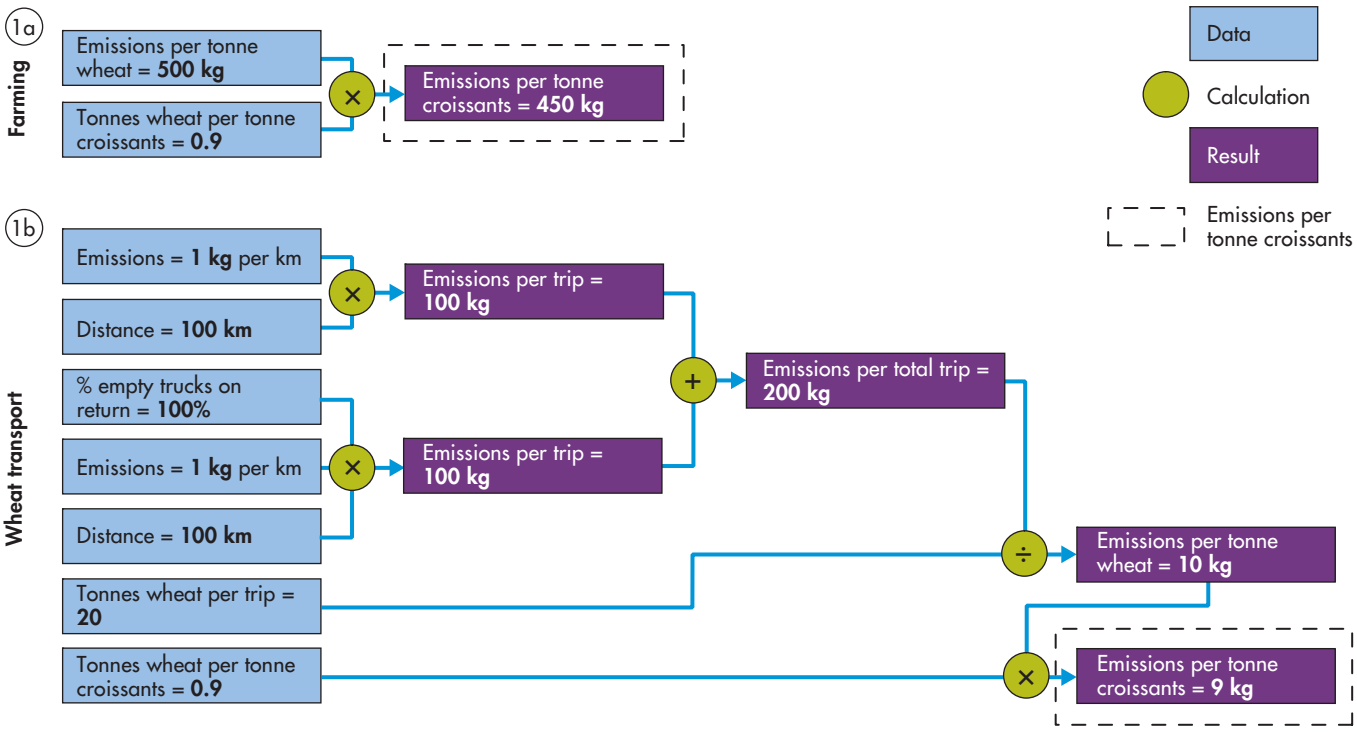
Mass balance example: flour production



Process map: croissants example

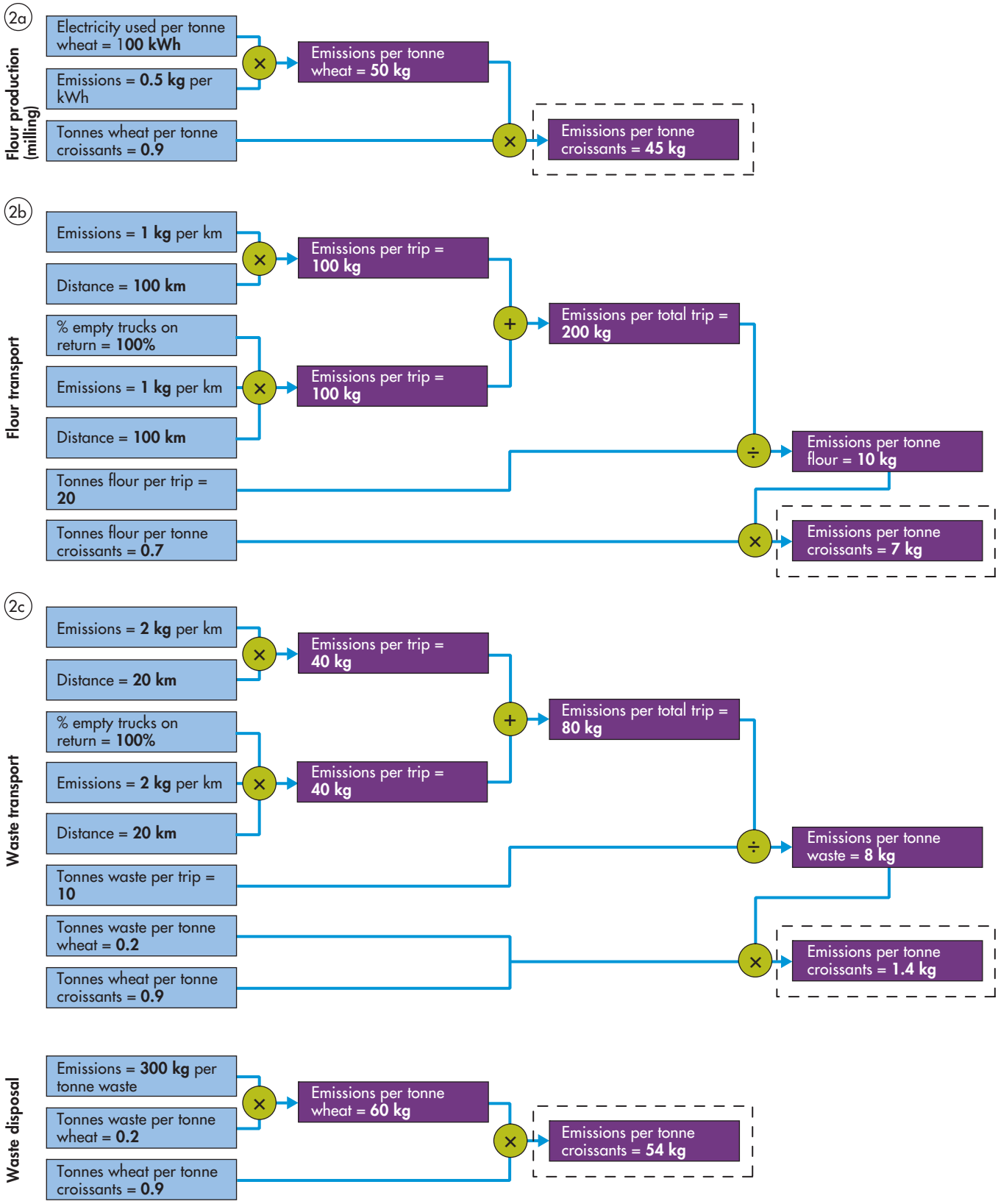
This simplified example aims to build basic understanding of the product footprinting calculation using illustrative values. It does not reflect a complete or fully representative calculation. In practice, software programmes are available – some with data sets attached – that can help with the calculations.

The footprint calculation table can be found in Appendix III. Below is a series of diagrams describing the calculations for each activity step-by-step.



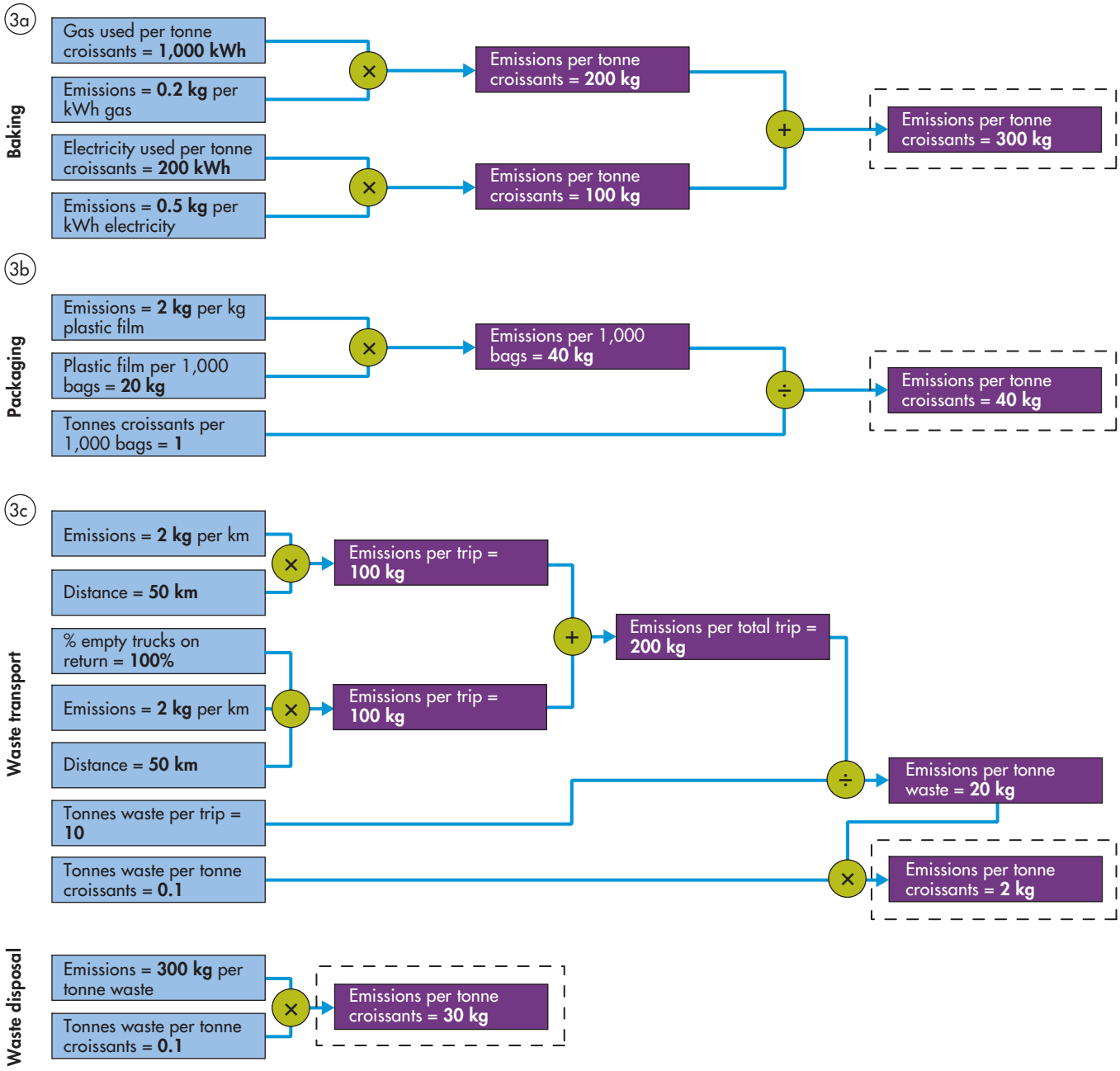
Note: all emissions described in kg CO_2e

Raw material cultivation and transport (wheat example)



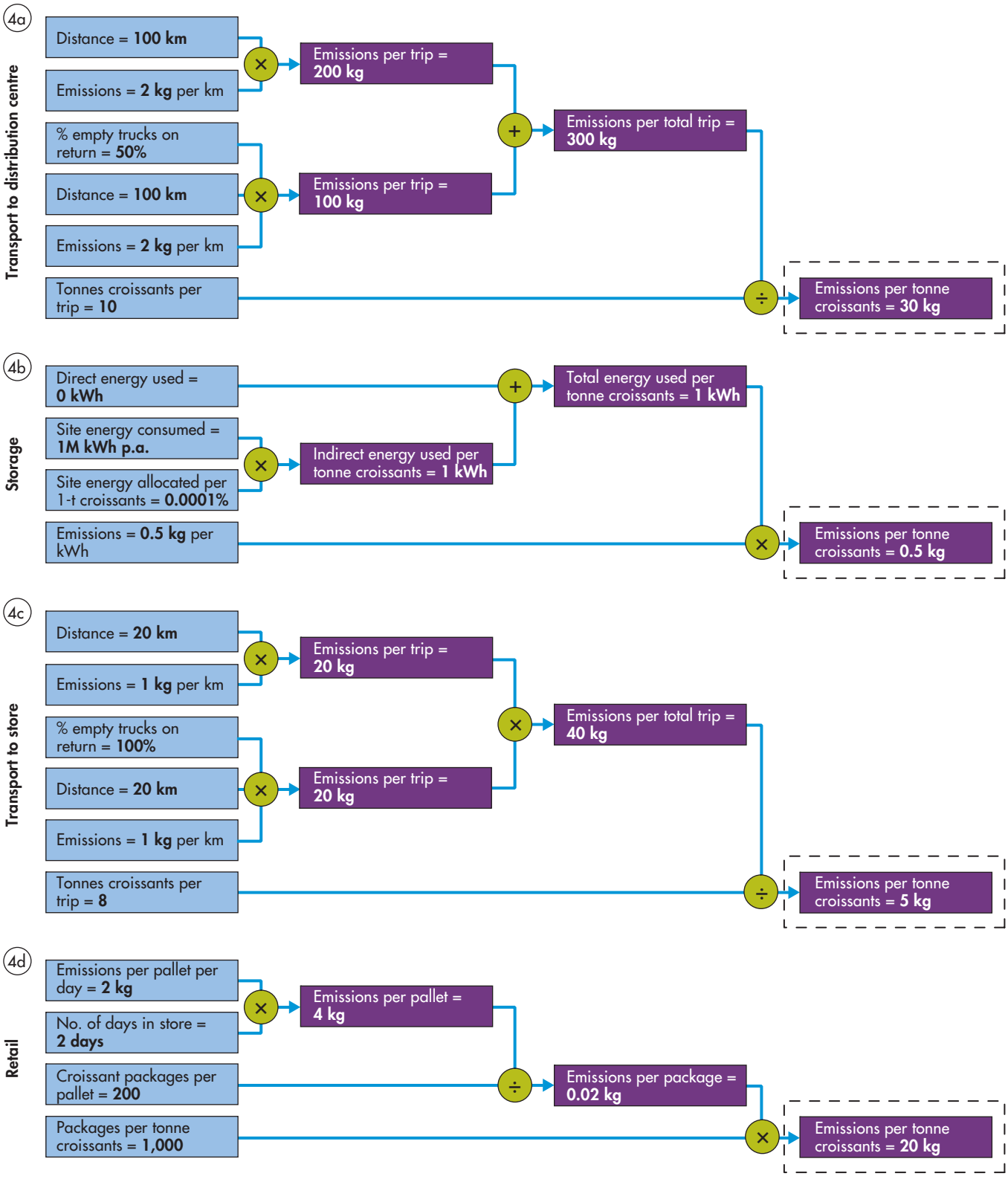
Note: all emissions described in kg CO_2e

Raw material production (flour example)



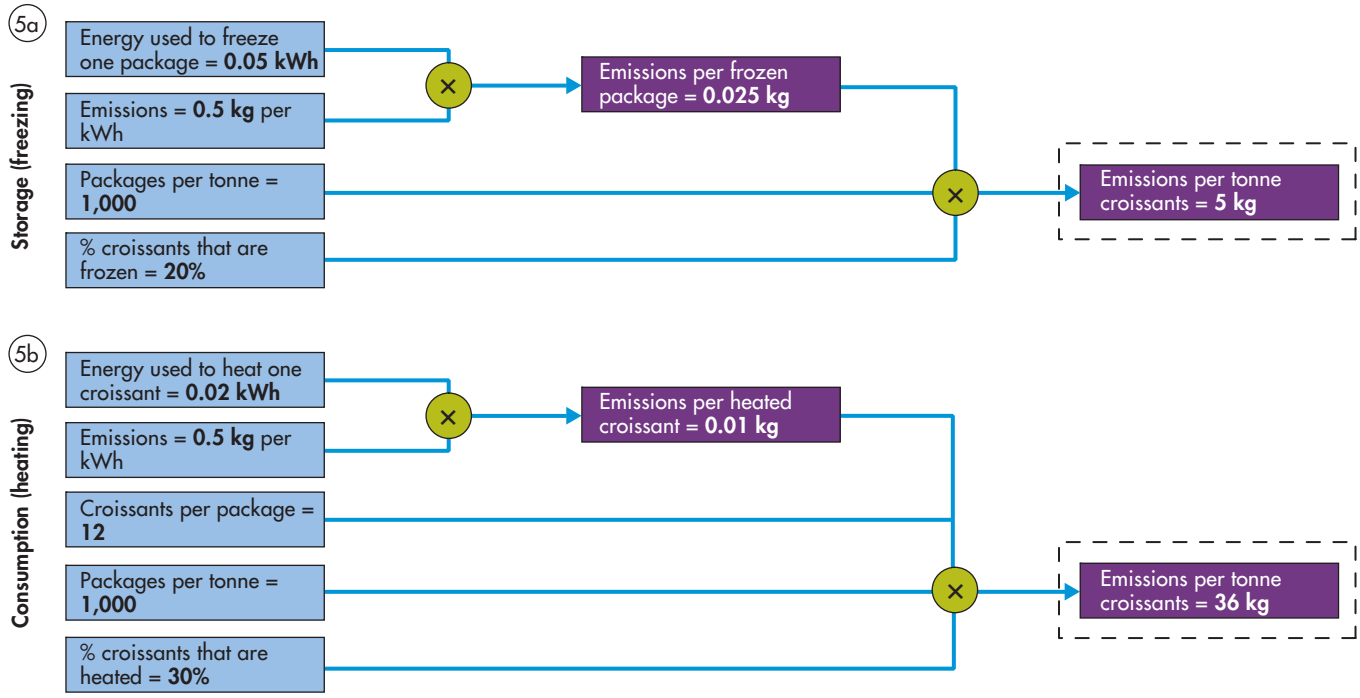
Note: all emissions described in kg CO_2e

Croissant production



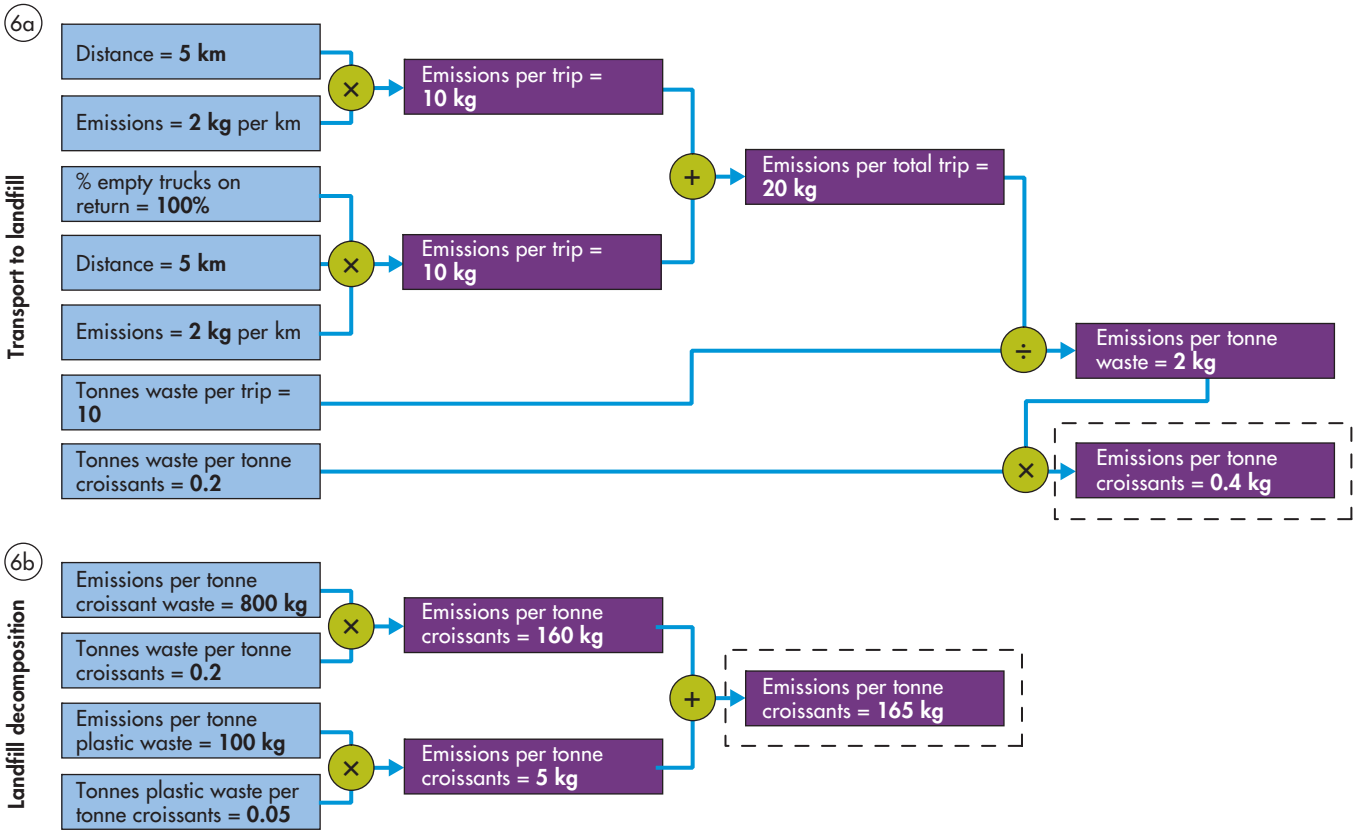
Note: all emissions described in kg CO_2e

Distribution and retail



Note: all emissions described in kg CO_2e

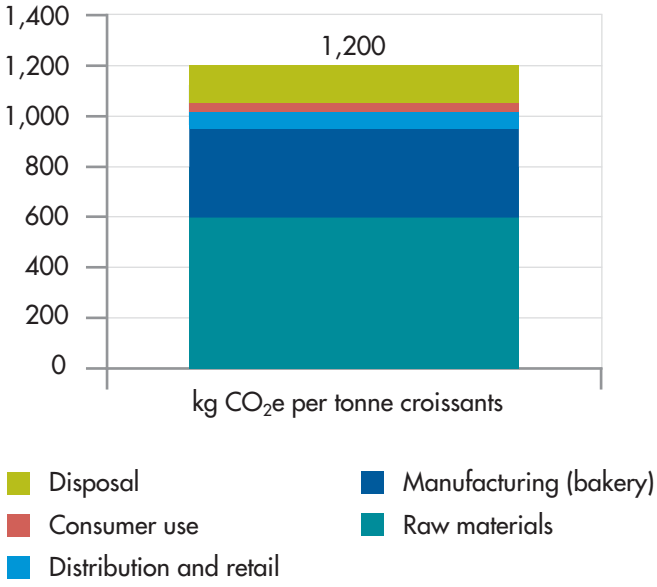
Consumer use



Note: all emissions described in kg CO_2e

Disposal

Having calculated the emissions for each step, deduct any carbon stored during the life cycle (see detail in *Carbon storage in products*). The net amount represents the total GHG emissions caused by each material and process across the product's life cycle, and therefore the final product carbon footprint – in this case, 1,200 kg CO_2e per tonne croissant, or 1.2 kg CO_2e per 12-pack.



Product carbon footprint: croissants example

Treatment of specific emission drivers

Some GHG emission sources have unique aspects that affect their assessment and are specified to more detail in PAS 2050 (see specific references in the text below). These situations, which concern measurement and allocation, are described here, with accompanying guidance.

Measurement

Delayed emissions

Emissions that are released over time through long use (e.g. light bulbs) or final disposal phases cannot be treated as a single release of emissions at the start of the 100-year assessment period. Therefore, these emissions must be calculated to represent the weighted average time in the atmosphere during the assessment period. PAS 2050 provides the calculation method and an example in Annex B.

100-year assessment period

The PAS 2050 method assesses the impact of GHG emissions arising from the life cycle of products over a 100-year period following the formation of the product.

Carbon storage in products

Some products that are formed from plant-based carbon (not fossilised) actually store carbon and therefore create 'negative' emissions by taking GHGs out of the atmosphere. PAS 2050 (Section 5.4) contains details on the circumstances when stored carbon can be counted and how to calculate the storage benefit. A summary is also given below.

Eligibility

Products can claim a storage benefit in the following situations.

1. The product is not a food (for humans) or feed (for animals)
   - To simplify the application of PAS 2050, there is no requirement to calculate the carbon storage in food products
2. Greater than 50% of the plant-based component's mass remains removed from the atmosphere for one year or more following production (e.g. wooden furniture such as a table)
   - This rule again simplifies the application of PAS 2050, so that products containing minor amounts of carbon do not have to undergo the carbon storage analysis
3. Material containing the plant-based carbon was especially created or recycled/re-used to input to this product and thus the storage benefit is *additional* to what would have occurred without the product being created
   - For example, products made from timber from a managed plantation forest would receive a carbon storage benefit; however, products using timber from a native, unmanaged forest (e.g. primary rainforest) would not receive a carbon storage benefit

- This is a key requirement: PAS 2050 allows for a carbon storage benefit *only* where the material storing the carbon is additional to the storage that would have occurred anyway

Calculation
PAS 2050 uses the same approach for carbon storage (release) as for delayed emissions (see PAS 2050 Annex C).

Calculation of the carbon storage of products requires an understanding of the fate of the products over a 100-year period. Over this time, some of the product may be burnt (releasing CO_2), some may end up as waste (with or without CO_2 release), some will be recycled and some will remain as the original product.

In these different situations, it is important to understand how much of the carbon in the product is released as CO_2 over the 100 years, and when it is released. Carbon released as CO_2 early in the 100-year period has much less impact on the carbon storage assessment than carbon that has been retained by the product for the full 100 years.

Where a product is recycled, the carbon storage benefit ends for that product; however, a product using recycled material receives a carbon storage benefit (as long as you can demonstrate that the recycled material was created for the purpose of being used in the product).

Example: If a table built from wood satisfied the eligibility conditions and lasted for 10 years, it would have a storage benefit for 10 years, but the magnitude of that benefit would decrease each year. The equation is in PAS 2050 Annex C.

Agriculture

Non-CO_2 emissions from livestock, their manure or soils should be included and estimated based on the approach described by the most recent IPCC Guidelines for National Greenhouse Gas Inventories or the highest Tier approach – latest peer-reviewed science – used by the relevant country (see PAS 2050 Section 7.8 and Clause 2 in IPCC Guidelines).

Land use change

If the product's supply chain directly caused non-agricultural land to be converted to agricultural use on or after 1 January 1990, then GHG emissions associated with the land use change must be included in the carbon footprint calculation (see PAS 2050 Section 5.5). If the timing of land use change is unknown, assume it occurred on 1 January of either (1) the earliest year when it can be confirmed that the land was used for agriculture, or (2) the current year.

Where land use change has occurred on or after 1 January 1990, the total GHG emissions from the change in land use are assumed to be released in equal annual amounts for 20 years.

Calculation

- Identify the country where the land use change took place
- Refer to PAS 2050 Table E.1 to find the appropriate emission factor (in tonnes CO_2e per hectare per year)
  - If unknown, use the highest potential emission factor

Note that GHG emissions from land use change are calculated separately from emissions arising from agriculture.

Also note that while PAS 2050 includes emissions arising from the conversion of (for example) forest to annual cropland, it does not include changes in soil carbon in existing agricultural systems.

Examples (agriculture emissions plus land use change):

- **Wheat imported from Argentina; farm converted from forest in 1980**
  - **Wheat emission factor: use IPCC average unless reputable Argentina-specific data can be found**
  - **Land use change emissions = 0**
- **Wheat imported from Argentina; farm converted from forest in 1995**
  - **Wheat emission factor: same as above**
  - **Land use change emissions = 17 tonnes CO_2e per hectare per year (from PAS 2050 Table E.1) for each year up to and including 2014**

Variable supply chain

Changes may happen frequently in supply chains, due to diverse causes such as unexpected supply disruptions, planned process improvements or different seasons causing changes to sources of raw materials and transportation routes.

To account for these changes, PAS 2050 specifies the following.

1. Temporary, unplanned change in the supply chain (see PAS 2050 Section 7.5.1)
   - Impact: if the disruption causes a greater than 10% increase in the product's carbon footprint and lasts for longer than three months, then reassess the product's GHG emissions
   - Example: if a company usually sources from two different plants, but one plant goes off-line for six months and the remaining plant has higher emissions, this would constitute a temporary, unplanned change. However, if after a quick screening analysis the total impact on the product's carbon footprint is only to increase it by 5%, then there is no need to reassess fully using primary activity data
2. Planned change in the supply chain (see PAS 2050 Section 7.5.2)
   - Impact: if the planned change causes a 5% increase or greater in the overall product footprint for three months or more, then the footprint must be reassessed and verified again
   - Example: a company decides to change its plastic packaging supplier to a new supplier with 20% higher emissions; if after a quick screening analysis the impact of this switch on the company's product footprint is 5% or more, then reassess and, if appropriate, repeat verification
3. Inherently variable and unpredictable supply chains (see PAS 2050 Section 7.6). In some cases, the supply chain may not change, but the amount of emissions coming from the supply chain varies. For example, when an organisation buys grid electricity, there may be no change in the supply chain – the organisation still buys grid electricity – but the GHG emissions from the electricity vary all the time.

   In these cases, data should be averaged over time to ensure that the result is representative of the variations in GHG emissions over the period of assessment.

Sampling

When an input comes from multiple sources (e.g. many small farms produce wheat for a particular flour mill), data can be collected from a representative sample. The use of sampling data must be justified against the requirements of PAS 2050 (see PAS 2050 Sections 7.7 and 7.2).

Example: If there are 100 small mills producing flour, measure the activity data and emissions at 10 mills chosen at random, then take the weighted average.

One method for determining the sample size is to use a square root approach: randomly select the square root, i.e. √(the total number of sources).

This technique should be used in accordance with data quality rules. For example, a wide range of answers from the sampling would suggest the need for further sampling to draw a clearer picture of the weighted average.

Recycling

The approach to calculating emissions from recycled inputs depends on the material (e.g. aluminium, glass, plastic) and whether the material's recycling system is part of a product system or not. A closed loop system implies that when recycled, the material does not change and is used again for the same purpose. For example, PET (polyethylene terephthalate) bottles can only be manufactured using recycled PET bottles (not other PET material). The material system is therefore considered closed.

To calculate the emissions of an input material containing recyclable matter:

1. Assess whether the recycled material is derived from a 'closed-loop' process (if not, see below)
2. Determine the proportion of input from recycled content vs. virgin material
   - Use the industry average unless the product's inputs are known to be different, e.g. if the specific product only uses 100% recycled PET bottles
3. Collect data on emissions caused by creating input material through recycling and virgin
4. Calculate the weighted average emissions per unit input according to the proportion of recycled vs. virgin material

For inputs with recycled material that is not part of a closed-loop recycling system, PAS 2050 requires that

the emissions arising from that material is assessed using an approach consistent with BS EN ISO 14044 which factors in the recycling rate across the entire material system. This allows some flexibility for those sectors that have little control over the recycled content of the input because it is purchased as a commodity, and also acknowledges sectors where there are high recycling rates, e.g. the aluminium industry.

Note that recycling is also considered at the disposal stage of the life cycle, where the recycled portion of a product is excluded from its life cycle emissions (and included in the product that uses it as a raw material input).

Energy

Energy-related emissions can be derived from fuel combustion, electricity or heat generation.

Emission factors for energy should include all emissions associated with the entire life cycle of the energy input, including:

- Mining, refining and transport of raw materials (e.g. coal, oil, gas)
- Generation of electricity
- Distribution
- Consumption
- Disposal of waste

For more details see PAS 2050 Section 6.4.2.

Different sources of energy can be treated differently depending on how they are generated.

1. On site generation and use: the emission factor is calculated from primary activity data and must include emissions from the fuel input's life cycle
2. Off site generation: use the emission factor provided by the supplier or other reliable secondary source
3. Renewable electricity

   Renewable electricity-specific emission factors (vs. national grid averages) can only be used when both:

   a) The specific process uses the renewable energy generated on site or an equivalent amount of the same type of renewable energy; and

   b) This renewable energy has not already been counted in any other emission factor (i.e. incorporated into the national grid average)

   The main purpose of this rule is to ensure no double counting of renewable energy. Often renewable energy is automatically incorporated into national averages as a source of zero-emissions electricity
4. Biomass/biofuels: include emissions arising from production but exclude CO_2 emissions arising from any plant-based carbon component
   - When fuel is produced from waste, the relevant emissions are those caused by the conversion of waste to fuel
   - When fuel is produced from plant matter, include the full life cycle emissions created by producing and using the fuel

Transport

Any GHG emissions arising from any transport required during the product's – and its raw materials' – life cycle are included in the carbon footprint assessment. Emission factors for transport should include emissions associated with creating and transporting the fuels required.

When products are distributed to different locations and transport distances vary, calculate the average GHG emissions based on the average distribution distance

of the product within each country over the chosen time period, *unless more specific data is available*. For more information, see PAS 2050 Section 6.4.6.

Exclusions

The following emission sources are excluded from the PAS 2050 life cycle GHG emission assessment.

1. Capital goods

   These emissions are excluded based on:

   - lack of carbon footprint data currently available to identify sectors where capital goods emissions are material and
   - cost/complexity of analysis

'Capital goods' are the goods used in the life cycle of a product, such as machinery, equipment and buildings.

2. Aircraft emissions uplift factor

   This is excluded due to considerable uncertainty on the relative size of the impact of non-CO_2 emissions from aviation through radiative forcing

3. Offsets

   These are excluded because PAS 2050 is an assessment of a specific product's life cycle GHG emissions; any reductions to the footprint should be directly attributable to changes made to the product's life cycle, not through unrelated activities such as purchase of emissions credits.

Allocation

Allocation of emissions is required where a process contributing to a given product's life cycle results in more than one useful product, i.e. a co-product, or by-product other than waste. Unlike waste, co-products have economic value and can be sold – as such they represent other discrete products.

'Allocation' involves the partitioning of GHG emissions from a single process to the different outputs of that process.

PAS 2050 specifies the following approach to allocation.

First, break down the process into sub-processes that each have only one output.

If this cannot be done, then expand the system to include impact of displaced products (e.g. avoided electricity due to a process relating to the product also generated electricity)

When neither of these avoidance measures is possible or practical, allocate GHG emissions in proportion to the economic value of the co-products (economic allocation), unless otherwise stated in PAS 2050.

In our croissants example, flour milling produces two co-products in addition to flour (the relevant product input): animal feed and wheat germ. For the purposes of this example, assume the milling process cannot be broken down into sub-processes resulting in discrete outputs, nor can system expansion be applied because no single displaced/avoided product can be identified for either of the two co-products.

In this case, economic allocation would be used: the GHG emissions arising from flour production – and the associated inputs – would be shared across these products according to revenue (as shown in Table 3).

Thus, in this example, the GHG emissions arising from flour production would be allocated to the three products according to revenue:

- 78% to flour
- 20% to wheat germ
- 2% to animal feed

Table 3: Allocating emissions across co-products

	Tonnes output per 1 tonne wheat input	£ per tonne output	Total £ per tonne wheat	% of total revenue
Flour	0.80 tonne	£200/tonne flour	£160	**78%**
Wheat germ	0.10 tonne	£400/tonne wheatgerm	£40	**20%**
Animal feed	0.10 tonne	£50/tonne animal feed	£5	**2%**
Total	*1.00 tonne*	*n/a*	*£205*	*100%*

Waste

Waste generates emissions when it breaks down in landfills or is incinerated. The PAS 2050 method treats these emissions differently depending on the material and process of disposal as follows.

Landfill

- CO_2 emissions from plant-based carbon in the waste are excluded, i.e. given a GWP of 0

- CO_2 emissions from fossil carbon are included in the product footprint with a GWP of 1
- All non-CO_2 emissions from any part of the waste are included and assigned the relevant GWP (see PAS 2050 Annex A), net of any CO_2 absorbed during plant growth

Incineration and methane combustion

- Generating useful energy – when methane is captured and used to generate electricity, any emissions are excluded from the product footprint and allocated to the energy being created (as input to another product's life cycle)
- No energy recovery – when methane is created but not used to generate electricity, emissions caused by fossil carbon (not plant-based carbon) are included in the product footprint (as with landfill)

Combined Heat and Power (CHP)

The total emissions from the CHP source are allocated to electricity and heat according to the amount of useful energy delivered in each. This varies depending on type of CHP input (see PAS 2050 Section 8.3):

- Boiler-based (e.g. coal, wood, solid fuel) – the ratio of emissions per MJ electricity to MJ heat is 2.5 to 1, based on the process-specific heat to electricity ratio: therefore, if 350 kg CO_2e were emitted by a CHP plant to generate 100 MJ electricity and 100 MJ heat, 250 kg CO_2e should be allocated to electricity and 100 kg CO_2e to heat
- Turbine-based (e.g. gas) – the ratio of emissions per MJ electricity to MJ heat is 2.0 to 1, again based on the process-specific heat to electricity ratio

Transport

When the product is transported along with other products, transport emissions are allocated on the basis of mass or volume, whichever is the limiting factor.

For example, if 1 tonne of croissants is shipped in a 2-tonne container along with 1 tonne of bread, the croissants would be allocated 50% of the emissions associated with that transport leg.

Reuse and remanufacture

Total product life cycle GHG emissions, excluding the use phase, are divided by the expected number of times the product is reused, including emissions associated with any remanufacturing required to make it usable again. Then this figure is added to a single use phase's emissions, resulting in a product footprint includes only a portion of the life cycle emissions, plus those from one full use phase.

For example, if a tyre can be re-treaded up to four times over the course of its life, this creates five distinct use phases, four of which require a re-manufacturing step. To calculate total product GHG emissions over one life cycle:

- Calculate all life cycle emissions excluding the use phase – for simplicity say this comes to 100 g CO_2e
- Add emissions from four re-manufacturing steps: assuming 25 g CO_2e per re-tread, for a total of $4 \times 25 = 100$ g CO_2e; thus the total emissions over the full life of a tyre are 200 g CO_2e
- Divide this by the anticipated number of uses: $200/5 = 40$ g CO_2e
- Now add the use phase emissions from a tyre to 40 g CO_2e for the total emissions over one life cycle

Now that the carbon footprint figure has been calculated, it is time to understand how precise and reproducible the measurement is. The next section explains this concept of uncertainty.

Step 5: Checking uncertainty (optional)

Uncertainty analysis in product carbon footprinting is a measure of precision. While not prescribed in PAS 2050, companies can benefit from assessing the uncertainty of their carbon footprint as described below – more detail on how to calculate uncertainty can be found in Appendix IV.

The objective of this step is to measure and minimise uncertainty in the footprint result and to improve confidence in footprint comparisons and any decisions that are made based on the footprint. Uncertainty analysis provides several benefits:

- Enables greater confidence in comparisons between products and in decision making
- Identifies where to focus data collection efforts, and where not to focus
- Contributes to better understanding of the footprinting model itself – how it works, how to improve it and when it is robust enough
- If communicated it indicates robustness of the footprint to internal and external audiences

Best practice in product carbon footprinting, as encouraged by PAS 2050, aims to minimise the uncertainty in the footprint calculation to help provide the most robust, reliable and replicable result. PAS 2050 does not explicitly require uncertainty analysis, although it may be necessary to meet data quality specifications. In practice, it is useful to delegate this task to someone experienced in uncertainty analysis and familiar with the product's carbon footprint model.

Reducing uncertainty

Once sources of uncertainty have been identified through the process described in Appendix IV, they can usually be reduced in the following ways:

- Replace secondary data with good quality primary activity data, e.g. replace an estimated electricity consumption factor with actual measurements from a line sub-meter

- Use better quality secondary data i.e. more specific, more recent, more reliable and/or more complete
- Improve the model used to calculate the carbon footprint by making it more representative of reality e.g. estimate each distribution leg individually, rather than a single estimate for total distribution
- Additional peer review and/or certification of the carbon footprint

It is not always the case that primary data will have lower uncertainty than secondary data, but an uncertainty estimate is a good way to decide whether to use primary or secondary activity data for a particular process/emission source.

Section III
Next steps

Depending on the objectives for the assessment, several different actions may be taken once a product carbon footprint has been calculated. Organisations that are only using PAS 2050 to guide a high-level analysis may want to move straight into identifying emission reduction opportunities. Others may want to verify the footprint method and number, either to provide more confidence in their own internal decision making or as a step towards making external claims.

Validating results

In general, it is useful to verify the product carbon footprint in order to ensure any actions or decisions are made on the basis of a correct and consistent analysis. However, the level of verification necessary depends on the project goals – for communication to customers, a higher level of verification is needed than if the data is only be used internally.

PAS 2050 specifies three levels of verification depending on how the product carbon footprint will be used (see PAS 2050 Section 10.3 for more information):

1. Certification – independent third party certification body accredited by an internationally recognised accreditation body (e.g. United Kingdom Accreditation Service, UKAS). Here, an auditor will review the process used to estimate the carbon footprint, check the data sources and calculations and certify whether PAS 2050 has been used correctly and whether the assessment has achieved conformity. This is advisable for external communication of the footprint results and may be desirable in any case, to ensure decisions are made on the basis of correct information.
2. Other-party verification – non-accredited third parties should demonstrate compliance with recognised standards for certification bodies and provide for external validation on request. This approach may not offer the level of confidence that fully accredited certification bodies can provide.
3. Self-verification – if choosing to self-verify, follow the method outlined in BS EN ISO 14021[6]. Note that users of the footprint may have lower confidence in this option.

Independent certification is highly encouraged when companies want to communicate the carbon footprint publicly. Third party certification by accredited experts also provides peace of mind that any subsequent decisions made (e.g. to reduce emissions and costs, choose suppliers, change receipts and discontinue products) are supported by robust analysis.

Different product footprints are not truly comparable unless the same data sources, boundary conditions and other assumptions are used.

Reducing emissions

Product carbon footprints can provide valuable insights to help reduce GHG emissions. The footprinting exercise both provides a baseline against which to measure future reductions and helps identify opportunities to reduce emissions across all phases of the product's life cycle. The analysis offers a way to

[6] BS EN ISO 14021, *Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)*.

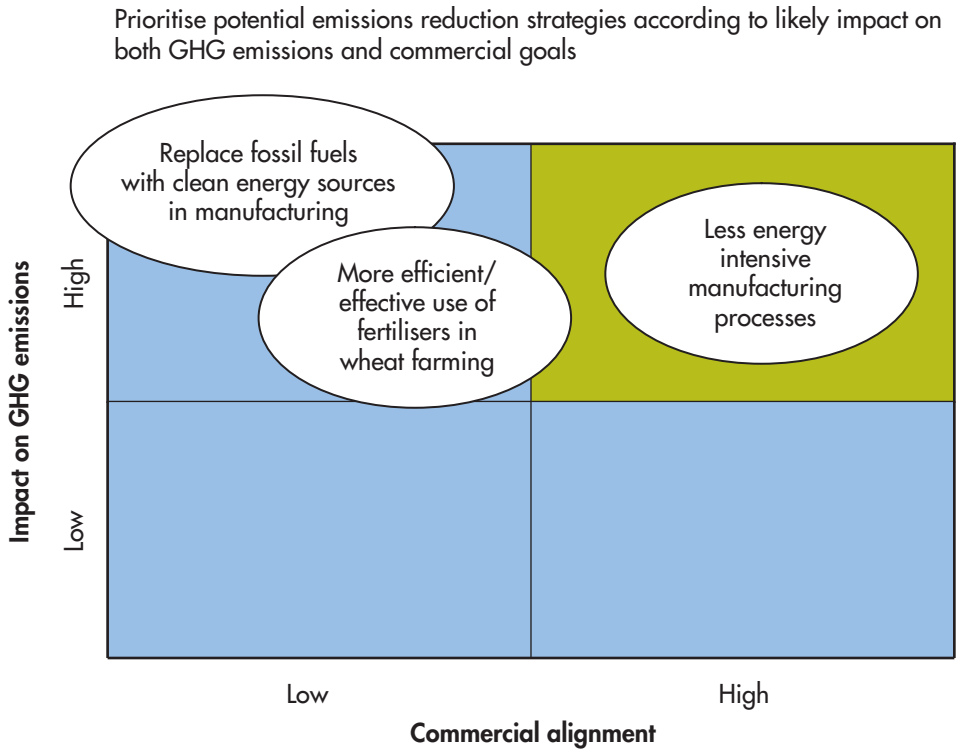
Common emission reduction opportunities

- Energy use
  - Change from electricity to gas
  - Increase proportion of energy from renewables
- Production
  - Decrease waste volumes
  - Increase scale
  - Decrease amount of processing
  - Change manufacturing practices and improve efficiency
- Distribution
  - Decrease heating/cooling in storage and transport
  - Decrease distances travelled
- General
  - Include energy/carbon criteria in purchasing/supplier choices
  - Include energy/carbon criteria in design decisions
  - Change product design/configuration/materials, e.g. 100% recycled bottles
  - Change technology choice (e.g. upgrading equipment to be more energy efficient)
  - Improve inventory management

engage with suppliers, distributors, retailers and consumers on how to reduce emissions (see box, left).

The product footprint analysis itself helps to identify the main drivers of GHG emissions. It may be useful to classify these according to who has control over each driver (e.g. industry-wide, market/customers, supply chain, internal). For all main drivers, explore ways to reduce emissions and consider actions that can be taken across the value chain to achieve these reductions. Then assess the GHG impact, cost, feasibility and potential market reaction of each action, across all product life cycle steps. One helpful approach is to use sensitivity analysis in the carbon footprint model in order to help quantify impacts and make these decisions.

Considerable cost savings can be achieved by decreasing energy use and waste. These should be compared to the investment required and any potential increases to operating costs as a result of emission/cost reduction strategies (see the prioritisation framework, below).



Prioritisation framework

The potential impact of any carbon reduction activity on customers should also be considered, including: perceptions of value, quality and service; choice and range; availability and convenience; and differentiation.

Prioritisation criteria are specific to each company's situation, but most companies choose a combination of emissions impact and commercial opportunities (cost reduction and/or revenue potential), followed by other strategic considerations, when deciding on actions.

Communicating the footprint and claiming reductions

PAS 2050 does not specify any requirements for communicating a footprint or making reduction claims. One source of detailed guidance can be found in the *Code of Good Practice for product GHG emissions and reduction claims*[7], sponsored by the Carbon Trust and the Energy Saving Trust and developed through a consultative process in conjunction with PAS 2050. This document provides guidelines for consistent, transparent communication of product emissions and reduction claims.

Another source for guidance on making environmental product claims is Defra's *Green Claims* guide.[8] This guide, supported by the Confederation of British Industry, the British Retail Consortium, the Local Authorities Coordinating Body on Food and Trading Standards and the British Standards Institution, helps businesses present environmental information and claims to customers about their products.

The decision to communicate a product carbon footprint – and how – depends on the original objectives and can include many different messages, formats and audiences, including:

- Customers, via carbon footprint information provided on-pack, at point-of-sale, in product instructions, advertisements, sales materials, websites, press releases, etc.
- Internal management
- Employees
- Supply chain partners
- Industry associations
- Media
- Investors

[7] *Code of Good Practice for product GHG emissions and reduction claims* (2008) is available at *www.carbontrust.co.uk*.
[8] *Green Claims – Practical Guidance, How to Make a Good Environmental Claim* (2003) is available at *www.defra.gov.uk/environment/consumerprod/pdf/genericguide.pdf*.

Appendix I

PAS 2050 application across different product types

	B2C goods	B2B goods	Services
Product functional unit definition	• Typical size/quantity sold to consumer (e.g. one 12-pack croissants)	• Typical size/quantity sold to business consumer (e.g. one tonne flour)	• Typical, comparable offering (e.g. one night's hotel stay)
Process map/ boundaries	• Include all life cycle stages: – Raw materials – Manufacturing – Distribution/retail – Use – Disposal/recycling	• Include life cycle stages until point of delivery to customer: – Raw materials – Manufacturing – Delivery to customer gate	• Varies with type of service • Could include: – Opening/start-up – Ongoing use – Close-down • Include all activities, materials, energy and waste associated with providing a unit of service
Data collection	←	***Same for any product type***	→
Calculation	←	***Same for any product type***	→
Uncertainty	←	***Same for any product type***	→
Verification/ communication	←	***Same for any product type***	→

Impact of different product types on PAS 2050 implementation

Appendix II
Services examples

Calculating the carbon footprint of services follows exactly the same steps as for goods: PAS 2050 specifies a method that can be applied equally to services and goods. However, correctly identifying and understanding the service 'product' definition and the life cycle stages in the process map may be more challenging and may require extra effort to define.

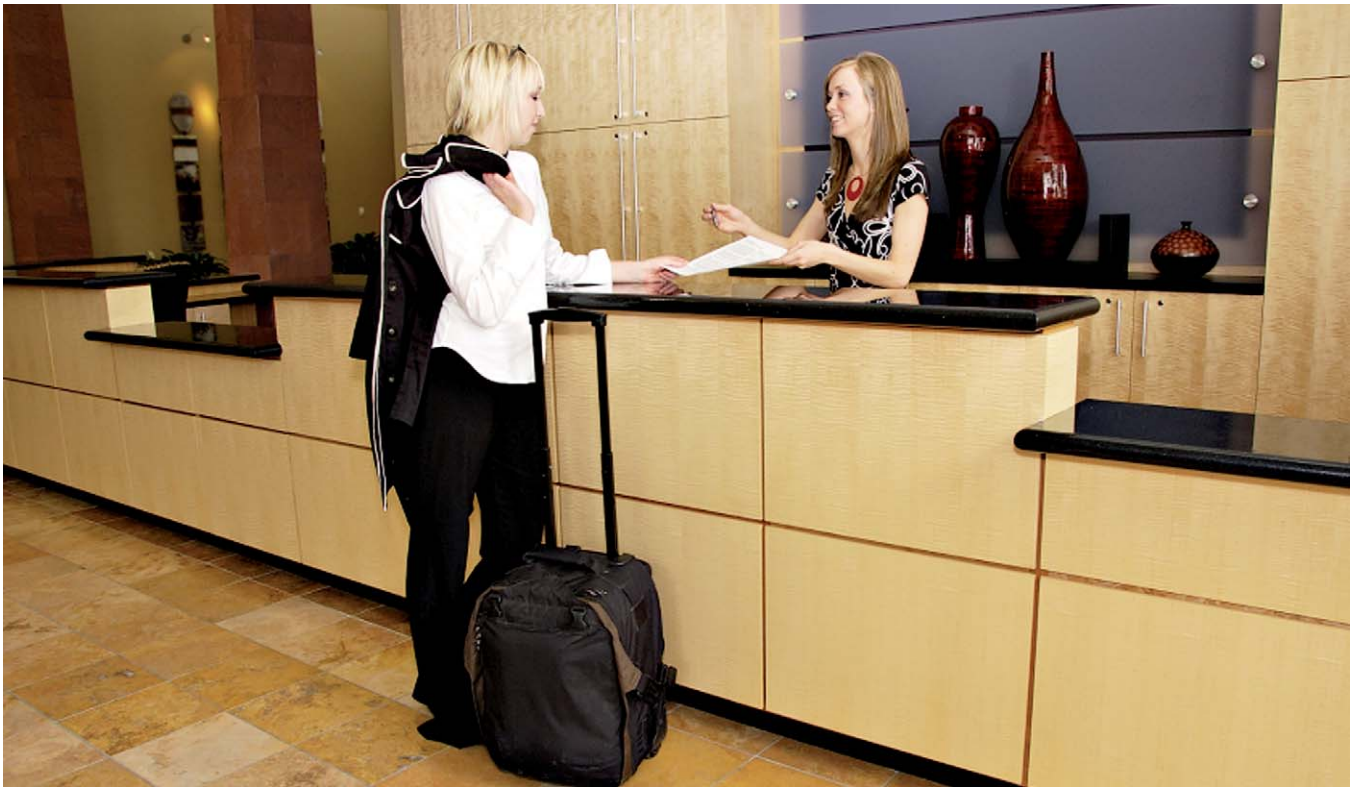
When choosing a service to footprint, try to define it in a way that would be most useful to the company and others using the footprint, i.e. make it:

- easily comparable to other services within your or your competitors' offering
- likely to generate actionable opportunities to reduce emissions
- relatively easy to understand and describe supply chain/process map

Example 1: one night's hotel stay

Consider a hotel chain that wants to calculate the carbon footprint of one night's stay.

First, define the functional unit. Assuming the hotel has different types of rooms, e.g. standard, deluxe, suite, it is likely that each class or size of room has a different footprint. To make a meaningful product definition, the hotel company chooses to assess its typical standard



rooms first, potentially rolling out the methodology to other classes of room later on. However, the functional unit must be defined in more detail to make data collection and comparisons easier. One possible definition could be the following: one night's hotel stay = 24 hours' worth of room/hotel usage.

Next, develop a process map for a night's hotel stay. Some possible components in the life cycle:

- Check-in
- Stay/use of the room
- Check-out
- Clean-up/preparation for next guest

Using these components, we can then dissect the activities, materials, energy and waste associated with each phase:

- Check-in
  - Computer used by Reception
  - Key
- Stay/use of the room
  - Electricity used by guest for lighting, TV, mini-bar
  - Energy for heat/air conditioning determined by guest
  - Water used by guest
  - Waste generated by guest
  - Proportion of overall hotel facilities used by guest (e.g. lifts, common areas, recreation/gym)
  - Toiletries
- Check-out
  - Computer used by Reception
  - Payment system
  - Paper for receipt
- Clean-up/preparation for next guest
  - Washing/drying linens
  - Use of cleaning products, vacuum, etc.

For the remainder of the footprinting analysis – data collection, the footprint calculation itself and uncertainty/quality-check of the result – follow Steps 3, 4 and 5 as described in the main text of this guide.

Example 2: IT services

For this example, a consumer-facing company wants to assess the carbon footprint of a particular package of customer support delivered through IT, such as an on-line payments system.

The first step is to define the functional unit. In this case, one hour of use of the online IT service by the customer was chosen as the functional unit. Next the process map was drawn, with help from suppliers and internal management, to include all supply chains that contribute to the provision of the IT service, customer use and any end-of-service impacts.

The following components in the life cycle were identified:

- Provision of hardware, software and updates to the service provider
- Office accommodation of service and support staff

- Updates to the service, providing call centre and on-line support
- Use of the service by customers
- Decommissioning of IT equipment

The activities within these life cycle stages include:

- Using current applications and services, and the activities and equipment needed to maintain this level of functionality
- Technology updates to software and hardware
- Paper use (e.g. print volumes)
- Call centres, and buildings housing the services (allocated as appropriate when these also provide services to other functions)
- Service provider and end users' equipment
- Staff associated with service development and delivery
- Operational emissions to include business travel and staff commuting
- Embedded emissions to be included from building and services
- Decommissioning to include the IT equipment and electronic archive of data
- Treatment of waste and capital allocation.

Once the process map was drawn in detail, the company proceeded with *Step 3: Collecting data* and *Step 4: Calculating the footprint* as described in this guide.

Appendix III

Product carbon footprinting calculation – worked example

This case study is purely illustrative and does not represent a real example of croissant production; the values have been chosen for their simplicity, to make this case study as easy to follow as possible. The results are not intended to reflect a fully representative carbon footprint of croissants.

Input	Amount	Source
Raw materials		
Wheat		
(1a) **Farming**		
kg CO_2e per tonne wheat	500	*Emission factor database*
tonnes wheat per tonne croissants	0.9	*Supplier interview*
kg CO_2e per tonne croissants	**450**	*Calculation: emissions per tonne wheat × tonnes wheat per tonne croissants*
(1b) **Transport**		
average distance (km)	100	*Supplier interview*
kg CO_2e per km	1	*Emission factor database; based on vehicle type*
kg CO_2e per outbound journey	100	*Calculation: emissions per km × km per journey*
% empty on inbound journey	100%	*Supplier interview*
kg CO_2e per inbound journey	100	*Calculation: % empty on return × emissions per km × km per journey*
kg CO_2e per total trip	200	*Calculation: emissions outbound + emissions inbound*
tonnes wheat per trip	20	*Supplier interview*
kg CO_2e per tonne wheat	10	*Calculation: emissions per total trip/tonnes wheat per trip*
tonnes wheat per tonne croissants	0.9	*Supplier interview*
kg CO_2e per tonne croissants	**9**	*Calculation: emissions per tonne wheat × tonnes wheat per tonne croissants*
Flour		
(2a) **Production (milling)**		
kWh per tonne wheat milled	100	*Supplier interview*
kg CO_2e per kWh	0.5	*Emission factor database; based on national grid*
tonnes wheat per tonne croissants	0.9	*Supplier interview*
kg CO_2e per tonne croissants	**45**	*Calculation: emissions per kWh × energy used per tonne wheat × tonnes wheat per tonne croissants*
(2b) **Flour transport**		
average distance (km)	100	*Supplier interview*
kg CO_2e per km	1	*Emission factor database; based on vehicle type*

Input	Amount	Source
kg CO_2e per outbound journey	100	*Calculation: emissions per km × km per journey*
% empty on inbound journey	100%	*Supplier interview*
kg CO_2e per inbound journey	100	*Calculation: % empty on return × emissions per km × km per journey*
kg CO_2e per total trip	200	*Calculation: emissions outbound + emissions inbound*
tonnes flour per trip	20	*Supplier interview*
kg CO_2e per tonne flour	10	*Calculation: emissions per total trip/tonnes flour per trip*
tonnes flour per tonne croissants	0.7	*Supplier interview*
kg CO_2e per tonne croissants	**7**	*Calculation: emissions per tonne flour × tonnes flour per tonne croissants*
(2c) **Waste**		
Transport		
average distance (km)	20	*Supplier interview*
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per outbound journey	40	*Calculation: emissions per km × km per journey*
% empty on inbound journey	100%	*Supplier interview*
kg CO_2e per inbound journey	40	*Calculation: % empty on return × emissions per km × km per journey*
kg CO_2e per total trip	80	*Calculation: emissions outbound + emissions return*
tonnes waste per trip	10	*Supplier interview*
kg CO_2e per tonne waste	8	*Calculation: emissions per total trip/tonnes waste per trip*
tonnes waste per tonne wheat	0.2	*Supplier interview*
tonnes wheat per tonne croissants	0.9	*Supplier interview*
kg CO_2e per tonne croissants	**1.4**	*Calculation: emissions per tonne waste × tonnes waste per tonne wheat × tonnes wheat per tonne croissants*
Disposal		
kg CO_2e per tonne waste	300	*Emission factor database; based on carbon content, likely decay rate and % escaped gas*
tonnes waste per tonne wheat	0.2	*Supplier interview*

Input	Amount	Source
kg CO_2e per tonne wheat	60	*Calculation: emissions per tonne waste × tonnes waste per tonne wheat*
tonnes wheat per tonne croissants	0.9	*Supplier interview*
kg CO_2e per tonne croissants	**54**	*Calculation: emissions per tonne wheat × tonnes wheat per tonne croissants*

Other raw materials calculated as above

Other raw materials include butter, which due to its high emissions factor represents a higher proportion of the total footprint than that suggested by its mass (and thus a higher proportion of the overall product footprint than is suggested by these results).

Manufacturing

(3a) Baking

kWh gas used per tonne croissants	1000	*Supplier interview*
kg CO_2e per kWh gas	0.2	*Emission factor database; based on gas source*
kg CO_2e per tonne croissants	200	*Calculation: kWh gas used per tonne croissants × emissions per kWh gas*
kWh electricity used per tonne croissants	200	*Supplier interview*
kg CO_2e per kWh electricity	0.5	*Emission factor database; based on national grid*
kg CO_2e per tonne croissants	100	*Calculation: kWh electricity used per tonne croissants × emissions per kWh electricity*
total baking kg CO_2e per tonne croissants	**300**	*Calculation: kWh gas emissions per tonne croissants + kWh electricity emissions per tonne croissants*

(3b) Packaging

kg CO_2e per kg plastic film	2	*Emission factor database*
kg plastic film per 1,000 bags	20	*Supplier interview*
kg CO_2e per 1,000 bags	40	*Calculation: emissions per kg plastic film × kg plastic film per 1,000 bags*
tonnes croissants per 1,000 bags	1	*Internal data*
kg CO_2e per tonne croissants	**40**	*Calculation: emissions per 1,000 bags/tonnes croissants per 1,000 bags*

(3c) Waste

Transport

average distance (km)	50	*Supplier interview*

Input	Amount	Source
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per outbound journey	100	*Calculation: emissions per km × km per journey*
% empty on inbound journey	100%	*Supplier interview*
kg CO_2e per inbound journey	100	*Calculation: % empty on return × emissions per km × km per journey*
kg CO_2e per total trip	200	*Calculation: emissions outbound + emissions inbound*
tonnes waste per trip	10	*Supplier interview*
kg CO_2e per tonne waste	20	*Calculation: emissions per total trip/tonnes waste per trip*
tonnes waste per tonne croissants	0.1	*Supplier interview*
kg CO_2e per tonne croissants	**2**	*Calculation: emissions per tonne waste × tonnes waste per tonne croissants*
Disposal		
kg CO_2e per tonne waste	300	*Emission factor database; based on carbon content, likely decay rate and % escaped gas*
tonnes waste per tonne croissants	0.1	*Supplier interview*
kg CO_2e per tonne croissants	**30**	*Calculation: emissions per tonne waste × tonnes waste per tonne croissants*
Distribution		
(4a) **Transport to distribution centre**		
average distance (km)	100	*Distributor interview*
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per outbound journey	200	*Calculation: emissions per km × km per journey*
% empty on inbound journey	50%	*Distributor interview*
average distance (km)	100	*Distributor interview*
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per inbound journey	100	*Calculation: % empty on inbound × emissions per km × km per journey*
kg CO_2e per total trip	300	*Calculation: emissions outbound + emissions inbound*
tonnes croissants per trip	10	*Distributor interview*

Input	Amount	Source
kg CO_2e per tonne croissants	**30**	*Calculation: emissions per total trip/tonnes croissants per trip*
(4b) **Storage**		
direct energy used (kWh)	0	*Distributor interview*
annual kWh used by storage site	1,000,000	*Distributor interview*
portion attributed to 1 T croissants	0.0001%	*Distributor interview*
indirect energy used per tonne croissants (kWh)	1	*Calculation: site energy × allocation per tonne croissants*
kg CO_2e per kWh	0.5	*Distributor interview*
kg CO_2e per tonne croissants	**0.5**	*Calculation: emissions per kWh × kWh per tonne croissants*
(4c) **Transport to stores**		
average distance (km)	20	*Distributor interview*
kg CO_2e per km	1	*Emission factor; based on type of vehicle*
kg CO_2e per outbound journey	20	*Calculation: emissions per km × km per journey*
% empty on inbound journey	100%	*Distributor interview*
average distance (km)	20	*Distributor interview*
kg CO_2e per km	1	*Emission factor; based on type of vehicle*
kg CO_2e per return journey	20	*Calculation: % empty on inbound × emissions per km × km per journey*
kg CO_2e per total trip	40	*Calculation: emissions outbound + emissions return*
tonnes croissants per trip	8	*Distributor interview*
kg CO_2e per tonne croissants	**5**	*Calculation: emissions per total trip/tonnes croissants per trip*
(4d) **Retail**		
kg CO_2e per pallet per day	2	*Emission factor database; based on storage conditions (ambient)*
average # of days in store	2	*Retailer interview*
total kg CO_2e per pallet	4	*Calculation: emissions per pallet per day × # of days in store*
No. of croissant packages per pallet	200	*Customer interview*
kg CO_2e per package	0.02	*Calculation: emissions per pallet/croissant packages per pallet*

Input	Amount	Source
No. of packages per tonne croissants	1,000	*Retailer interview*
kg CO_2e per tonne croissants	**20**	*Calculation: emissions per package × packages per tonne croissants*
Consumer use		
(5a) **Storage (freezing)**		
kWh for freezing 1 package	0.05	*Industry association*
kg CO_2e per kWh	0.5	*Emission factor database; based on electricity grid*
kg CO_2e per frozen package	0.025	*Calculation: emissions per kWh × kWh per package frozen*
No. of packages per tonne croissants	1,000	*Internal data*
% of croissants that are frozen	20%	*Internal survey data*
kg CO_2e per tonne croissants	**5**	*Calculation: emissions per frozen package × packages per tonne croissants × % of croissants that are frozen*
(5b) **Consumption (heating)**		
kWh for heating 1 croissant	0.02	*Government data*
kg CO_2e per kWh	0.5	*Emission factor database; based on electricity grid*
kg CO_2e per heated croissant	0.01	*Calculation: emissions per kWh × kWh per croissant heated*
No. of croissants per package	12	*Internal data*
No. of packages per tonne croissants	1,000	*Internal data*
% of croissants that are heated	30%	*Internal survey data*
kg CO_2e per tonne croissants	**36**	*Calculation: emissions per heated croissant × croissants per package × packages per tonne croissants × % of croissants that are heated*
Disposal		
(6a) **Transport to landfill**		
average distance (km)	5	*Municipal waste interview*
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per outbound journey	10	*Calculation: emissions per km × km per journey*

Input	Amount	Source
% empty on return journey	100%	*Municipal waste interview*
average distance (km)	5	*Municipal waste interview*
kg CO_2e per km	2	*Emission factor database; based on vehicle type*
kg CO_2e per return journey	10	*Calculation: % empty on return × emissions per km × km per journey*
kg CO_2e per total trip	20	*Calculation: emissions outbound + emissions return*
tonnes waste per trip	10	*Municipal waste interview*
kg CO_2e per tonne waste	2	*Calculation: emissions per total trip/tonnes waste per trip*
tonnes waste per tonne croissants	0.2	*Internal survey data: 20% of croissants thrown away*
kg CO_2e per tonne croissants	**0.4**	*Calculation: emissions per tonne waste × tonnes waste per tonne croissants*
(6b) **Landfill decomposition**		
Croissants		
kg CO_2e per tonne croissant waste	800	*Emission factor database*
tonnes waste per tonne croissants	0.2	*Internal survey data: 20% of croissants thrown away*
kg CO_2e per tonne croissants	160	*Calculation: emissions per tonne croissant waste × tonnes waste per tonne croissants*
Plastic bags		
tonnes plastic waste per tonne croissants	0.05	*Internal data (assume 100% of bags thrown away)*
kg CO_2e per tonne plastic waste	100	*Emission factor database*
kg CO_2e per tonne croissants	5	*Calculation: emissions per tonne plastic waste × tonnes plastic waste per tonne croissants*
kg CO_2e per tonne croissants	**165**	*Calculation: croissant waste emissions + plastic waste emissions*
Total per tonne	**1,200**	
Total per 12-croissant package	**1.2**	

Appendix IV

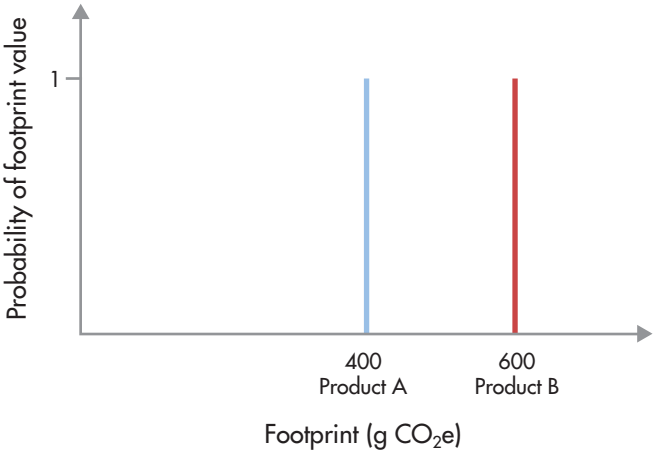
Uncertainty analysis

With zero uncertainty, there is no variation in the carbon footprint assessments (illustrated below, left). In this ideal scenario, the two product footprints can be compared, and users of the footprint information can be confident their decisions are based on accurate data.

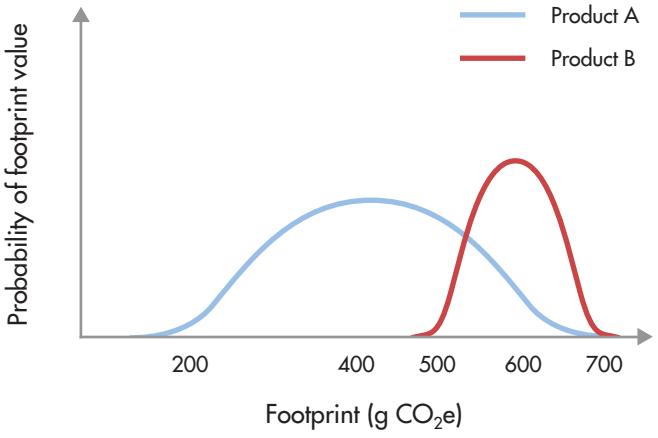
However, uncertainty creates challenges for comparisons and decision making as illustrated below, right.

Uncertainty in carbon footprinting comes from two sources: technical uncertainty and natural variability. Technical uncertainty is created by limited data quality, ineffective sampling, wrong assumptions, incomplete modelling and other flaws in the footprint calculation itself. These factors are analysed in the uncertainty calculation described overleaf. Natural variability is accounted for in the definition of a product carbon footprint as an average, or representative figure, so it does not need to be quantified.

Because the nature of a footprint calculation involves estimates and judgement, every model input has some degree of uncertainty associated with it. Each input has a probability distribution around the mean value, or the number used in the model. The distribution curves can take any shape, e.g. normal (as in the example below).



Zero uncertainty



Uncertainty in this example is the value along the x-axis greater or less than the products' footprint estimates of 400 and 600.

Product A has greater uncertainty than Product B.

Higher uncertainty in footprint result = lower confidence in comparisons

Uncertainty calculation

The recommended approach for calculating uncertainty is to perform a Monte Carlo analysis of the carbon footprint model created in Step 4. There are many software packages available for conducting a Monte Carlo analysis; alternatively some LCA packages have integrated Monte Carlo functionality. A Monte Carlo analysis involves three stages:

1. Define the probability density for each input by identifying: the distribution type (e.g. normal or lognormal); upper/lower bounds of the input value to reach 95% confidence; and correlation factors
2. Next, through a process of many repetitions, randomly vary each input value according to its distribution, and record the resulting new value of the output (carbon footprint)
3. Repeat the process for each input, thereby building up a probability density of the footprint result. This uncertainty resultt can then be reported as a '±%' or a range of values.

Defining the probability density of each model input is best performed during the data collection in Step 3. In some cases the model input probability density will already be established, such as the precision of an electricity meter or the uncertainty of an emission factor from a published study; in other cases the input's probability density must be determined by an expert, most likely the person who measured the input in the first place. Some secondary databases also include uncertainty information.

Using uncertainty

Uncertainty analysis produces data that can help in the following ways:

- To quantify the overall uncertainty of a carbon footprint (range and distribution of the carbon footprint itself), as described above
- By providing a sensitivity/contributory analysis: analysing uncertainty by life cycle stage or model input to identify relative 'hot spots', which have higher uncertainty than others

Glossary

Allocation
Partitioning the input or output flows of a process between the product system under study and one or more other product systems

Biogenic
Derived from biomass, but not fossilised or from fossil sources

Biomass
Material of biological origin excluding material embedded in geological formations or transformed to fossil

Boundary
Set of criteria specifying which unit processes are part of a product system (life cycle)

Business-to-business (B2B)
Provision of inputs, including products, to a third party that is not the end user

Business-to-consumer (B2C)
Provision of inputs, including products, to the end user

Capital goods
Goods, such as machinery, equipment and buildings, used in the life cycle of products

Carbon dioxide equivalent (CO_2e)
Unit for comparing the radiative forcing (global warming impact) of a greenhouse gas expressed in terms of the amount of carbon dioxide that would have an equivalent impact

Carbon footprint
The level of greenhouse gas emissions produced by a particular activity or entity

Carbon storage
Retaining carbon of biogenic or atmospheric origin in a form other than as an atmospheric gas

Combined heat and power (CHP)
Simultaneous generation in one process of useable thermal energy and electrical and/or mechanical energy

Co-products
Any of two or more products from the same unit process or product system [BS EN ISO 14044:2006, 3.10]

Data quality
Characteristics of data that relate to their ability to satisfy stated requirements

Downstream emissions
GHG emissions associated with processes that occur in the life cycle of a product subsequent to the processes owned or operated by the organization in question

Emission factor
Amount of greenhouse gases emitted, expressed as carbon dioxide equivalent and relative to a unit of activity (e.g. kg CO_2e per unit input).

NOTE Emission factor data is obtained from secondary data sources.

Emissions
Release to air and discharges to water and land that result in greenhouse gases entering the atmosphere

Functional unit
Quantified performance of a product for use as a reference unit

Greenhouse gases (GHGs)
Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds

NOTE GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluoro-carbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6)

Input
Product, material or energy flow that enters a unit process

Life cycle
Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end of life, inclusive of any recycling or recovery activity

Life cycle assessment (LCA)
Compilation and evaluation of inputs, outputs and potential environmental impacts of a product system throughout its life cycle

Life cycle GHG emissions
Sum of GHG emissions resulting from all stages of the life cycle of a product and within the specified system boundaries of the product

Mass balance
Quantification of total materials flowing into and out of a process

Material contribution
Contribution of any one source of GHG emissions to a product of more than 1% of the anticipated life cycle GHG emissions associated with the product

NOTE A materiality threshold of 1% has been established to ensure that very minor sources of life cycle GHG emissions do not require the same treatment as more significant sources.

Offsetting
Mechanism for claiming a reduction in GHG emissions associated with a process or product through the removal of, or preventing the release of, GHG emissions in a process unrelated to the life cycle of the product being assessed

Output
Product, material or energy that leaves a unit process

Primary activity data
Quantitative measurement of activity from a product's life cycle that, when multiplied by an emission factor, determines the GHG emissions arising from a process

NOTE Examples include the amount of energy used, material produced, service provided or area of land affected.

Product(s)
Any good(s) or service(s)

NOTE Services have tangible and intangible elements. Provision of a service can involve, for example, the following:

- *an activity performed on a consumer-supplied tangible product (e.g. automobile to be repaired);*
- *an activity performed on a consumer-supplied intangible product (e.g. the income statement needed to prepare a tax return);*
- *the delivery of an intangible product (e.g. the delivery of information in the context of knowledge transmission);*
- *the creation of ambience for the consumer (e.g. in hotels and restaurants)*
- *software consists of information and is generally intangible and can be in the form of approaches, transactions or procedures.*

Product category
Group of products that can fulfil equivalent functions

Product category rules (PCRs)
Set of specific rules, requirements and guidelines for developing environmental declarations for one or more product categories according to BS EN ISO 14040:2006

Raw material
Primary or secondary material used to produce a product

Renewable energy
Energy from non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases

Secondary data
Data obtained from sources other than direct measurement of the processes included in the life cycle of the product

NOTE Secondary data is used when primary activity data is not available or it is impractical to obtain primary activity data. In some case, such as emission factors, secondary data may be preferred.

System boundary
Set of criteria specifying which unit processes are part of a product system (life cycle)

Upstream emissions
GHG emissions associated with processes that occur in the life cycle of a product prior to the processes owned or operated by the organization in question

Use phase
That part of the life cycle of a product that occurs between the transfer of the product to the consumer and the end of life of the product

Use profile
Criteria against which the GHG emissions arising from the use phase are determined

Useful energy
Energy that meets a demand by displacing an alternative source of energy

Waste
Materials, co-products, products or emissions which the holder discards or intends, or is required to, discard

CARBON TRUST

Code of Good Practice for Product Greenhouse Gas Emissions and Reduction Claims

Guidance to support the robust communication of product carbon footprints

Contents

The Carbon Trust is an independent company set up by the UK Government in 2001 in response to the threat of climate change. Its mission is to accelerate the move to a low carbon economy by working with business and the public sector to reduce carbon emissions and develop commercial low carbon technologies.

The Code of Good Practice for product greenhouse gas (GHG) emissions and reduction claims has been developed by the Carbon Trust and Energy Saving Trust to promote the reduction of product life cycle GHG emissions.

This Code has been developed in parallel to PAS 2050, a new standard for assessing carbon footprintings of products. PAS 2050 – *specification for the assessment of the life cycle greenhouse gas emissions of goods and services* – was co-sponsored by the Carbon Trust and the UK department for Environment, Food and Rural Affairs (Defra), and published by the British Standards Institution.

This Code is freely and publicly available for use by any organisation with an interest in measuring and reducing product life cycle greenhouse gas emissions, regardless of the format used (e.g. literature, adverts or product labels).

To download a copy, and for more information on The Carbon Trust or this Code, please visit The Carbon Trust website at: www.carbontrust.co.uk.

Introduction

i. Aims of this Code

This Code of Good Practice for Product Greenhouse Gas (GHG) Emissions and Reduction Claims (the Code) supports the communication and reduction of product life cycle GHG emissions. To achieve this, claims made under this Code must be accurate, verifiable, relevant and not be misleading.

The Code provides a robust structure for reporting the life cycle GHG emissions of products, or a reduction in these emissions, to internal or external stakeholders. This is achieved by helping organisations to communicate their products' life cycle GHG emissions and/or emission reductions, assessed in conformity with PAS 2050, in a robust and clear manner, and on a consistent basis. Product GHG emissions and reduction information may be used by companies, consumers and other stakeholders to make business and purchasing decisions.

Note 1: "Product" means both goods and services.

Note 2: "Product GHG emission" means the GHG emissions arising from the life cycle of the product.

ii. Applicability of this Code

This Code has been developed by the Carbon Trust and the Energy Saving Trust to be used by organisations operating at any stage of the supply chain, anywhere in the world. Application of this Code requires assessment of the product's life cycle GHG emissions in conformity with the specifications in BSI PAS 2050:2008 – *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.*

Note: Compliance with this Code alone does not entitle companies to use the Carbon Trust or the Energy Saving Trust name or logo in any way in association with claims, labels or other company communications about their GHG emissions.

iii. Scope of this Code

This Code provides companies, consumers and other stakeholders with guidance on how to:

- Communicate the life cycle GHG emissions of products clearly, credibly, on a consistent and comparable basis, and with sufficient supporting information.
- Support claims relating to reductions in life cycle GHG emissions associated with a specific product over time.

The life cycle GHG emissions of products determined by using PAS 2050, and changes in these emissions over time, do not provide an indicator of the full environmental impact of providing and using these goods or services, and do not:

- Relate to social, economic and environmental impacts arising from the provision of products other than those relating to GHG emissions.
- Infer wider benefits in relation to non-GHG emissions, acidification, eutrophication, toxicity, biodiversity, labour standards or other social, economic and environmental impacts.
- Infer the wider environmental performance of a company.

It is not currently possible to set relative reduction performance targets across different products. However, it is anticipated that PAS 2050 and this Code will accelerate the development of consistent information on product life cycle GHG emissions and reductions which, over time, could be used for such purposes.

iv. Background

Why focus on reducing product greenhouse gas emissions?

Moving to a low carbon economy in order to mitigate climate change will require fundamental changes to the way that organisations deliver goods and services. This Code is part of the Carbon Trust's initiative to encourage organisations to reduce emissions across their supply chains by providing robust, clear and consistent information of their products' life cycle GHG emissions and their reduction. Such information can be used by businesses, consumers and other stakeholders to make informed business and purchasing decisions.

The standards and guidance developed to support organisations seeking to assess and reduce their product GHG emissions are set out in two core documents:

- The *BSI British Standards PAS 2050:2008 – Specification for the assessment of the life cycle greenhouse gas emissions of goods and services (PAS 2050)*, which provides a common approach for the assessment of the life cycle greenhouse gas emissions of goods and services.

- This *Code of Good Practice for Product GHG Emissions and Reduction Claims*, which sets out the requirements for organisations making consistent and credible claims regarding their products' emissions and emissions reductions, as assessed using PAS 2050.

PAS 2050 is a stand-alone standard, co-sponsored by the Carbon Trust and Defra, and published by the British Standards Institution (BSI). While PAS 2050 provides a common basis for the assessment of product GHG emissions, it does not include any requirements for either the communication of this emissions assessment, or the assessment of emission reduction over time. The requirements for organisations wishing to assess and declare their product emissions and/or reductions are set out in this Code which, while a standalone document, builds upon the requirements of PAS 2050. For more information about the BSI PAS 2050, see: www.bsi-global.com/PAS2050.

This initiative is complementary to other work that organisations may carry out to reduce their corporate climate impacts. It is desirable that organisations will focus their product GHG emissions reduction efforts on those goods and services with high potential for change, for example products:

- With high life cycle GHG emissions, and where the opportunity for reductions could be significant.
- With high emissions arising from the way customers use products, and where product information can help individuals reduce emissions.
- Where there is a high variability in GHG emissions within a product category, i.e. lower-carbon choices can have a significant impact.

v. Challenges and general approach

This Code recognises, and aims to address, a number of challenges associated with claims regarding GHG emissions and/or emissions reduction associated with products. In particular, this Code addresses:

a. The conflict between rewarding improvement and rewarding absolute performance.

b. The challenge of comparability.

c. The trade-off between simplicity and completeness.

A. Rewarding improvement and rewarding absolute performance

Organisations assessing the GHG emissions of their products could claim that they have reduced the GHG emissions of a product, or they could claim that the product has low GHG emissions. There are challenges associated with both types of claim.

The challenge of 'reduction' claims is that they do not inform customers about the absolute level of emissions. A product claiming major reductions in its GHG emissions may still have higher emissions than a similar product whose GHG emissions were lower to begin with. The challenge facing 'low emission' claims is that there is a lack of sufficiently consistent information available to clearly define 'low', together with uncertainty over which other products should be used in the comparison to determine 'low' and 'high'.

This Code addresses this challenge by requiring that where an organisation makes claims about the reduction in emissions of their product, it shall also declare information about the absolute levels of emissions associated with that product.

This approach recognises actions taken by organisations to reduce the GHG emissions associated with their products, whilst simultaneously making information available which, over the longer term, will allow customers to distinguish between 'low' and 'high' GHG emissions products.

B. The challenge of comparability

Historically, there has not been sufficient comparable information to allow comparisons of product emissions to be made. Similarly, it has not been possible to set relative reduction performance targets based on emissions of other products, nor on reduction achievements.

This Code requires organisations to report publicly the absolute emission levels of the product(s), and to disclose supporting information explaining how these emissions were assessed to facilitate comparisons by others.

This approach aims to support the development of robust, consistent and readily accessible data which over time will enable comparison of product GHG emissions both within and between product categories.

C. The trade-off between simplicity and completeness

The evaluation of product GHG emissions can be complex, and decisions have to be made about both the scope of the assessment and the presentation of the results. Some effort is required to gain stakeholder acceptance in relation to claims about GHG emissions.

Any organisation aiming to communicate messages about the GHG emissions of products, or a reduction in those emissions over time, has to contend with this complexity, and the consequent need for customer understanding.

Increasing the amount of information associated with a claim may increase the level of confusion, and fail to inform customers. However, failing to acknowledge this inherent complexity may lead to the perception that a company is making incomplete or even misleading claims.

The approach taken in this Code is to recognise that 'on-product' or 'point-of-sale' material will often be simplified, in order to be informative to customers. However, this simplicity must be backed up with a high level of transparency through the disclosure of detailed information, in order to avoid customer misinformation.

This Code adopts a 'principle based approach' to address these challenges. The Code is structured in six sections:

- Section 1 lays out the principles that guide any claims related to product life cycle GHG emissions and reductions.
- Section 2 sets out the requirements for organisations communicating product life cycle GHG emissions.
- Section 3 covers the requirements for organisations communicating product life cycle GHG emissions reductions. This section includes the requirements for an organisation to demonstrate that robust emissions reductions have been achieved.
- Section 4 specifies requirements for the provision of supporting information in the form of a Product Emissions Report for products on which claims are made.
- Finally sections 5 and 6 contain a glossary and list of references respectively.

Development process

This Code was developed by the Carbon Trust and the Energy Saving Trust in association with Arup Consulting, OneWorldStandards Ltd and the Pacific Institute, and with technical support from E4tech. The process was overseen by an independent Steering Group. Details of the development process, governance and Steering Group membership are set out in Appendix 2.

1. Principles for claims about product life cycle GHG emissions and reductions

This Code has taken into account existing frameworks on environmental declarations and labels, including ISO 14021 on self-declared environmental claims and the UK Government's Green Claims Code. This Code is designed to comply fully with applicable elements of the nine principles specified in ISO 14020:2001 in relation to environmental declarations and labels, together with a tenth principle regarding the requirement for claims to support effective decision-making. These principles are presented below.

Principle 1: Environmental labels and declarations shall be accurate, verifiable, relevant and not misleading. For the purpose of this Code, this means:

a) Claims shall be accurate

Assessments of product life cycle GHG emissions and/or reductions shall be based on full conformity with PAS 2050.

b) Claims shall be verifiable

Declarations of conformity with this Code shall only be made by organisations whose conformity has been verified by an independent third party organisation that has been accredited in conformity with ISO 14065 and which has certification to PAS 2050 and this Code within its scope.

c) Claims shall be relevant

Product claims about GHG emissions and reductions shall be specific to the product about which the claim is made.

d) Claims shall not be misleading

Claims based on the product's life cycle GHG emissions shall be limited to GHG emissions and shall not imply broader environmental impacts (e.g. water, waste, resource efficiency).

Claims shall not confuse low carbon emissions with reductions in carbon emissions.

Note 1: For example, organisations in conformity with this Code shall not make generic claims that a product is 'environmentally friendly' or 'better for the environment'.

Note 2: For example, a claim that a product is a 'low carbon product' because the manufacturer has reduced its product life cycle emissions would be misleading unless the manufacturer could present evidence that the product's absolute levels of emissions were low compared to other equivalent products in the market, using the same method of measurement.

Principle 2: Procedures and requirements for environmental labels and declarations shall not be prepared, adopted, or applied with a view to, or with the effect of, creating unnecessary obstacles to international trade.

Principle 3: Environmental labels and declarations shall be based on scientific methods that are sufficiently thorough and comprehensive to support the claim, and that produces results that are accurate and reproducible.

Principle 4: Information concerning the procedures, methods, and any criteria used to support environmental labels and declarations, shall be available and provided upon request to interested parties. All claims shall be substantiated by the publication of supporting information as specified in Section 4 of this Code.

Principle 5: The development of environmental labels and declarations shall take into consideration all relevant aspects of the life cycle of the product, in conformity with PAS 2050.

Principle 6: Environmental labels and declarations shall not inhibit innovation which maintains or has the potential to improve environmental performance.

Principle 7: Any administrative requirements or information demands related to environmental labels and declarations shall be limited to those necessary to establish conformance with applicable criteria and standards of the labels or declarations.

Principle 8: The process of developing environmental labels and declarations should include an open, participatory consultation with interested parties. Reasonable efforts should be made to achieve consensus throughout the process.

Principle 9: Information on the environmental aspects of products and services relevant to an environmental label or declaration shall be available to purchasers and potential purchasers from the party making the environmental label or declaration.

Principle 10: Claims about product GHG emissions and reductions shall support effective decision-making, i.e. claims shall help companies, consumers and other stakeholders make choices which will be effective in reducing GHG emissions over time.

(Adapted from ISO 14020:2001)

2. Communicating product life cycle GHG emissions

2.1 Declaring overall emissions

Claims relating to a product's life cycle GHG emissions shall be reported as a single figure encompassing the total emissions for the product per functional unit, taking account of all the phases of the product's life cycle, and assessed in conformity with PAS 2050.

2.2 Declaring emissions for specific phases of the life cycle or multiple PAS 2050 results

Companies may also report:

a. Emissions for individual phases of a products life cycle.

b. Results based on different scenarios for a products sourcing, manufacturing, distribution, use or disposal.

c. Different results assessed at different points in time (e.g. before and after reduction); provided the overall most recent result is also disclosed, in conformity with clause 2.1.

Note: For example organisations can make the following claims:

- The life cycle GHG emissions of this product is 50gCO_2e per functional unit, and 80% of these emissions are associated with the use and disposal of this product.
- The life cycle GHG emissions of this product are 50gCO_2e per functional unit. Eighty percent of these emissions are associated with the use and disposal of this product. These emissions can be reduced by 10gCO_2e per functional unit by line drying rather than tumble drying.

2.3 Units of measurement

2.3.1 Standard unit of measurement

Product life cycle GHG emissions shall be reported as a mass of carbon dioxide equivalent (CO_2e), as defined in PAS 2050.

Note: The units used should be consistent with the norm for the sector or the country where the claim is being communicated e.g. grams or kilograms in EU, pounds in USA.

2.3.2 Functional unit

The life cycle GHG emissions for the product shall be specified per functional unit. For services, or for goods delivering a service, emissions shall be specified per unit of service provided.

Note: Example
- Product X has GHG emissions of 10gCO_2e per 100g unit.
- Service Y has GHG emissions of 500gCO_2e per day.

2.3.3 Product unit

A company may report a product's life cycle GHG emissions on a product unit basis, provided that the result based on a functional unit is also presented.

Note: Example
- Product X has life cycle GHG emissions of 10gCO_2e per 100g unit, or 50gCO_2e for the whole pack.

2.4 Result precision and rounding

There may be uncertainty in the assessment of product GHG emissions. The reported emissions per functional unit (FU) shall be rounded according to the following rules:

Life cycle GHG emissions per functional unit (CO_2e/FU)	Round to nearest
>10g, <=20g	1g
>20g, <=40g	2g
>40g, <=100g	5g
>100g, <=200g	10g
>200g, <=400g	20g
>400g, <=1000g	50g
>1.0kg, <=2.0kg	0.1kg
>2.0kg, <=4.0kg	0.2kg
>4.0kg, <=10kg	0.5kg
etc	etc

Rounding is to be applied to the final GHG emission assessment that is to be communicated, not during the calculation of the emission assessment.

Note 1: For example, a product whose overall emissions are presented in its Product Emissions Report as being 58gCO_2e per 100g unit would be referred to as emitting 60gCO_2e per 100g unit when communicated. An annual reduction of 6.5gCO_2e per 100g would be rounded up to 7g for communication purposes. An annual reduction of 1.16gCO_2e per 100g (i.e. 2%) would be reported as a reduction of 1.2gCO_2e per 100g for communication purposes.

Note 2: The bands are set such that the maximum change to a reported result occurring due to rounding is the same for each functional unit range.

Note 3: Rounding rules will be subject to review as more evidence of uncertainty is gained through the implementation of this Code.

2.5 Up to date assessment

Declarations of emissions shall be based on assessments in conformity with PAS 2050 that have taken place within the last two years.

3. Communicating product life cycle GHG emissions reductions

3.1 Requirements for reductions achieved

Organisations may make public declarations relating to achieved reductions in product life cycle GHG emissions when the requirements described in this section have been met, i.e.:

- Emissions reductions are proved in conformity with the requirements in Section 3.1.1.
- Banking of emissions is in conformity with Section 3.1.2.
- Claims conform to the requirements of Section 3.1.3.

3.1.1 Proof of emissions reduction achievements

Organisations may make public declarations relating to achieved reductions in product life cycle GHG emissions when they can demonstrate that these emissions have decreased between two assessments carried out in conformity with PAS 2050 and independently verified. The reduction refers to the total GHG emissions of the product, and may have accrued at any point in the life cycle of the product. The declarations need to be updated at least every two years.

Reduction claims in conformity with this Code shall only be used for comparison of the same product over time i.e. a product which is sold as the same product. Where a product has been withdrawn from the market, and replaced by a similar product, a reduction claim shall not be made by comparing the emissions of the retired product with those of the new product.

3.1.1.1 Reduction of emissions of products with variable emissions

Where the GHG emissions associated with the life cycle of a product vary over time (e.g. seasonal products), reductions in emissions shall be calculated by comparing average emissions over equivalent time periods (e.g. emissions over one year) at the beginning and end of the reporting period.

Note: For example, if apple juice was made from one type of apple in the winter and another in the summer, but presented to consumers as an identical product throughout the year, an emissions reduction for the apple juice would be calculated by comparing the average emissions over the year at the beginning and end of the reporting period.

3.1.1.2 Period of assessment

The maximum period over which any reduction in GHG emissions from products is assessed shall be two years. Organisations may choose to claim reductions over shorter time periods.

Note: If an unforeseeable event occurs that forces a temporary change in the supply chain that impacts upon the lifecycle GHG emissions (e.g. flooding in one country forces a change in sourcing of agricultural product), a company may choose to wait until the period of temporary change is over to re-assess its life cycle GHG emissions, i.e. until their sourcing has returned to its previous state. The maximum extension allowed is one year, i.e. compliance with this Code could be extended to a maximum of three years in this case before a new PAS 2050 assessment is required. For the purpose of his Code 'temporary change' is defined as that with duration of less than one year.

3.1.1.3 Updating the baseline due to changes in PAS 2050 or data quality

Organisations shall use the most recent version of PAS 2050 to assess reductions in GHG emissions over the reporting period. This ensures both consistency of the assessment across the reduction period, and that measurement is in accordance with the most recent PAS 2050 version.

Organisations shall use consistent sets of data to assess their emissions when measuring reduction.

Note: For example, an organisation may be able to provide more accurate or specific data in the assessment of their most recent emissions at the end of the two year reporting period than the ones they used to assess the initial baseline, such as newly determined primary data (data from their process) or more specific secondary data (for example, data on the exact type of material used, rather than the material class as a whole). Where this is the case, the same data shall also be used to update the baseline calculations.

3.1.1.4 Unclear quantitative results

In cases where the quantitative assessment of the emissions reduction subject to the claim is unclear, the company shall identify, and disclose to the verifier, the specific actions underpinning the emissions reduction claim. These include changes in processes or inputs.

Note: For example, where the emissions factor for a process or input is subject to uncertainty, evidence of reduction of the underlying activity shall be disclosed to verifiers to support conformity.

3.1.2 Banking reduction achievements

Organisations which have reduced their product emissions by more than 5% in any two year reporting period may choose to bank a proportion of that emission reduction. Banked emission reductions may contribute to emission reductions in subsequent reporting cycles. Banking can occur for a maximum of six years (i.e. three reporting cycles) following the year in which the banked reduction occurred. Any banked reduction shall be offset by any increases in the underlying emissions due to other factors. The assessment of the emissions reductions needs to conform to PAS 2050.

See 3.1.3.2 on requirements for declaring banked reductions.

Note: For example, a company may make a major investment in a power plant or step-change in its production process that reduces its product life cycle emissions by 12% from the baseline. A company could decide to make claims over a maximum period of six years (i.e. an average of 2% reduction per year), provided there are no other increases in life cycle emissions over that 6-year period. If, two years later, emissions assessed according to PAS 2050 show to have increased by 2% due to other factors (over the reduced baseline), the net effect will be to allow the company to claim 6% over the next four years (rather than the 8% that had been banked).

3.1.3 Communication of emission reductions

Organisations may make public claims about achieved reductions of their products' GHG emissions at any time after reduction has been achieved, as evidenced by conformity with the requirements laid out in Sections 3.1.1 and 3.1.2, provided the following requirements have been met.

3.1.3.1 Form

Declarations shall contain the product carbon emissions assessed in conformity with PAS 2050, the emissions reduction expressed in absolute and/or percentage terms and the year of baseline comparison. All measures shall be expressed in terms of functional unit, in conformity with the requirements of Section 2 of this Code.

Note: For example, 'The carbon footprint of this product is 50gCO_2e per [functional unit]. We reduced this footprint by 10gCO_2e per [functional unit] between 2008 and 2012.'

3.1.3.2 Declaring banked reductions

Banked emissions that have been calculated in accordance with Section 3.1.2 can be declared in their totality in each reporting period clearly stating the baseline year, provided net emissions of the product remain lower than the initial baseline and are reported net of any increase in emissions occurred during the reporting period due other factors. The latest emissions according to PAS 2050 shall be declared and updated every two years.

Note: For example, if a company achieved emissions reductions of 20% (20gCO_2e/Functional Unit) in 2010 it can choose to bank these reductions until 2016 if it so wishes. Provided the product's emissions do not increase over the reporting period due to other factors, the company may choose to declare "We have reduced the life cycle GHG emissions of this product by 20% since 2010" in 2012, 2014 and 2016. If the emissions of the product increased by 8% in 2013 (over the reduced baseline), the company could declare in 2012: "We have reduced the life cycle GHG emissions by 20% since 2010" but in 2014 they can only declare "We have reduced the life cycle GHG emissions by 12% since 2010".

3.2 Requirements for unquantified reduction commitments

Organisations may make public declarations regarding unquantified commitments to reduce product life cycle GHG emissions when the requirements described in this section (Section 3.2) have been met, i.e.:

- Robust emissions reductions commitments are proved in conformity with the requirements in Section 3.2.1.
- Claims conform to the requirements of Section 3.2.2.

3.2.1 Proof of emissions reduction commitment

Organisations may make public declarations of their commitments to reduce product GHG emissions when they can demonstrate that their commitment is robust, in conformity with the requirements in this section.

3.2.1.1 Baseline assessment

A baseline assessment of the product's life cycle GHG emissions has been completed in conformity with the specifications of PAS 2050, independently verified.

3.2.1.2 Plans to reduce

The company has a plan of actions to reduce their product emissions. An overview of these actions to reduce emissions shall be disclosed for verification purposes.

3.2.2 Communication of unquantified reduction commitments

Organisations may make public claims about commitments to reduce their products' GHG emissions when the commitment conforms to the requirements laid out in Section 3.2.1, provided the following requirements have been met.

3.2.2.1 Form

Declarations shall contain the baseline carbon emissions assessed in conformity with PAS 2050, and an explicit commitment to reduce the product's emissions during a specified time period that shall not be longer than two years, in conformity with the requirements in Section 3.1.1.2. The specific year when compliance is expected shall be stated at the point where the claim is being made and/or within the complementary information disclosed in the Product Emissions Report (see Section 4 of this Code). No quantified declarations of future reduction commitments shall be made.

Note: For example, a company can claim "We are committed to reducing the life cycle GHG emissions of Product X by 20YY".

However, a company cannot claim "We are committed to reducing the life cycle GHG emissions of Product X by Z%/Z g by 20YY".

3.3 Failure to comply

3.3.1 Quantified reduction not achieved

In the event that a company fails to achieve quantified reductions during a reporting period (two years) in conformity with the requirements in Section 3.1, the company is no longer compliant with the reduction proof requirements of this Code in relation to that product. In this case, claims regarding emissions reduction or emissions reductions commitments of that product shall not be made until emissions reduction has been achieved.

3.3.2 Declaration of reduction achievements after previous failure

If, after failing to comply with this Code during one reporting period (two years) for a particular product, an organisation subsequently achieves a reduction in the next (two year) reporting period, the company may declare their reduction achievement again. In this case, the organisation may choose to compare current emissions with the previous lowest baseline.

Note: For example, if an organisation reduces the life cycle GHG emissions of product X by 4% between 2010 and 2012 but no further reductions are then made until 2016, the organisation can make reduction claims in 2012 but not in 2014. If 2016, a further 3% reduction has occurred since 2012, the claim in 2016 can be either "The GHG emissions of product X is 100g/functional unit. We have reduced these emissions by 7% since 2010" or "The GHG emissions of product X is 100g/functional unit. We have decreased these emissions by 3% since 2014".

3.3.3 Failure due to *'Force Majeure'*

Organisations that fail to achieve reduction solely due to a *force majeure* event may normalise the baseline emission assessment to remove the impacts of *force majeure* and assess the reduction comparing with the normalised baseline.

For the purposes of this document *force majeure* events include fire, flood, earthquake, storm, hurricane or other natural disaster (including pests and diseases), war, invasion, act of foreign enemies, hostilities (whether war is declared or not), civil war, rebellion, revolution, insurrection, military or usurped power or confiscation, terrorist activities, government sanction, blockage, embargo, interruption or failure of energy suppliers.

Note 1: For example, if a company's manufacturing site for a particular product suffered major flooding which resulted in manufacturing being switched to a less efficient plant, which increased its product life cycle GHG emissions, the company could re-assess its baseline to take this into account. In this case both the baseline and the new result after the two year period assessments would use the most recent (less efficient) manufacturing data. If the net result of these assessments showed that life cycle GHG emissions had reduced over the two year period then the company would remain in conformity with this Code.

Note 2: Weather can affect the baseline for numerous products, in particular in agriculture. Extreme weather or other events could be considered as force majeure on a case by case basis by the verifiers, in agreement with the accreditation body. An extreme event is defined as that falling outside the normal historical range used to assess the emissions arising from the product; refer to PAS 2050 for further information on data requirements.

4. Supporting information: The Product Emissions Report

Note: Appendix 1 provides a template that may be used as the basis for the Product Emissions Report prepared in conformity with the requirements of this Code.

4.1 Scope of the Product Emissions Report

Claims relating to the life cycle GHG emissions of products shall be supported by the publication of a 'Product Emissions Report' which provides context and explains the basis for the claim being made. The Product Emissions Report may cover one or more products. Where more than one product is covered, the report only needs to cover common references to several products once, and detail the information that is specific to each individual product.

The Product Emissions Report shall provide an overview of the method, assumptions, limitations and results of the assessment for the product(s) it covers. The Report shall be of sufficient detail to allow the reader to understand the complexities and trade-offs inherent in the assessment of the life cycle GHG emissions of products following the requirements described below.

4.2 Background information

The Product Emissions Report shall provide the following introductory information:

a. The name of the company producing or providing the product(s).

b. The specifications and/or other documents against which the company has been assessed for conformity (e.g. the title, number and date of the versions of the BSI PAS 2050, and Code of Good Practice for product GHG emissions and reductions claims).

c. The name of the body/bodies that have verified the company's conformity with the requirements of PAS 2050 and with the requirements of this Code.

d. The year for which the assessment results remain valid (i.e. two years from the date of the most recent assessment).

4.3 Company policy

The Product Emissions Report shall specify the company policy and strategy in relation to climate change, including:

a. A public statement/ policy identifying how climate change is relevant to its business activities in terms of risks (regulatory, physical, reputational) and opportunities.

b. A summary of the company's strategy to manage carbon across the company as a whole.

c. A summary of the company's objectives/targets for the reduction of GHG emissions across the company as a whole.

Note: Reference to the company's publicly available, completed Carbon Disclosure Project (CDP5) Greenhouse Gas Emissions Questionnaire (2007) would satisfy the requirements specified in clause 4.3.

4.4 Product emissions declarations: supporting information

For each product covered by the Product Emissions Report, the following information shall be provided:

a. The specific product(s) for which life cycle GHG emissions are reported (e.g. Brand X washing powder; Z Hotel accommodation).

b. The quantitative results of the most recent verified PAS 2050 assessment(s).

c. The date(s) of the emission assessment.

4.5 Product emissions reduction claims: supporting information

Organisations making claims regarding life cycle GHG emission reductions of their products shall include the following information in the Product Related Emissions Report:

a. The specific product(s) for which life cycle GHG emissions are reported.

b. The baseline emissions figure as assessed before the reduction took place, and the subsequent most recent emissions figure assessed after the reduction took place (as specified in 4.4).

c. The dates when both the baseline emissions and most recent emissions results on which the reduction claim is based were assessed.

d. The emissions reduction achieved expressed in absolute and/or percentage format.

e. The time period over which the reduction took place.

f. Explanation of banked results shall be disclosed by organisations making claims based on banked savings.

g. Explanation of baseline updates shall be disclosed by organisations when the original baseline figure has been revised to reflect changes in PAS 2050 versions or data. In these cases the Product Emissions Report shall include the original baseline emissions figure, the revised baseline figure (using the new or updated information), and the latest emissions results after reductions have taken place (also based on the new or updated information). The Product Emissions Report shall also include an explanation of the changes in the baseline.

h. Explanation of impacts of force majeure shall be disclosed by organisations who wish to claim reductions taking account of 'force majeure' events (as defined in Section 3.3.3 of this Code). In these cases, the Product Emissions Report shall include all the original baseline emissions figure, the revised baseline figure (normalised taking into account the impact of the force majeure event), and the latest emissions results after reductions have taken place. The Product Emissions Report shall also include an explanation of the force majeure event.

4.6 Boundaries and data: supporting information

Claims regarding both product emissions and reductions shall be supported by the following information:

a. A description of the boundaries of the emissions assessment for the product and the basis for the boundary decisions for the product and for its use profile.

Note 1: PAS 2050 identifies two potential sources for defining the boundaries for the assessment of life cycle GHG emissions: i) the boundaries specified in a relevant Product Category Rule (PCR), or ii) where a PCR does not exist for the product the default boundaries described in the PAS 2050. The Product Emissions Report shall refer to the source used for the PAS 2050 assessment, and when they have not used a PCR, define broadly the boundaries for the specific product under analysis.

b. The sources of secondary data which have been used for the assessment, including the sources of conversion factors.

Note 2: This specification requires that the sources of data shall be disclosed, not the data itself. Sources shall be declared that cover all the material sources of emissions, i.e. 95% of the total estimated product emissions.

4.7 Disclaimer about uncertainty of results

The Product Emissions Report shall include a disclaimer regarding the level of uncertainty associated with the reported emissions results. The disclaimer could take the form of a qualitative statement regarding the uncertainty of the results, or a quantitative assessment of uncertainty if available.

Note: For example, an organisation could use this disclaimer about the uncertainty of the results: "The emissions figures provided in this report have been assessed in conformity with the requirements of the PAS 2050, using the primary and secondary sources of data specified in this report. Based on the PAS 2050 we believe that our assessment has identified 95% of the likely GHG emissions associated with the full life cycle of the product(s) covered in this report. However, readers should be aware that even primary sources of data are subject to uncertainty and variation over time. The figures given in this report should be considered as our best estimates, based on reasonable costs of evaluation".

4.8 Location of supporting information

4.8.1 Reference to supporting information

All claims described in Sections 2 and 3 of this Code shall include a clear reference to a freely accessible website where the additional supporting information specified in Section 4 is available.

Note: For example "The carbon footprint of this product is 50g CO_2e per [functional unit]. See www.ourcarbonfootprint.com for more information".

4.8.2 Location of reference to supporting information

In the case of product on-pack information, if the reference to supporting information is not included on the pack itself (e.g. due to lack of space), the information shall be provided by other visible means at the point of sale or other communication vehicles for the product.

5. Glossary

Note: All definitions are taken from BSI PAS 2050 unless explicitly stated otherwise.

Banking of GHG emissions savings

Crediting of GHG emission reductions to a future year or compliance period.

Baseline

Initial assessment of product life cycle GHG emissions, against which future reduction targets and reductions are measured.

Carbon dioxide equivalent (CO_2e)

Unit for comparing the radiative forcing of a GHG to carbon dioxide.

(ISO 14064-1:2006, 2.19)

Note: Greenhouse gases, other than CO_2, are converted to their carbon dioxide equivalent value on the basis of their per unit radiative forcing using 100-year global warming potentials defined by the Intergovernmental Panel on Climate Change (IPCC).

Carbon footprint

The total set of GHG emissions caused directly and indirectly by an individual, organisation, event or product.

Claim

Information appearing on a product, its packaging, or in related literature or advertising material, relating to its environmental aspects. It can take the form of text, symbols, or graphics.

Note: A straight piece of advice to consumers of the product – for example, about care in its use or disposal – is not regarded as a claim. But such advice should still give consumers relevant information on which they can realistically act.

(UK Department of Trade and Industry Green Claims Code, June 2000)

Customer

Buyer of goods and services.

Declaration

Claim in relation to some aspect of a product or service.

Note: A declaration may take the form of a statement, symbol or graphic on a product or package label, in product literature, in technical bulletins, in advertising or in publicity, amongst other things.

(Adapted from ISO 14020:2001 definition of an 'environmental declaration')

Force majeure

Extraordinary event(s) or circumstance(s) beyond the control of the parties, including fire, flood, earthquake, storm, hurricane or other natural disaster (including pests and diseases), war, invasion, act of foreign enemies, hostilities (whether war is declared or not), civil war, rebellion, revolution, insurrection, military or usurped power or confiscation, terrorist activities, government sanction, blockage, embargo, interruption or failure of energy suppliers.

Functional unit

Quantified performance of a product for use as a reference unit.

(ISO 14044:2006, 3.20)

Greenhouse gases (GHGs)

Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds.

(PAS 2050:2008, 3.26)

Life cycle

Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to final disposal.

(ISO 14040:2006, 3.1)

Life cycle GHG emissions

Sum of greenhouse gas emissions resulting from all stages of the life cycle of a product and within the specified system boundaries of the product.

(PAS 2050:2008, 3.3.2)

Primary activity data

Quantitative measurement of activity from a product's life cycle that, when multiplied by an emission factor, determines the GHG emissions arising from a process.

(PAS 2050:2008, 3.36)

Product

Any good or service.

(Adapted from ISO 14040:2006, 3.9)

Product category

Group of products that can fulfil equivalent functions.

(ISO 14025:2006, 3.12)

Secondary data

Data obtained from sources other than direct measurement of the processes included in the life cycle of the product.

(PAS 2050:2008, 3.43)

Unit process

Smallest portion of a life cycle for which data are analysed when performing a life cycle assessment.

(PAS 2050:2008, 3.45)

Use phase

that part of the life cycle of a product that occurs between the first arrival of the product at the consumer and the end of life of the product.

(PAS 2050:2008, 3.47)

6. References

Normative references

PAS 2050: 2008 *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services*.

Informative references

Carbon Disclosure Project (CDP5) *Greenhouse Gas Emissions Questionnaire* (2007).

Global Framework for Climate Risk Disclosure: *a statement of investor expectations for comprehensive corporate disclosure* (October 2006).

Green Claims Code, Revised (2000) UK Department for Environment Transport and the Region and Department for Trade and Industry.

ISO 14020: 2001 *Environmental labels and declarations – General principles*.

ISO 14021:2000 *Environmental labels and declarations – Self declared environmental claims*.

ISO 14025:2006 *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*.

ISO 14044:2006 *Environmental management – Life cycle assessment – Requirements and guidelines.*

ISO 14064-1:2006 *Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.*

ISO 14064-2: 2006 *Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements.*

ISO 14065:2007 *Greenhouse gases – Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition.*

Appendix 1
Product Emissions Report template

Introduction

This report presents [verified] information about the Company A in-store trial to assess the GHG emissions of its croissants range. It provides information on Company A's overall strategy for climate change mitigation and that specific to the croissants line assessed in conformity to PAS 2050.

This report conforms to the requirements for public disclosure of the life cycle GHG emissions of products laid out in the 'Code of Good Practice for product GHG emissions and reductions'. It aims to provide the basis to allow consistent information for product GHG emissions and reduction, assessed in conformity with PAS 2050.

1. Background information	
1.1	**Name of company:** Company A
1.4	**Specifications and/or other documents against which the company has been assessed for conformity** *(e.g. the title, number and date of the versions of BSI Publicly Available Specification)*: i. PAS 2050:2008 ii. Code of Good Practice for product GHG emissions claims: 2008
1.5	**Name and Accreditation Reference of the independent, third party verifier:** The Carbon Label Company, a wholly-owned subsidiary of the Carbon Trust, Accreditation Reference – e.g. Accreditation body 0001
1.6	**Date of Verification:** 6th July 2008

2. Company policy in relation to climate change:	
2.1	**Company policy and strategy** *NOTE: the policy and strategy statement shall include at least the following:* *a. A public statement/ policy identifying climate change as being relevant to its business activities.* *b. A summary of the company's strategy to manage carbon emissions across the company.* *c. A summary of the company's target(s) to reduce GHG emissions across the company as a whole.* **Company A public position (from 2008 Corporate Social Responsibility Review):** Our policy is to integrate environmental sustainability concerns into our core business strategy and practices. Our climate change strategic goal is to reduce our direct emissions by 50% from 2000 levels by 2010 and to help employees and customers to reduce their carbon footprints. Specific targets include: • Reduce our energy use by 30% vs. 2000 levels by 2010. • Cut our employees' business travel by 20% from 2000 levels by 2010. • Assess the life cycle GHG emissions of at least 50% of our product categories by mid-2009. • Invest £5M during 2008 in engagement programmes to help our consumers and employees identify and implement actions to reduce further the GHG emissions resulting from our activities. Further information can be found in the Company A 2008 Corporate Social Responsibility Review: http://www.companya.com/csrreview08/.

3. Product emissions declarations: Supporting information		
Product reference number: 1		
3.1	**Product(s) assessed in conformity with PAS 2050 on which claims are made:** Company A 12-pack butter croissants	
3.2	**Product emissions: Full life cycle GHG emissions for the product** *(most recent quantitative result of the assessment reported as a single figure, and taking account of all the phases of the product's life cycle, in compliance with the specification of the PAS 2050[1,2,3,4].)* Raw materials: Manufacturing: Distribution/ retail: Consumer use: Disposal:	1,100g per pack 550g 300g 60g 40g 170g
3.3	**Optional: GHG emissions for individual phases of a product's life cycle**	n/a
3.4	**Optional: GHG emissions results based on different scenarios of life cycle management**	n/a
3.5	**Date of assessment for results specified in 3.2 - 3.4 (above)**	30th July 2008

4. Product emissions reduction: Supporting information		
4.1	**Product(s) assessed in conformity with PAS 2050 on which claims are made:** Company A 12-pack butter croissants	
4.2	**Baseline emissions** *(Baseline assessment on which the reduction claim is being made by comparing it with the most recent assessment reported in 3.2 – above)*	1,150g per pack
4.3	**Date of assessments of baseline stated in 4.1 (above)**	2nd Feb. 2008
4.4	**Claimed GHG emission reduction for the product** *(expressed in absolute and/or percentage terms comparing baseline (4.1 – above) to current (3.2 – above)*	4%
4.5	**Time over which reduction has taken place:**	Feb-July 2008
Description of drivers of reduction claims		
4.6	**Description of the high-level actions that have been implemented, or which are planned to be implemented, to reduce the life cycle GHG emissions of the product(s) listed in this report:** • Action 1: Implement reduction initiatives covering the Company A direct carbon footprint (described in section 2.1 in 2008 Corporate Social Responsibility Review), which has a knock-on impact on the carbon footprint of each of Company A's products (underway). • Action 2: To work with raw materials suppliers to promote the development of low- or alternative-fertiliser wheat agriculture techniques (underway). • Action 3: To work with raw material manufacturers to promote the use of renewable energy sources to power production facilities (future initiative).	
4.7	**Explanation of banked results:** N/A	
4.8	**Explanation of baseline updates:** The baseline has been updated from the initial assessment in February to adjust to the use of more accurate primary data regarding flour milling. This has reduced our initial baseline assessment from 1,500g/pack (stated in our report dated in February 2nd 2008) to the normalised result: 1,150 g/pack, reported here.	
4.9	**Explanation of impact of force majeure:** N/A	

[1] Figures for GHG emissions shall be specified as mass of CO_2 equivalent (CO_2e) as defined by PAS 2050.

[2] The product-related life cycle GHG emissions for the product shall be specified per functional unit of the product. For services, or for goods delivering a service (e.g. a light bulb delivering the service of supplying light) emissions should be specified as mass of CO_2e per unit of service provided.

[3] A company may report a product's life cycle GHG emissions on a product unit basis provided that the result based on a functional unit is also presented.

[4] See paragraph 2.4 of the Code for rules about rounding of reported emissions figures.

5. Boundaries and data: Supporting information		
5.1 Product reference Number(s)	**5.2 Emissions assessment boundaries and the basis for the boundary decisions** *(PCR or PAS specifications)*	**5.3 Sources of secondary data which have been used for the assessment**
Product reference 1: Company A 12-pack butter croissants	PAS 2050 rules used to specify boundaries. Specific boundaries and categorisations are described below.	**General: Standard emissions factors and general inputs:** • Company A and supplier primary data. • Carbon Label Company Emissions Factor Database v6.0, drawing on ecoinvent data v1.3, Dukes Digest 2006, International Energy Agency 2004, IPCC 2001 and Defra 2007, Continuing Survey of Road Goods Transport.
	1 Raw materials include wheat farming (fertiliser production, transport and application), flour milling, and other ingredients' and packaging materials' production and transport to bakery.	**Raw materials** • Company A primary data, for transport, flour milling, and packaging materials. • Ecoinvent data v1.3, for wheat farming and other ingredients. • Carbon Label Company Emissions Factor Database v6.0.
	2 Manufacturing includes mixing and baking croissants; packaging.	**Production** • Company A primary data for all activity data. • Carbon Label Company Emissions Factor Database v6.0.
	3 Distribution and retail includes transport to distribution centre, storage at the distribution centre, distribution to stores, storage and display at stores.	**Distribution:** • Company A primary data. • Carbon Label Company Emissions Factor Database v6.0. • http://www.infoplease.com/atlas/calculate-distance.html. **Retail Store:** • Retailer B primary data. • Carbon Label Company Emissions Factor Database v6.0.
	4. Use includes consumer storage (freezing) and consumption (re-heating).	**Use:** • Company A secondary data, based on research amongst consumers use patterns of their product, conducted between 1st January and 31st December 2007. • Carbon Label Company Emissions Factor Database v6.0.
	5. Disposal includes transport to landfill and decomposition of waste and plastic packaging.	**Disposal:** Carbon Label Company Landfill Emissions Model, using: • http://www.defra.gov.uk/ENVIRONMENT/WASTE/topics/packaging/faq.htm. • Micales J. A., Skog K. E. (1997): The Decomposition of Forest Products in Landfills. International Biodeterioation and Biodegradation, Elsevier, Vol. 39, No. 2-3, p. 145-158. • Ecoinvent data v1.3: Sanitary Landfill model. • Ecoinvent report No. 13 – part III Table 6.2. • Zimmermann P., Doka G., Huber F., Labhardt A., Menard M. (1996): Ökoinventare von Entsorgungsprozessen, Grundlagen zur Integration der Entsorgung in Ökobilanzen. ESU-Reihe, 1/96, Zürich: Institut für Energietechnik, ETH Zurich. • BUWAL (2001): Energieproduktion aus Abfällen 1990-2000, Stand 27.12.2001. BUWAL, Berne, Switzerland. • Engineeringtoolbox.com.

6. Disclaimer about uncertainty of results

The emissions figures provided in this report have been calculated in accordance with the requirements of the PAS 2050 method, using the primary and secondary sources of data specified above. Based on the PAS 2050 method of assessment we believe that our assessment has identified 95% of the likely GHG emissions associated with the full life cycle of the product(s) covered in this report. However, readers should be aware that even primary sources of data are estimates and are subject to variation over time, and the figures given in this report should be considered as our best estimates, based on reasonable cost of evaluation.

Appendix 2
Development process and governance

The Code of Good Practice for Product GHG Emissions and Reduction Claims (the Code) was developed by the Carbon Trust and the Energy Savings Trust, with the support of Arup, OneWorldStandards and the Pacific Institute, and with technical support from E4tech.

The Carbon Trust is a member of the ISEAL[5] Alliance, and followed the guidance of the ISEAL Code of Good Practice for Setting Social and Environmental Standards ('the ISEAL Code') in the development of this Code.

In particular, the development process aimed to:

- Ensure that there was broad participation in the development of the Code by the full range of interested parties.
- Be fully transparent in relation to governance, procedures, participation, comments resolution and decision-making.
- Strive for consensus on the Code final content among a balance of the interested parties.

The development process was approved and overseen throughout by a multi-stakeholder 'Reduction and Communication Steering Group' with representation from Government, businesses, industry, NGO and academia of (see table below).

The first draft of the Code was released to the public and to a specialist working group for consultation on 3 March 2008. After analysis of the comments and discussion with the Reduction and Communication Steering Group a second draft was released for public consultation on 20 May 2008. After a period of public review and comment the draft was finalised and approved by the Reduction and Communication Steering Group in September 2008, and by the Carbon Trust Board of Directors in October 2008.

Full details of the development process and the comments submitted are available from the Carbon Trust on request.

Name	Affiliation
Prof. Jim Skea (Chair)	Research Director, UK Energy Research Centre
Terence Ilott	Deputy Director Environment, Business and Consumer Division, UK Department for the Environment, Food and Rural Affairs
Dr Paul Jefferiss	Carbon Trust Board member[6]
Prof. Roland Clift	Distinguished Professor of Environmental Technology, University of Surrey
Mark Kenber	Policy Director, The Climate Group
Dr. Sally Uren	Director of Business, Forum for the Future (represented by Dan Crossley and Tom Berry)
Prof. Jacquie Burgess	Professor of Environmental Risk, University of East Anglia
Lucy Yates	Senior Policy Advocate, National Consumer Council
Nick Monger-Godfrey	Head of Corporate Social Responsibility, John Lewis Partnerships
Karen Galloway	Marketing Manager for Seafish Industry Authority
Adrian Arnold	Head of Partner Marketing, Energy Saving Trust (EST)
Nigel Dickie	Director, Corporate and Government Affairs, Heinz UK and Ireland
Stephen Reeson	Energy Manager, Food and Drink Federation

[5] The International Social and Environmental Accreditation and Labelling (ISEAL) Alliance is an association of leading voluntary international standard-setting and conformity assessment organisations that focus on social and environmental issues. Members include the Forestry Stewardship Council, Fairtrade Labelling Organisation and Social Accountability International, amongst others. The ISEAL Code of Good Practice is the international reference for setting credible voluntary social and environmental standards. It is referenced by a range of governmental and inter-governmental guidelines as the measure of credibility for voluntary social and environmental standards. See www.isealalliance.org for more information.

[6] Acting as independent advisor for the purpose of this Code's development.

www.carbontrust.co.uk

The Carbon Trust was set up by Government in 2001 as a private company.

Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

We do this through five complementary business areas:

Insights – explains the opportunities surrounding climate change
Solutions – delivers carbon reduction solutions
Innovations – develops low carbon technologies
Enterprises – creates low carbon businesses
Investments – finances clean energy businesses.

www.carbontrust.co.uk
0800 085 2005

ACT ON CO_2 is the Government's initiative to help individuals understand and reduce their carbon footprint. Visit http://actonco2.direct.gov.uk for more information.

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CTC745

Case Study CTS057

Working with HBOS

Product carbon footprinting in practice

HBOS is the first financial services company to be involved in product carbon footprinting and labelling. More important, it is the first company to footprint and label a service using the draft PAS 2050[1]. As such, it proves that the PAS approach to product carbon footprinting can be applied successfully to services as well as to physical products.

[1] BSI Publicly Available Specification (PAS) 2050 is based on the product carbon footprinting method originally developed by the Carbon Trust and trialled with Walkers, Boots and innocent. The Carbon Trust later co-sponsored, along with the UK Department for Environment, Food and Rural Affairs (Defra), the development of PAS 2050 by BSI British Standards.

Company background

Formed in 2001 from the merger of Halifax and Bank of Scotland, HBOS is one of the largest financial services organisations in the UK. Its activities cover retail and corporate banking, insurance, investment and asset management. HBOS is among the largest savings and mortgage providers in the UK, and 2 out of every 5 UK households is an HBOS customer. The company employs 65,000 people in the UK and 73,500 worldwide.

Reducing its contribution to climate change is a key component of HBOS' corporate responsibility strategy. HBOS also sees opportunity in climate change mitigation – any cost savings it achieves through energy efficiency and waste reduction measures translate into a cost advantage relative to competitors.

Why HBOS became involved

HBOS is committed to showing sector leadership to reduce GHG emissions. It has worked with the Carbon Trust since 2003 and reduced its own emissions by 7% between 2006 and 2007. Key drivers of this reduction were:

- Installing low-energy light bulbs in 80% of its 2,200 building sites.
- Introducing stronger energy efficiency standards for new buildings and new energy efficiency measures in older buildings.
- Launching a 'green miles' initiative to reduce employee travel.

Based on its efforts, HBOS has become a recognised leader in climate change mitigation, with several sustainability awards, including membership in the Global 100 Most Sustainable Companies and ranking as a Climate Leader by the Carbon Disclosure Project for the past four years.

HBOS wanted to build on this leadership position and become the first bank in Europe to carbon label a banking product. Working with the Carbon Trust, HBOS became the test case for the carbon footprinting method on a service, as opposed to a physical product. The PAS 2050 method provides a way of measuring emissions across the 'life cycle' of a savings account, all the way from opening the account through to making transactions to eventually closing the account, and thus helped HBOS identify carbon hot-spots and where to focus improvement efforts.

HBOS also wanted to use the Carbon Trust Carbon Reduction Label to provide a clear and simple way of communicating with customers about carbon emissions.

The Web Saver account was launched by Halifax in 2000 and made a logical test case as it is one of the bank's most popular savings accounts, with more than 1.1 million accounts[2].

[2] HBOS 2008 Climate Change Report, www.hbosplc.com

Calculating the carbon footprint of a service

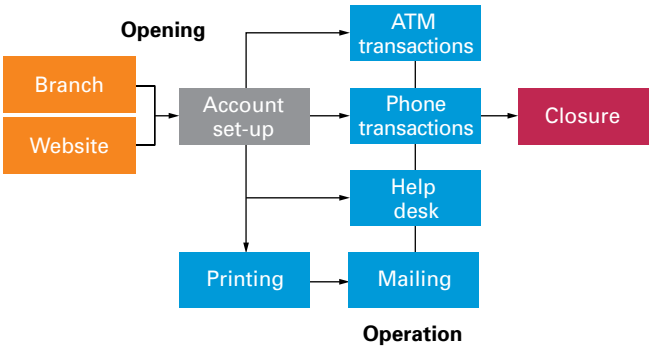
The footprint calculation included activities and materials involved in both the opening and subsequent operation of the account. This pilot therefore influenced the development of PAS 2050 as it required the consideration of situations in which there is a one-off opening process followed by a potentially indefinite period of operation.

Calculating the carbon footprint of a service is similar to the calculation for a physical product, with the following exceptions:

- Defining the 'product'.
- Determining the life cycle or product system boundary.

'Product' and 'functional unit' definition requires significant thought for services (as opposed to physical products where it is more straightforward). For example, should the emissions be expressed as 'per year of account operation', or 'for the (undefined) lifetime of the account' or 'per transaction' or 'per £ saved in the account'? In this case, 'per year of account operation' was chosen as it allowed HBOS to calculate a single standard number to use across all its Web Saver customers, regardless of how much they saved or how old their account was.

Chart 1 *Halifax Web Saver account process map*



Setting the system boundary[3] for a service is more challenging than for a physical product. For example, it is much harder to differentiate between emissions associated with managing the product (e.g. call centre or operations centre emissions) from head-office emissions, which should be excluded. These considerations are critical for:

- Comparability[4] – using system boundaries from the customer's perspective make subsequent footprint calculations more readily comparable both within companies and across competitors.
- Data collection – system boundaries will determine what emissions will be included or excluded, and therefore what data needs to be collected.

HBOS and the Carbon Trust determined the Web Saver account life cycle to have the stages described in Chart 1.

[3] 'Setting the system boundary' is the process to define what activities, materials and energy should be included in the life cycle of the service.

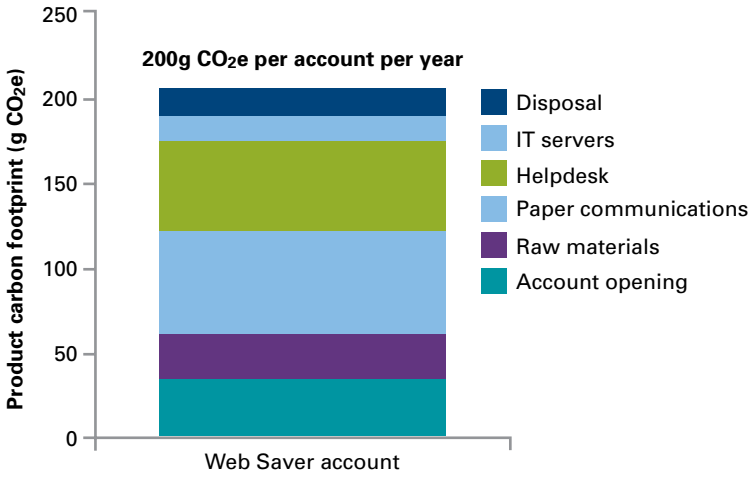
[4] True comparability can only be achieved by using consistent data sources, boundary assumptions and certification rules.

Most data was collected internally since the activities involved in the savings account's 'life cycle' are primarily owned and managed by HBOS. A number of suppliers were also approached, such as the ATM providers, printer, debit card suppliers and the service company that manages energy usage of ATMs and branches.

The footprint model was certified by the Carbon Trust's subsidiary Carbon Label Company to ensure compliance with the draft PAS methodology and yielded the footprint result shown in Chart 2.

The carbon footprint of the Web Saver account was calculated to be 204g per year of operation, rounded to 200g per the Code of Good Practice on Product Emissions and Reduction Claims. Opening the account generates 170g of CO_2e, which equates to 34g CO_2e when split over the five years an account typically stays open, and the ongoing running of the account generates 170g CO_2e each year.

Chart 2 *Halifax Web Saver account carbon footprint*

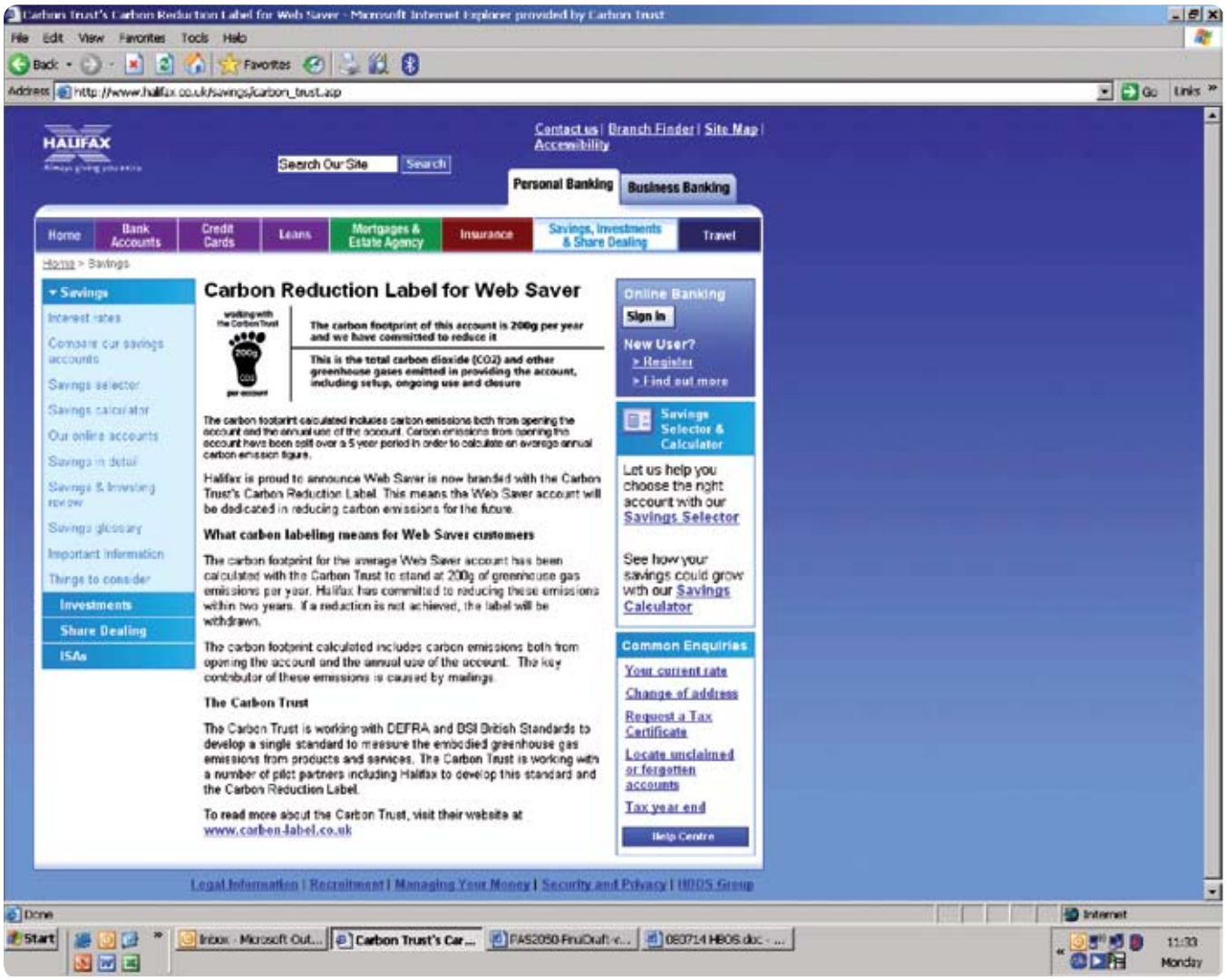


Using the Carbon Reduction Label

The Web Saver Carbon Reduction Label has been placed on the Halifax Web Saver website, as shown in Chart 3.

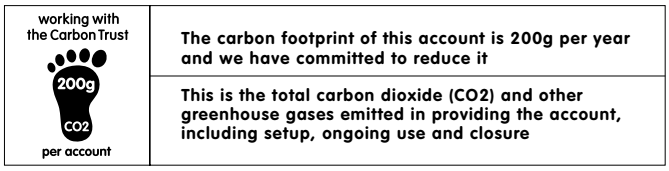
The Carbon Trust Carbon Reduction Label communicates the account's footprint of 200g CO_2e, as well as HBOS' commitment to reduce these emissions – the 'reduce it or lose it' clause within the Label.

Chart 3



The website offers additional information to help educate consumers on the key drivers of the savings account's emissions, such as mailings, which enable consumers to play a role in reducing emissions too. Employees at local branches have been trained on the results of the footprinting process and what the Carbon Reduction Label means.

Chart 4 *Halifax Web Saver accounts' Carbon Reduction Label*



Achievements

The footprinting exercise uncovered some surprise sources of carbon emissions, showing the value of a product-level (rather than a corporate-level) footprinting analysis.

For example, ATM transactions constituted 13% of the average Web Saver account's carbon footprint. This was unexpected given that few Web Saver accounts even come with a debit card, and highlights the energy-intensive nature of ATM machines.

Other opportunities identified include:

- Reduce paper usage – HBOS had already reduced paper considerably, but the carbon footprinting exercise identified paper as a further opportunity for emissions reductions:
  - The company has pledged to reduce paper further through simple measures like two-sided printing.
- Check energy consumption of new equipment and service design – energy use is a key driver of service emissions:
  - To that end, HBOS is rolling out more efficient ATMs that use significantly less electricity – as much as 30% less – resulting in both energy cost savings and emissions reductions.
- Make energy use a criteria when designing data centres – HBOS has begun a major review of data centre practices to establish opportunities for energy and resource saving.
- Improve energy efficiency for helpdesks – HBOS is implementing a new programme to reduce energy use across all of its buildings, including helpdesks.

Way forward

HBOS is currently assessing next steps for its carbon footprinting and labelling activity.

The company will continue to pursue the opportunities for energy savings identified through the footprinting exercise to reduce the energy costs and carbon emissions associated with Web Saver.

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CTS057

Case Study CTS058

Working with PepsiCo and Walkers

Product carbon footprinting in practice

As the first company to pilot the original method for assessing product carbon footprints and the first to introduce the Carbon Trust Carbon Reduction Label, Walkers offers several important lessons. This experience provided a practical, company-led perspective to inform the development of the footprinting method that became BSI PAS 2050[1] and the Carbon Reduction Label itself. Walkers is also a case study in the power of effective supplier engagement to reduce carbon emissions; the importance of making public commitments to drive real action and results; and provides evidence that carbon footprinting and labelling matter to consumers.

[1] BSI Publicly Available Specification (PAS) 2050 is based on the product carbon footprinting method originally developed by the Carbon Trust and trialled with Walkers, Boots and innocent. The Carbon Trust later co-sponsored, along with the UK Department for Environment, Food and Rural Affairs (Defra), the development of PAS 2050 by BSI British Standards.

Company background

PepsiCo UK and Ireland is the parent company of Walkers. PepsiCo also owns other leading UK brands including Quaker, Tropicana, Copella and Pepsi. The company employs over 5,500 people across 13 locations around the UK.

The Walkers business includes the largest crisp manufacturing plant in the world, plus several other manufacturing, distribution and corporate sites. Since 2007 Walkers has sourced 100% British potatoes for all its crisps, leading to a supply chain that is concentrated in the UK.

The PepsiCo and Walkers businesses both have strong commitments to sustainability. At the global level PepsiCo has committed to 'performance with purpose', with a sustainability strategy to minimise its use of energy and water; limit packaging and waste; and reduce its carbon footprint around the world.

In the UK, PepsiCo has taken this commitment further by defining three key environmental challenges that pose fundamental questions for society and business: climate change, resource depletion and water use – the areas where it believes it has the greatest ability to act and influence. According to CEO Salman Amin: "Our business relies on a successful society and healthy planet to grow and meet future consumer needs. In time, everything we do needs to be seen through what environmental purpose it serves as much as financial performance".

Walkers has worked with the Carbon Trust on energy efficiency and carbon management since 2002. It has succeeded in reducing energy use in its own operations by more than 30% since 2000. This work also led to better understanding of the drivers of carbon emissions, and to the realisation that its supply chain represents a large source of potential emissions reductions.

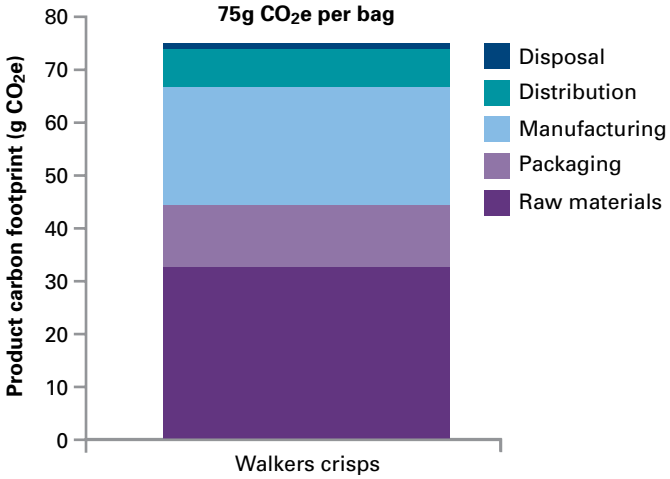
This realisation led Walkers to launch significant work to better understand the carbon impact of its supply chain, including the Carbon Trust initiative to quantify greenhouse gas GHG emissions across product life cycles.

Supply chain assessment

In late 2006 Walkers became the first pilot company to work with the Carbon Trust to analyse the carbon footprint of a product (crisps) across the entire product life cycle, from raw materials to manufacture and packaging through to disposal of the crisp bag (Chart 1). At the time the method excluded the consumer use phase, but since crisps do not require any energy during consumer storage or consumption, use phase emissions would be negligible.

Walkers and the Carbon Trust's findings confirmed the hypothesis that the majority of Walkers crisps footprint lay outside of its direct control, primarily in raw materials – potatoes, sunflowers and seasoning. This understanding has led to a series of initiatives with suppliers and distributors to identify the root causes of high emissions and opportunities to reduce them.

Chart 1 *Product carbon footprint: Walkers crisps*



Richard Evans, Chief Executive of Walkers says: "There is a great opportunity for us to work closely with our suppliers to encourage them to understand and reduce their carbon footprints, and to identify opportunities where we can work together to reduce our collective impact on the environment".

Walkers did not stop at its upstream partners – it also wanted to engage downstream as well, in particular with consumers directly. It felt the best way to reach consumers was to provide a label in order to:

- Clearly articulate the product's carbon footprint.
- Demonstrate credibility through the Carbon Trust's verification of the footprint.
- Make a public commitment to reduce emissions from the current footprint.

As a consequence, Walkers was the first product to display the Carbon Trust Carbon Reduction Label on pack in March 2007.

Achievements

Walkers has worked hard to identify ways to reduce its direct contribution to greenhouse gas emissions. The product carbon footprinting and labelling exercise resulted in further significant impact. Results particularly worth highlighting are:

- Energy use per kg crisps produced has fallen almost 33%, from 4.6 kWh/kg to 3.1 kWh/kg 2000-2007, achieved through improved shut-down and start-up processes, optimised lighting systems and a range of investments in new technologies.
- PepsiCo UK reduced its overall carbon intensity (CO_2e per kg of production) by 5.9% during 2007.

In addition to taking responsibility for emissions caused by its own production processes, Walkers is actively engaging with its supply chain partners to identify further emissions reduction opportunities. At the end of 2007 and again in 2008, Walkers brought together key suppliers of raw materials and packaging at a series of Supply Chain Summits. In these meetings, Walkers described the process of product carbon footprinting and why it considers it a priority to help reduce emissions across the supply chain.

The first meeting was primarily to raise awareness and ask for suppliers' help in conducting product-level footprints in more detail; the second was designed as a workshop where suppliers would report back on their more detailed data collection and analysis, and to set the stage for future brainstorming sessions on ways to reduce emissions.

These Supply Chain Summits demonstrate a key benefit of product carbon footprinting – developing a 'chain of custody' whereby every participant across the supply chain takes ownership of (1) calculating their part of the carbon footprint and (2) identifying opportunities to reduce emissions during their 'custody' of the product. In this case, one company's efforts have expanded into seven, as key suppliers joined the effort.

Greater collaboration drives further carbon benefits, as companies work together to brainstorm ways to minimise emissions both within their own activities and across the entire chain. In Walkers' experience, it helps to engage suppliers if you are a key customer and can leverage a strong relationship. Likewise, it provides an opportunity to improve relationships with suppliers by offering a vehicle to think of ways to improve operations and coordination across the supply chain.

Beyond suppliers, Walkers was able to engage consumers as well through trialling the Carbon Reduction Label (Chart 2). Consumer feedback has been positive, although it also highlights considerable opportunity to build awareness and education.

Initial research[2] suggests high awareness (~80%) and low cynicism of carbon labelling and the Carbon Reduction Label specifically. Consumers are positive and appear to be making use of the information as intended:

- 79% agree with the statement: "it makes me more aware of the environmental impact of the products and services I choose to buy".
- 71% agree that the Carbon Reduction Label: "helps me to reduce the carbon footprint of my regular shopping items".

Chart 2 *Walkers crisps Carbon Reduction Label*

Scores on both statements have increased ~10 percentage points between July 2007 and February 2008, implying consumer awareness is rising and attitudes towards the Label are increasingly positive.

In addition, consumers said the Carbon Reduction Label improved their perception of Walkers' brand: 44% of those surveyed say it makes them more positive towards Walkers as a company.

Steve John, Corporate Affairs Director at PepsiCo UK & Ireland, says of the consumer research: "At such an early stage we think these results are encouraging, and suggest that consumers are hungry for more robust information on the carbon impact of the products and services they buy. We believe consumers appreciate our public declarations of our commitment to reduce".

A summary of the consumer research results can be found at www.pepsico.co.uk/carbonlabel.

[2] Walkers commissioned customer research after launching the Carbon Reduction Label in July 2007 and again in February 2008 to test consumer reactions to it (Populus Concerned Consumers Survey July 2007; 1,063 adults aged 18+). The research contributed to the company's understanding of awareness, perception and impact of the Carbon Reduction Label on consumers, and to track changes over time.

Road ahead

Armed with the experience gained from footprinting and labelling Walkers crisps in the UK, the company is considering how its experiences could be applied to other product lines. PepsiCo is committed to broadening its strategic partnership with the Carbon Trust to extend product footprinting to additional product lines and countries.

In the UK, Quaker is now calculating its product carbon footprint, and will work towards adopting the Carbon Reduction Label. In addition, PepsiCo globally has commissioned research on product footprinting from Columbia University in the US and will participate in WRI/WBCSD's development of international supply chain carbon emissions standards, together with the Carbon Trust.

PepsiCo UK & Ireland has pledged to continue to reduce carbon emissions in its production activities through:

- Converting all energy used in direct operations to renewable sources within 15 years.
- Increasing total share of electricity from renewable sources from 8% to 14% within three years.
- Reducing energy use by a further 20% per kg production within three years.
- Using waste oil from Walkers as a fuel in its distribution fleet.
- Ensuring all manufacturing plants are ISO 14001 accredited by end-2008.

It has also incorporated sustainability criteria into capital expenditure decision making on investments over £2.5m, and it is exploring ways to introduce a sustainability lens into new product development and innovation processes.

During 2009, Walkers and PepsiCo will continue their supplier engagement activities, with the goal of setting shared carbon goals and targets. They will also invest in further research to help farmers reduce emissions through better agricultural and storage practices, including how to reduce soil erosion from potato farming and identifying varieties of potato that can grow using less water.

Key lessons

The Walkers case offers useful lessons for future carbon footprinting and labelling initiatives:

- Public commitment drives action:
  - Walkers has taken seriously its commitment to reduce its product footprint stating: "a public facing climate commitment forces business decisions to be focused through an environmental lens" as after all "nothing is more public than the front of your packet".
- Power of profile – choosing a key brand (Walkers), having a senior manager/CEO who is committed to the initiative and a public commitment all contribute to the momentum and focus necessary for a successful footprinting and labelling initiative by engaging employees, suppliers and customers and ensuring results materialise.
- Detailed, product-level carbon analysis helped identify new "hot spots" to reduce emissions across the supply chain.
- Chain-of-custody model helps to achieve high-impact emissions reductions:
  - Understanding that only 30% of its products carbon footprint comes from its own manufacturing processes, Walkers focused its efforts where it could have the greatest impact – on working with suppliers to reduce emissions across the supply chain.
  - An open, participative approach – including sharing information, leading by example and encouraging other businesses to engage in carbon reduction – is critical to achieving collaboration, but it requires considerable trust between supply chain partners.
- Consumers "get it":
  - Early reactions to the Carbon Reduction Label are positive and driving the right behaviours: consumers feel better able to make informed buying decisions armed with credible carbon information.

- Carbon management can contribute to better business decisions:
  - For the first time business decisions, such as capital investments, are being judged through a 'carbon lens' and other sustainability criteria.
  - Projected carbon impacts of different changes/ investments are being used as an important step towards overall 'carbon governance'. Walkers is measuring the net impact of a number of business decisions on the product footprint – to ensure the overall trend is downwards over time.

Finally, as the first pilot partner Walkers has had considerable impact on the development of the footprinting method and the evolution of the Carbon Trust Carbon Reduction Label.

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CTS058

Case Study CTS055

Working with Tesco

Product carbon footprinting in practice

Tesco represents the largest test of the BSI PAS 2050[1] draft product carbon footprinting method and the Carbon Trust Carbon Reduction Label. Set in the context of the commitment from Tesco's CEO to find a "universally accepted and commonly understood measure of the carbon footprint of every product we sell", this case outlines the benefits of conducting footprinting projects across multiple products in multiple categories to maximise learning and consumer education opportunities.

[1] BSI Publicly Available Specification (PAS) 2050 is based on the product carbon footprinting method originally developed by the Carbon Trust and trialled with Walkers, Boots and innocent. The Carbon Trust later co-sponsored, along with the UK Department for Environment, Food and Rural Affairs (Defra), the development of PAS 2050 by BSI British Standards.

Company background

Tesco plc is the third largest grocery retailer in the world. It employs over 440,000 people in 13 markets – 280,000 of those in the UK. Over 30 million people shop with Tesco worldwide every week.

In 2006, Tesco launched its 'Community Plan' in the UK, before rolling it out to its other markets. Sir Terry Leahy, Tesco's CEO describes this as 'our plan to put social and environmental issues at the heart of our business[2].'

The Tesco Community Plan discusses a wide range of corporate and social responsibility areas. It identifies three strategic priorities for tackling climate change:

- Setting an example by measuring and reducing Tesco's own direct carbon footprint.
- Using 'resources and relationships to work with others to achieve a low carbon economy of the future'.
- 'Empowering customers to make environmental choices…by providing the information on which to make an informed choice'.

In January 2007, Tesco announced it would measure and publish its direct carbon footprint. Tesco worked with environmental consultant ERM to map the total carbon footprint of its business worldwide. Tesco used the knowledge gained from this study to prioritise areas in which to concentrate efforts to achieve carbon emissions reduction and as a mechanism to track progress. Tesco published the results of this survey on its website.

The product carbon footprinting and labelling project described in this case study builds upon the knowledge and data gained in the organisational carbon footprint work, but it goes further to cover Tesco's second and third strategic priorities laid out above. The project helped Tesco understand the emissions associated with the full life cycle of selected products – allowing the identification of wider emission reduction opportunities and empowering consumers to make environmental choices.

Product carbon footprinting and labelling pilot: motivation

As part of the development of its Community Plan, Tesco asked consumers about their attitudes to climate change. It found that many consumers wanted to do more to mitigate climate change but there were a number of barriers which prevented them from doing so. These can be split into three main types:

1. They lacked the basic information and understanding to know which products to buy and how to use them.
2. They wanted to be sure that any small changes they made individually were part of a larger movement by consumers and businesses to cut emissions.
3. They wanted assurance that a switch to low-carbon consumption would not be prohibitively expensive for them to make.

In response to this, Tesco launched a broad initiative in January 2007 to empower consumer decision making by measuring and providing carbon information on everything Tesco sells. In his launch speech, Sir Terry Leahy laid out a vision for green consumerism: "We [as a society] will not tackle the challenge of climate change by enlisting only the few. The green movement must become a mass movement in green consumption. For this to happen we must break down the barriers of information and price. Customers need good information to make the right choices and they need to be able to afford to make these choices".

As part of the effort to provide this information Sir Terry Leahy announced that Tesco would be starting the quest for:

"A **universally accepted and commonly understood measure** of the carbon footprint of every product we sell – looking at its complete life cycle from production, through distribution to consumption" and

"A **clear system of labelling** so that in future customers will be able to compare a product's carbon footprint just as easily as they can currently compare its price or nutritional value"[3].

To start to make this far-reaching objective a reality, Tesco agreed to work with the Carbon Trust to assess the product carbon footprint of 20 products in late 2007. This was the largest test of the product carbon footprinting method at the time, covering products across four categories:

- Potatoes.
- Light bulbs.
- Laundry detergents.
- Orange juice.

[2] http://www.tescoreports.com/crreview08/cr-bus.html

[3] Speech by Sir Terry Leahy given to invited stakeholders at a joint Forum for the Future and Tesco event in central London on January 18th 2007.

The products were carefully selected to challenge assumptions and answer questions to inform the development of the PAS 2050 method. Specifically:

- Light bulbs – how to treat the 'use phase' of a product in which the majority of emissions comes from energy consumed during product use.
- Orange juice – how to treat seasonality in supply chains together with the impact of concentration and temperature on the finished product footprint.
- Potatoes – study products from multiple suppliers with different emissions depending on how they are cooked.
- All – look at both food and non-food supply chains.

In addition, Tesco wanted to compare footprints across similar products within a category.

Supply chain analysis and footprint calculations

Tesco invested heavily in supporting suppliers through the footprinting process. To make the process easier, it developed a template and offered one-to-one support for suppliers throughout the data collection and footprint assessment. They used supplier workshops to engage suppliers in the goals of the footprinting exercise and in interpreting the results.

Complex supply chains proved more challenging in the data collection phase, as multiple ingredients and multiple suppliers – including overseas suppliers – made data collection more complex and labour-intensive. The main difficulty was the language barrier with some suppliers.

Tesco chose to use ERM as consultants to conduct the product carbon footprint analyses, and the Carbon Trust certified conformity of the assessments against the draft PAS 2050.

Laundry detergent example

The laundry detergent example demonstrates the ability of product carbon footprinting to uncover interesting insights. Tesco found that concentrated liquid detergent had a smaller carbon footprint (600g CO_2e per wash) than washing powder or tablets (750g and 850g CO_2e per wash respectively) based largely on the manufacturing stage in the life cycle. Concentrated detergents use less of some ingredients and less packaging; this gives them a smaller footprint than their diluted equivalent. Ingredient choice also makes a difference: the materials used in concentrated liquid detergent are less carbon intensive than those used in tablets or powder.

Chart 1 shows the process map for a detergent. Chart 2 shows the life cycle emissions of different kinds of detergent.

Chart 1 *Process map washing detergent*

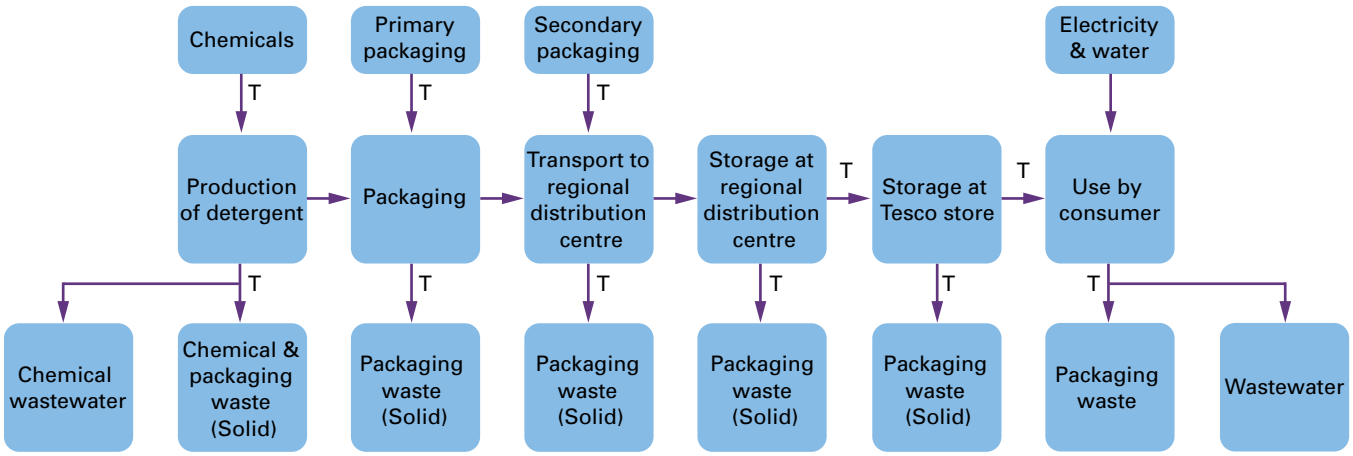
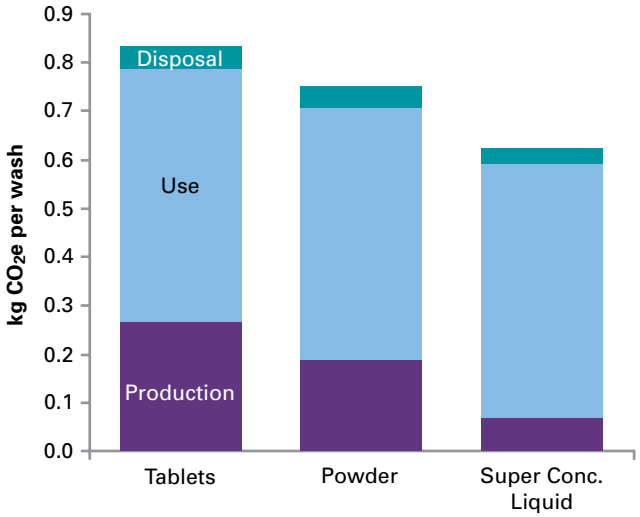


Chart 2 *Product carbon footprints of different detergent types*



However, the vast majority of carbon emissions of laundry detergent arises from the electricity and water consumed during the use phase (495g CO_2e per wash, which is more than 80% of the footprint for Super Concentrated Liquid Detergent). This finding drove Tesco to two actions:

- Educate consumers on their role, i.e. measure and advertise the impact of washing at 30°C and line drying.
- Work with suppliers to ensure all detergents can be used effectively at 30°C.

Informing consumers to make decisions was the primary motivation behind Tesco's decision to start the product footprint journey. Therefore, Tesco's plans involved testing a consumer-facing label from the beginning.

Use of the Carbon Reduction Label

In April 2008, Tesco began a trial of the new Carbon Reduction Label across the four product categories it footprinted. The Carbon Reduction Labels were used on-pack (Charts 3 and 5), at point of sale and in a supporting leaflet (Chart 4) in order to maximise the opportunity to inform and educate consumers. Because all the products being labelled were Tesco's own-brand, this allowed quicker packaging changes and thus Tesco could introduce the labels relatively quickly.

Tesco's wish to educate consumers and influence their behaviour was paramount to the evolution of the Carbon Reduction Label from its original design. This evolution was guided by consumer market research from the Carbon Trust, Tesco, PepsiCo and others.

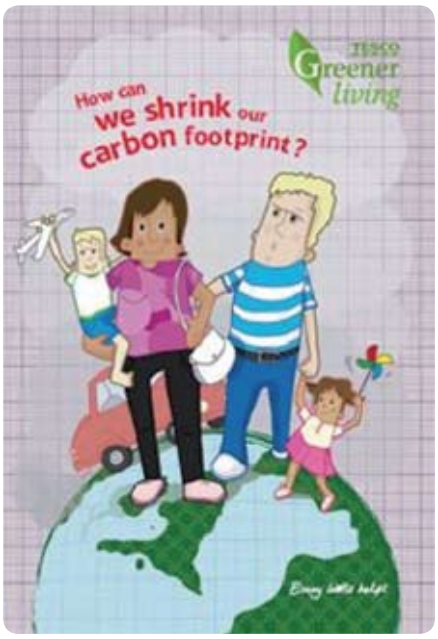
In addition to displaying the product carbon footprint, commitment to reduce that footprint and stating that Tesco is 'Working with the Carbon Trust', the updated Carbon Reduction Label that Tesco displays also shows:

- An explanation of what a product 'carbon footprint' is: "*The total carbon dioxide (CO_2) and other greenhouse gases emitted during [the product's] life, including production, use and disposal*".
- Carbon comparisons to other relevant products footprinted using the same PAS 2050 method and assumptions (for example, Tesco Non Biological Tablets have a footprint of 850g per wash. The Label states: "By comparison, the footprint of Tesco non-biological washing powder is 750g per wash").
- Suggestions for consumers about how they can lower the footprint further during the use phase (for example, "Help to reduce this footprint. Washing at 30°C rather than 40°C saves 160g CO_2 per wash").

Chart 3 *Carbon Reduction Label used on Tesco detergents*

The on-pack Carbon Reduction Label was supported with point-of-sale label displays and the publication of a customer leaflet titled '*How can we shrink our carbon footprint?*' (Chart 4) which was mailed to over 100,000 homes and is available in most large Tesco stores.

Chart 4 *Tesco's consumer leaflet describing product carbon footprints*



At the time of the trial's announcement Tesco's CEO said:

"We are delighted to be taking this major step with the Carbon Trust. We want to give our customers the power to make informed green choices for their weekly shop, and enlist their help in working towards a revolution in green consumption. We encourage all our suppliers and competitors to support the Carbon Trust in this collaboration".

Achievements

By footprinting and labelling multiple products across four categories, Tesco maximised its opportunity to learn. Key findings include:

- How food is cooked can have a significant impact on its carbon footprint, as we discovered with potatoes. Consumers can reduce this by microwaving or boiling on the stove rather than oven cooking. For example, the carbon footprint of oven baking King Edward potatoes is more than 3.5 times greater than boiling or microwaving them.
- As conventional wisdom suggested, energy-saving light bulbs produce more carbon emissions during manufacturing than conventional light bulbs; however, this is more than offset by the energy efficiency they provide during the use phase – an example of the 'carbon myth'-busting enabled by product carbon footprinting.
  - Use phase accounts for ~99% of the life cycle carbon emissions of a light bulb, so high-impact reduction efforts would focus on increasing the energy efficiency of this phase, such as designing better low-energy bulbs and boosting their sales through consumer education and promotions.
- Raw material production is the primary driver of orange juice carbon emissions, driven by inorganic fertilisers used by the supplier. Shipping the oranges from Brazil actually caused much lower emissions than expected.
- Concentrated orange juice has a lower carbon footprint than pure squeezed juice, due to lower volumes needing to be shipped and reduced need for energy to refrigerate during transport and retail.

Chart 5 *Carbon Reduction Label used on Tesco orange juice*

Tesco is working hard to share these findings both with consumers – to help them make more informed purchase and use decisions – and suppliers in order to drive emissions reductions across the supply chain.

In addition, by working with a broad and challenging set of everyday product categories, Tesco put the product carbon footprinting method through a significant test.

Findings helped inform the evolution of the PAS 2050 method in key areas, such as product definitions, the need for standardisation in the use phase calculations and how to calculate emissions for a raw material produced by multiple suppliers.

Tesco's suppliers are already rolling out emissions reduction measures. For instance, its potato suppliers are introducing the following:

- More efficient refrigeration equipment, reducing both energy consumption and direct gas emissions.
- More targeted application of agricultural inputs such as fertilisers and pesticides, contributing both to lower input costs for farmers as well as reduced GHG emissions.
- Extending natural potato dormancy, thereby reducing the need for cold storage.

In addition, Tesco's suppliers have identified ways that Tesco can help them reduce emissions further, through measures such as better network planning to improve vehicle utilisation for deliveries. These results show the benefits of collaboration across the supply chain and conducting a thorough analysis of supply chain efficiency.

Road ahead

Tesco is committed to extending its trial of the product carbon footprinting method and Carbon Reduction Label on more products.

The immediate next steps for Tesco are to understand the consumer impact of the 20 products labelled so far and to footprint and label a further set of Tesco products. The key questions Tesco will address in its consumer research are:

- Has consumer understanding of product carbon footprinting and Labels increased?
- What impact does the Label have on actual consumer behaviour?

The next stage in the trial will likely include the full range of products in the categories already analysed.

Tesco would also like to test the methodology on new categories:

- Complex products with multiple raw materials.
- Complex supply chains with multiple different factories.

The goal of this phase of the trial is to better understand what it will take to footprint and label all of their products, as a first step towards developing a comprehensive strategy, including the best ways to reduce emissions over time. Armed with a greater understanding of consumer reactions – and the need for additional education – along with experience footprinting and labelling additional products, Tesco will develop a blueprint for roll-out across more product categories.

At the same time, Tesco will continue to work with suppliers to reduce emissions across the supply chain.

Key lessons

As the first pilot company to test the product carbon footprinting method and Carbon Reduction Label at scale, Tesco offers several important lessons:

- Cost of carbon footprinting declines with scale and experience – suppliers typically need help when they are contributing to a footprint assessment for the first time.
- Product carbon footprinting multiple products across categories provides greater insight to carbon reduction opportunities:
  - Comparisons also allow supply chain partners to identify new carbon saving opportunities that would not be otherwise obvious.
- Retailers have a unique opportunity to educate consumers and empower them to make more informed decisions by supporting on-pack labelling and point-of-sale information.
- 'Conventional wisdom' about carbon emissions should be tested using real data, and in many cases it can be disproved. The Tesco experience demonstrates how product carbon footprinting can help shed light on urban myths such as energy-efficient light bulbs having a higher carbon footprint than conventional bulbs.
- The power of a public commitment from senior management – for example, the announcement from Tesco's CEO helped galvanise support for the initiative both within the company and among its suppliers, who are critical to the footprinting process.

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Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

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