CARBON ASSESSMENT OF TICKETING DELIVERY SYSTEMS

Mr Samuel Chapman
—Environmental Consultant

Telephone
—+44 (0)131 538 5528
—+44 (0)778 459 4651
Email
—info@en-count.co.uk
—samuelchapman@en-count.co.uk

www.en-count.co.uk

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En-Count is a sustainability consultancy based in Edinburgh, UK specialising in life cycle assessments. En-Count offers impartial carbon and life cycle impacts of products and services.

<u>Client</u>

WeGotTickets
Unit 13 Kings Meadow
Ferry Hinksey Road
Oxford
OX2 0DP

Executive Summary

This study conducts a comparative life cycle carbon audit to examine the environmental burdens of ticketing options. The audit is beneficial as it adopts a holistic perspective that contributes to understanding relationships between service relationships and exposes significant burdens in individual ticketing options. This is particularly valuable for evolving digital delivery systems whose environmental loads are currently not well known.

For comparison, each activity involved in the ticketing life cycle – from ticket printing and email creation to delivery and processing – are modelled. The basis for this assessment is:

- One order (or “ticket order”) processed;
- Digital system elements such as the servers and workstations are modelled; and
- Paper production and delivery for traditional ticketing options are examined.

This study compares and quantifies environmental performance of each activity with a focus on Greenhouse Gas (GHG) emissions.

It is concluded that energy and GHG burdens of digital ticket delivery, such as WeGotTicket’s standard model which is used in this study, are significantly lower than traditional ticket delivery systems. The study endorses WeGotTicket’s solution as an environmentally friendly option; it avoids paper consumption, physical delivery and handling of tickets.

“For every ticket order sold, WeGotTickets has 1070 times less environmental impact in relation to Greenhouse Gas emissions than the equivalent concert ticket order from a traditional ticketing delivery system.”

or

“The WeGotTickets approach to ticket delivery can fill a venue 1070 times before having the same environmental impact as one single show in the traditional framework.”

1. Introduction

Advances in digital technology and the growth of information networks are allowing organisations to move into the digital world. More and more processes are going online to streamline the process; saving time and money. Another major factor is the environmental impact of these outsourced online systems and whether or not they are helping the environment. The obvious answer would be yes, since paper use and delivery services are reduced. This study can now confirm this through assessing the GHG emissions related to the various ticketing options. This life cycle carbon audit takes into consideration all the elements involved in an outsourced traditional ticket printing and delivery system, in emailing the ticket for personal printing and in the WeGotTickets method of an email only.
The client has asked for a carbon audit with particular focus on the carbon cost of three ticketing options currently deployed by ticketing companies:

a. Printing and postage of paper tickets (traditional approach)
b. Print at home tickets delivered via email (email and print approach)
c. Tickets delivered by email that require no printing (WeGotTickets approach)

The three ticketing options will be further explained in section 4, Goal Definition and Scope.

The client has provided details on typical resource use for paper tickets, as well as extensive information on current ticket orders and mailings for their business.

Computing and server detail has also been provided which includes server life span and utilisation time. This information is required to conduct an environmental impact assessment of the digital delivery of tickets.

2. Method

This study will take the approach commonly used by industry professionals for analysis of the environmental impacts of products and services. This is called Life Cycle Assessment (LCA) and is described by the International Standard Organisation's (ISO) framework 14040 [1]. ISO 14040 is a tool which systematically quantifies environmental aspects such as energy and material consumption, greenhouse gases etc. This study will focus on GHG emissions.

ISO 14040 describes the principles and framework for LCA. This standard defines three major components of an LCA:

- Goal definition and scope: According to ISO 14040 the goal definition should be stated clearly and consistent with the intended application of the study.
- Inventory Analysis: This means to build a system model according to the requirement of the goal and scope definition. It consists of process flow of activities and products, data collection of raw materials, energy use and waste; and calculation of energy/resource use and pollutant emission of the system in relation to the functional unit.
- Impact assessment: It aims to describe the inventory results as environmentally relevant information, e.g. Global Warming Potential (GWP) impact associated with paper production.

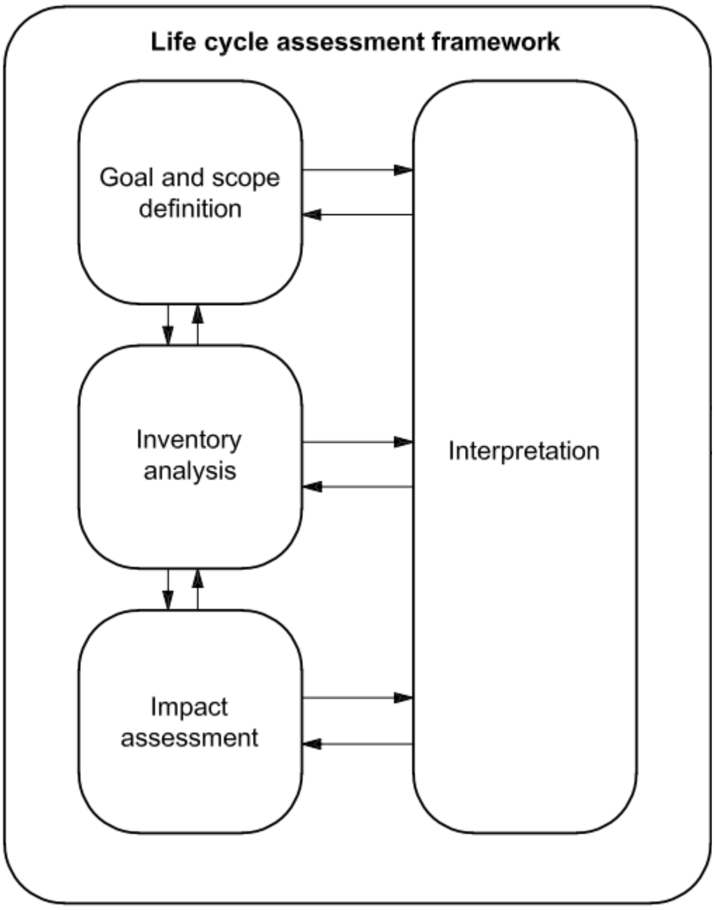

Figure 1: Stages of an LCA

3. Goal Definition and Scope

Goal definition and scope is the first step of an LCA study as it describes the intention and framework of the study. It includes purpose of study, unit of analysis (Functional Unit) and system boundaries.

4.1. Purpose of Study

This study will provide a comparison between three ticketing options currently used in the industry relating to their environmental burdens. Firstly, it is important to quantify the environmental burdens of each method in order to find the option with lowest burden while secondly, to explore opportunities to create more sustainable ticketing systems in general for the sector.

4.2. System Boundaries

In this study, three ticketing options are modelled using a life cycle approach, similarly to the ISO 14040 LCA methodology, to compare their environmental impacts, particularly to understand what the GHG emissions of these systems are.

WeGotTickets has provided detail on their business activities over 12 months, which provides the basis for this study. This equates to approximately 60,200 tickets and sending out mailings of 28,000 mailings per month. This is equivalent to 2.15 tickets per order. This is important for providing a comparable functional unit of one order (a.k.a. one ticket order).

4.2.1. Traditional Approach

The traditional ticketing approach models the process by which orders have been handled as standard for many years. While there is some variation in practice, paper and approach, the main processes for this study are outlined here. This is the most complex approach modelled in this study.

In this approach, ticket production is modelled. This includes pulp production and distribution. Secondly, paper production is modelled relating to paper invoice included with order. This includes pulp production and distribution as per ticket production. Finally, envelope production is modelled, containing similar processes. Also included is email confirmation, which is now considered standard in the sector. This process appears in all three approaches.

Distribution in the form of delivery to the customer is modelled next in order to consider.

The final life cycle process in an order's life is the disposal of the ticket, paper and envelope. Average UK figures for the disposal of paper are assumed per order.

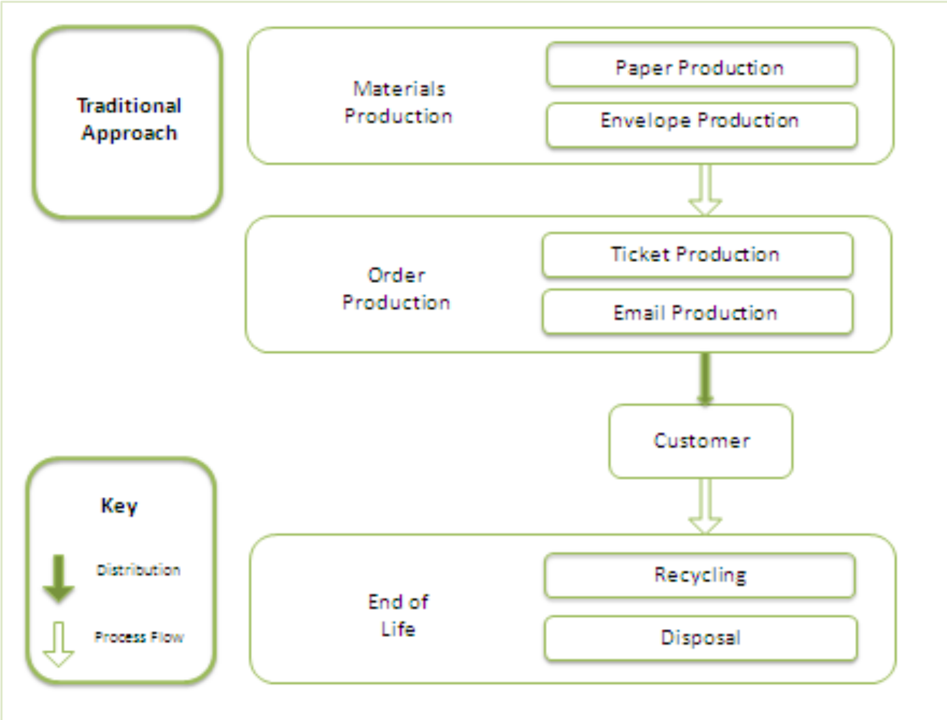

Figure 2: Traditional Process Flow Diagram

4.2.2. Email and Print Approach

This second approach models the process more commonly used in a variety of sectors for order delivery. This consists of the customer receiving an email that they are required to print in order to complete their order at the event destination. This is included in the study in order to highlight customer influence due to their obligation to use paper at home. While it is difficult to specify printer use for private individuals, some average data can be utilised for the sake of this study.

Disposal of the printed order is also modelled in this section, again assuming UK average data for paper recycling.

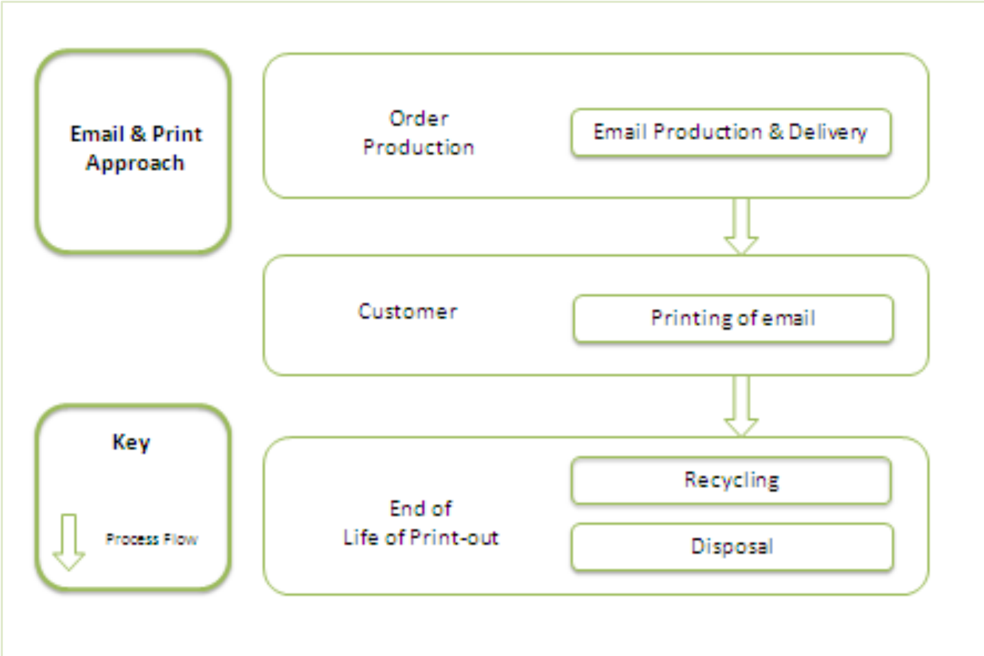

Figure 3: Email and Print Process Flow Diagram

4.2.3. WeGotTickets Approach

The final approach models the method currently adopted by WeGotTickets for delivering their orders to customers. This entails an email only and no requirement to print the order. Indeed, this is discouraged in the name of reducing resource use. The approach requires the same inputs as the previous approach in terms of emailing the order to the customer and will be modelled equally.

The delivery of an email confirmation utilises server and computer use by WeGotTickets assets only.

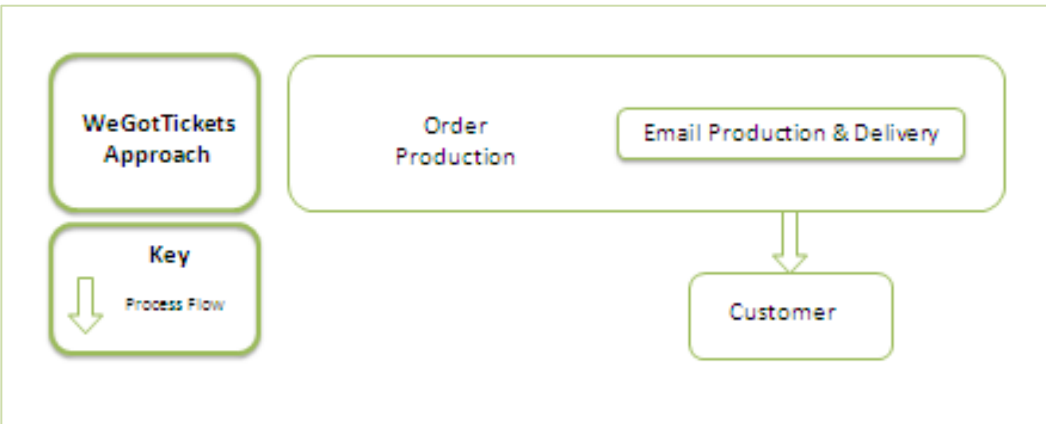

Figure 4: WeGotTickets Process flow diagram

4.2.4. Life Cycle Stages

This study presents the findings of a life cycle GHG study of the three approaches to ticket order delivery, as described above. Life cycle methodology follows a product or service from its “cradle” where raw materials are extracted through production and use to its end of life, “grave”. A typical LCA model consists of raw material acquisition, material processing, transportation, manufacturing, use and waste management. Figure 1 represents a typical LCA model, as shown in Section 2.

4.3. Functional Unit

Life cycle studies are based on a function unit (FnU) of analysis, meaning that a system’s impact is measured according to some aspect of its functionality in order to establish a legitimate and fair comparison between these systems; it is helpful to define the functional unit.

The environmental impacts of traditional approach, email and print approach and WeGotTickets approach to ticketing delivery systems are measured according to their functionality. In essence, these systems deliver orders of tickets to the customer.

The functional unit of this study will be defined as per one order delivered to the customer and the outcomes will be normalised with respect to one order. According to the client’s provided detail, this equates to 2.15 tickets per order, based on 12 months of business activity. The following table summarises the functional unit in relation to other parameters common in this study.

Order	FnU
Ticket	2.15
Email	1
Paper	1 x A4
Envelope	1

Table 1: Functional Unit parameters

4. Life Cycle Analysis

To make an inventory analysis means to construct a flow model of mass and energy balance. Life Cycle Inventories mainly include activities such as construction of flow chart, data collection and calculation of environmental burdens in relation to the functional unit – one order from the client in this instance.

In the previous section, Goal and Scope Definition, the boundaries are defined and also a general flow chart of activities is developed for each system. In this section, each activity is studied in more detail and depending on the significance of upstream and downstream burdens, the environmental loads are taken into consideration.

Data collection is one of the most important and time consuming activities in life cycle studies. To collect the required data, it is preferable to use data that are accessible and measurable directly from the client and are specific for the area of sales. Otherwise, the data will be collected from literature resources, LCA software packages, such as Simapro, and other secondary data. For instance, the energy requirement for computer production and disposal may be taken from the Europe in general. The Greenhouse Gas (GHG) emission or the global warming impact (expressed as CO2-equivalent) associated with electricity production reflects the UK's grid (1 kWh of electricity produces 0.525kgCO2e). This figure is taken from 2011 Defra GHG Reporting Guidelines [2].

For each activity, calculation of environmental loads is normalised with respect to the functional unit. Obviously, this study is subject to limitations and as the calculation is conducted, assumptions and idealisations are made.

4.1. Traditional Approach

The traditional approach represents a typical order delivery system for a ticketing agency if they were printing and supplying paper tickets to their customers. In this section, model elements associated with the traditional approach are described. This refers to figure 2.

4.1.1. Paper Production

Paper is the major material required in the three key processes that make up this approach. Inputs to this include tree pulp, electricity and transport. The key processes are:

- Ticket Production – detail from the client has led to an average of 2.15 tickets per order. A large variation in size and paper weight means that assumptions must be made for the base case of ticket production. A range can also be considered as shown below. The base case will be taken as standard.

Ticket	Size (mm)	Weight (gsm)
Minimum	143 x 50	200
Base case	165 x 85	250
Maximum	165 x 85	300

Table 2: Base case scenario

- Paper production – it is assumed that order details are provided per order on a sheet of A4 paper. Dimensions of A4 paper are 210 x 297 mm with a typical density of 80gsm.

- Envelope production – each order is delivered within an envelope. While variations are present in envelope size, a standard small envelope (110 x 220mm) is chosen for this study in order to be conservative and is considered most likely for a ticket order. A difference in seals and styles also exists in envelope choice; therefore this study will assume a wallet style, peal and seal envelope as shown below. Density of the paper used to produce the envelope is assumed to be 100 gsm.

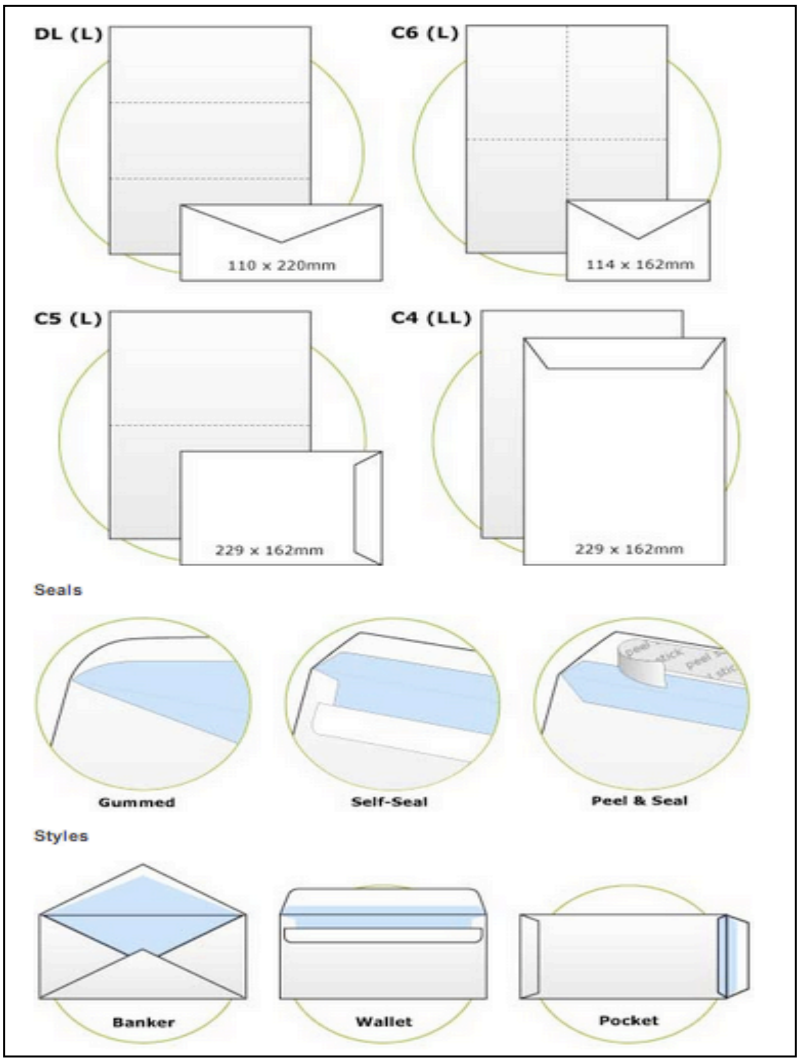

Figure 5: Typical Envelope Variations

Paper production involves different processes that have significant environmental impacts. These are harvesting, pulping, bleaching, refining, sheet forming, coating, cutting and packaging. There are many paper production facilities in Europe and they are usually use different resources and processes, which make it difficult to find unified life cycle data for paper production. In this study, the GHG emissions data reported by Ecoinvent database. This includes all aspects of the lifecycle, including de-inking and waste processing and recycling.

The lifecycle GHG burden of paper, ticket and envelope production is taken from the Ecoinvent database as above.

Firstly, the paper weight must be determined for one ticket order (2.15 tickets) based on the dimensions provided above.

Ticket order weight (g) = $2.15 \times 165 \times 85$ (mm^2) $\times$ 250 (g/m^2) $\times 10^{-6}$ (m^2/mm^2)

Ticket order weight (g) = 7.54

Secondly, the paper weight must be determined for one ticket order (one A4 print-out).

Paper weight (g) = 210×297 (A4) (mm^2) $\times$ 80 (g/m^2) $\times 10^{-6}$ (m^2/mm^2)

Paper weight (g) = 4.99

Finally, the paper weight must be determined for one ticket order (one wallet style, peel and seal envelope) based on the dimensions provided above. It is assumed that the total area of paper used is equal to twice the dimensions of the envelope. This study acknowledges that this does not consider the small extra amount of paper forming the overlapping seal, nor does it include the adhesive, therefore this assessment can be considered conservative.

Envelope weight (g) = $2 \times 110 \times 220$ (mm^2) $\times$ 100 (g/m^2) $\times 10^{-6}$ (m^2/mm^2)

Envelope weight (g) = 4.84

The GHG emission associated to each functional unit (FnU - one order) is calculated as follows:

GHG ($kgCO_2e$/FnU) = GHG Intensity ($kgCO_2e$/kg paper) x paper weight (kg)

Therefore:

$$GHG = 0.369 \times [(7.54 + 4.99 + 4.84) \times 10^{-3}] = 0.0064\ kgCO_2e/order$$

4.1.2. Delivery

Delivery of an order considers the transport of the order from the client to the customer through standard mail delivery services in the UK. This is clearly the most variable factor in this study since two different orders could have hugely varying transportation characteristics. As a result, an average delivery distance of 80km is assumed, on agreement with the client. In this study, it has not been possible to gain an average figure for the client's average order delivery distance at present. It should also be noted that the lifecycle of the delivery vehicle is considered out with the scope of this study.

In this study, it is assumed ticket orders are transported by light commercial vehicles for delivery. (Table 7b, Diesel (average), Annex 7, Defra reporting guidelines [2]. GHG Intensity = 0.252 $kgCO_2e$/km. This figure accounts for a laden weight of 460kg, therefore only a small proportion is attributed to the order weight.

Order GHG Intensity = order weight / laden weight x GHG intensity of vehicle

Order GHG Intensity = $17.37 \times 10^{-3} / 460 \times 0.252 = 9.52 \times 10^{-6}$ $kgCO_2e/km$

Order GHG ($kgCO_2e$) = Order GHG Intensity ($kgCO_2e/km$) x distance (km)

Order GHG = $9.52 \times 10^{-6} \times 80 = 0.00076$ $kgCO_2e$/order

4.1.3. Email Production

While the traditional approach models ticket delivery activities, it is important to remember that email confirmations are standard practice for ticketing agencies hence they should be included in a life cycle study such as this. In this approach, however, it is assumed that this email is not printed by the customer since they also receive this detail as hard copy. It is also assumed that the email confirmation is generated automatically and so does not require individual computing, as per the WeGotTickets Approach.

4.1.4. Server

Typically, email confirmations at WeGotTickets are created using servers. Servers have environmental impacts during their upstream (material acquisition and manufacturing), use and downstream (disposal). This method has been adapted from a report into digital invoice creation [3].

Information provided by the client shows that one ticket order takes 0.1895 seconds, based on server utilisation times.

Electricity Consumption to produce one order is calculated as:

Total Operating Electricity = 'Active' electricity + 'Overhead' electricity

Where,
'Active' Electricity (kWh/FnU) = Total Power (kW) x Working time per order (hour/FnU)

'Active' Electricity (kWh/FnU) = 0.2 x (0.1895/3600) = 0.000011 kWh/order

Overhead Electricity: Servers are continuously on but based on information provided by the client, there power output ranges from 100 – 200W at any time depending on load. Therefore, an assumption is made that the servers run at 200W except for 6 hours a day, relating to overnight periods where little or no orders may occur and it is out with office hours. This is summarised below.

Operating mode	Hours/Day	Power Output (W)
Full load	18	200
Low Load	6	100
Off	0	n/a

Table 3: Server Utilisation Detail

It can be seen that total overhead (low load) electricity consumption is:

Overhead Electricity (kWh/day) = Low Load (kW) x Load Hours (hours/day)

Overhead Electricity = 0.1 x 6 = 0.6 kWh/day

Therefore, per order:

Overhead Electricity (kWh/FnU) = Overhead Electricity (kWh/day) x [working time to produce one order (hours/FnU) / Full load (hours/day)]

Overhead Electricity = 0.6 x (0.0000526/18) = 0.0000018 kWh/order

Adding the electricity consumption of servers in use:

Total Operating Electricity = 0.000013 kWh/order

The only type of energy that is consumed for operation of digital equipment is electricity. According to the 2011 Guidelines for company reporting, the UK GHG intensity factor is 0.525kgCO_2e/kWh [2].

GHG (kgCO_2e/FnU) = Electricity (kWh/FnU) x 0.525 (kgCO_2e/kWh)

GHG = 0.000013 x 0.525 = 0.0000067 kgCO_2e/order
0.0067 gCO_2e/order

Upstream

An allocation must be made for the embodied carbon that exists in the servers used in generating one order. While it is difficult to use specific data for the servers used by the client, details for the lifecycle of a desktop computer without a screen have been taken from the Ecoinvent database and scaled proportionally to the power ratings of the server and computer. It is judged desktop computers also typical run at 100W. Therefore this step is not required. A server is a powerful computer with large amounts of storage capacity. A server is also considered to be permanently on i.e. 24 hours/day.

The GHG emissions are allocated to producing one ticket order using a time-based allocation factor. Assuming a 3-year equipment design life, total activity time for a server is:

Total activity time (hours) = 24 (hours/day) x 365 (days/year) x 3 (years) = 26,280 hours

Therefore, the FnU allocation factor is:

Allocation Factor = working time to produce one order (hours) / 26,280 (hours)

Allocation factor = $(5.26 \times 10^{-5}) / 26{,}280 = 2.0 \times 10^{-9}$

Applying this factor to server production GHG emissions provides server production burden for one ticket order (FnU):

From the Ecoinvent Database v2.2, the production of one desktop computer emits 7.54kgCO_2e.

Production GHG Emissions (kgCO_2e/FnU) = 7.54kgCO_2e/computer x allocation factor

Production GHG Emissions = 1.51×10^{-8} kgCO_2e/order

Downstream

Disposal GHG emissions are calculated using the allocation factor above. Data for the disposal of a desktop computer is from the Ecoinvent database v2.2 and refers to the manual dismantling and mechanical disposal of a desktop computer in typical European conditions (0.00169kgCO_2e). This is considered appropriate in the absence of specific data.

Disposal GHG Emissions (kgCO_2e/FnU) = 0.00169 (kgCO_2e/computer) x allocation factor

Disposal GHG Emissions = 3.38×10^{-12} kgCO_2e/order

Total

Total GHG emissions per ticket order (kgCO_2e/FnU) = Server Use + Server Production + Server Disposal

Total GHG = 0.00000672 kgCO_2e/order

0.0067 gCO_2e/order

4.2. Email and Print Approach

The email and print approach represents a typical order delivery system for a ticketing agency if they email orders to their customers who are required to print them prior to the event. In this section, model elements associated with the email and print approach are described. This refers to figure 3.

4.2.1. Email Production

The email production is considered in Section 5.1.3.

Total

Total GHG emissions per ticket order (kgCO_2e/FnU) = Server Use + Server Production + Server Disposal

Total GHG = 0.00000672 kgCO_2e/order

0.0067 gCO_2e/order

4.2.2. Print by Customer

The email procedure provides the customer with the information required to enter the event concerned. Difficulty lies in specifying exact number of A4 sheets that the typical customer will print off per order. While many customers will be conscious of printing only detail they require, it is not uncommon to simply print an email without constraining information to one A4 sheet for example. Information from the client confirms that on default print settings, a ticket order email utilises 2 A4 sheets. However, it is only a small amount of text on the second sheet. This, combined with the likelihood that some customers will fit their prints to one sheet of A4, results in this study assuming 1.5 sheets of A4 per order in this scenario.

Paper production involves different processes that have significant environmental impacts. In this study, the GHG emissions data reported by Ecoinvent database. This includes all aspects of the lifecycle, including de-inking and waste processing and recycling. This is the same procedure as Section 5.1.1 for paper production.

The paper's weight is determined for one ticket order (1.5 x A4 print-out).

Paper weight (g) = 1.5 x 210 x 297 (A4) (mm^2) x 80 (g/m^2) x 10^{-6} (m^2/mm^2)

Paper weight (g) = 7.49

The GHG emission associated to each functional unit (FnU - one order) is calculated as follows:

GHG ($kgCO_2e$/FnU) = GHG Intensity ($kgCO_2e$/kg paper) x paper weight (kg)

Therefore:

Ticket GHG = 0.369 x (7.49 x 10^{-3}) = 0.00276 $kgCO_2e$/order
2.76 gCO_2e/order

4.3. WeGotTickets Approach

The WeGotTickets approach represents a typical order delivery system for a ticketing agency if ticket orders are emailed to their customers who are not required to print them prior to the event. In this section, model elements associated with the WeGotTickets approach are described. This refers to figure 4.

The email production is considered in Section 5.1.3 above.

Total

Total GHG emissions per ticket order ($kgCO_2e$/FnU) = Server Use + Server Production + Server Disposal

Total GHG = 0.00000672 $kgCO_2e$/order
0.0067 gCO_2e/order

5. Assumptions

In order to be transparent about results, the following list outlines assumptions that have been made in the process of this study.

Paper weight for a ticket has been assumed to be 250gsm based on information provided by the client.

Paper weight for domestic printing has been assumed at 80gsm, the most common printer paper available in the UK.

Distance per order has been assumed, based on ticket order details provided by WeGotTickets.

GHG Emission intensity for paper has been assumed to be equivalent to Ecoinvent's (v2.2) process, paper production with deinking and recycling. This is used in order to capture some of the characteristics of printed tickets and paper as well as considering some waste prevention scenario such as recycling, common in Europe and the UK.

6. Impact Results and Analysis

The following section presents the results of the GHG emission assessments of the three ticketing approaches outlined in Section 5. It is important to state that these results are representative of the model of a typical ticketing agency conducting three different procedures for delivering ticket orders to their customers. Results show the associated environmental impacts of each approach in relation to total GHG emissions.

4.1. Traditional Approach

The following section presents the results of the GHG emission assessment of a typical order delivery system for a ticketing agency if they were printing and supplying paper tickets to their customers. This refers to figure 1.

Summary	GHG ($kgCO_2e$/FnU)	Percent of Total (%)
Paper Production	0.00184	25.6%
Ticket Production	0.00278	38.7%
Envelope Production	0.00179	24.9%
Delivery	0.00076	10.6%
Email Production	0.00000672	0.1%
TOTAL	0.0072	100.00%

Table 4: Results for Traditional Approach

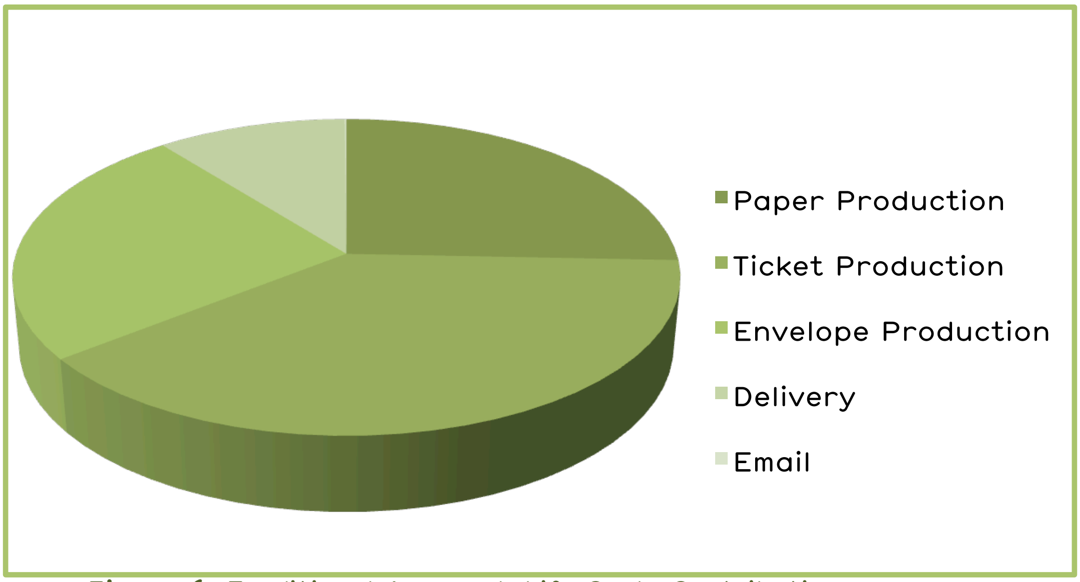

Figure 6: Traditional Approach Life Cycle Contributions

4.2. Email and Print Approach

The following section presents the results of the GHG emission assessment of a typical order delivery system for a ticketing agency if they were delivering ticket orders to their customers via email with a requirement for printing of the order. This refers to figure 1.

Summary	GHG ($kgCO_2e/FnU$)	Percent of Total (%)
Email Production	0.00000672	0.24%
Print by Customer	0.00276	99.76%
TOTAL	0.0027667	100

Table 5: Results for Email and Print Approach

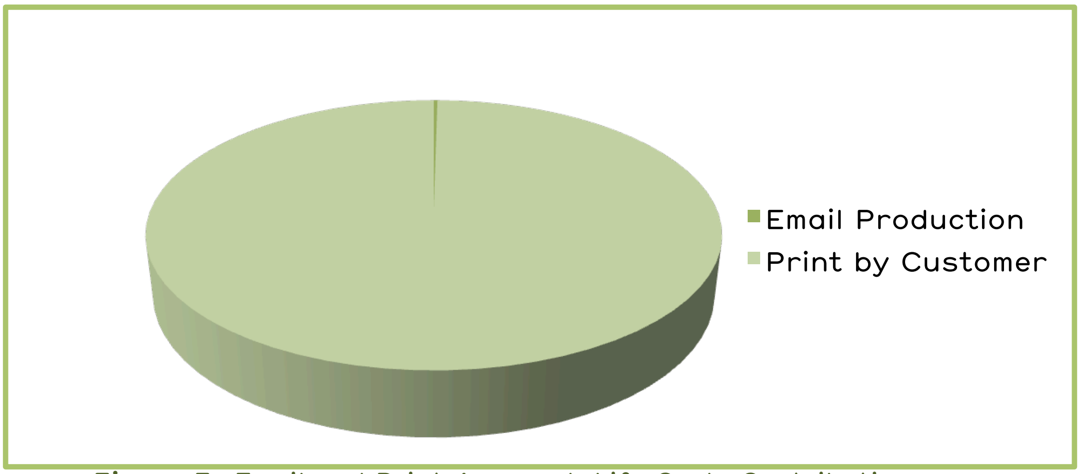

Figure 7: Email and Print Approach Life Cycle Contributions

4.3. WeGotTickets Approach

The following section presents the results of the GHG emission assessment of the WeGotTickets order delivery system of only delivering orders to their customers via email with no requirement for printing of the order. This refers to figure 3.

Summary	GHG (kgCO_2e/FnU)	Percent of Total (%)
Email Production	0.00000672	100
TOTAL	0.00000672	100

Table 6: Results for WeGotTickets Approach

A Pie chart is not included in the results since only one process is involved. Figure 5 represents results for this approach in the 'Email Production' Contribution.

4.4. Comparison of Approaches

In comparing the three ticket approaches, it is clearly seen that the WeGotTickets approach to ticket order delivery has the smallest environmental impacts. By removing paper requirements, delivery logistics and customer printing obligations, they have reduced their impact by 1070 times compared to if they were operating as a traditional ticketing agency.

The largest impact in the traditional approach is the use of paper and specifically, the ticket production. This is largely due to the thicker paper used for tickets. Delivery of the tickets only has a 10% contribution to the total impacts of a traditional ticketing approach but compared to the WeGotTickets approach, this is still double the total impact of that approach alone.

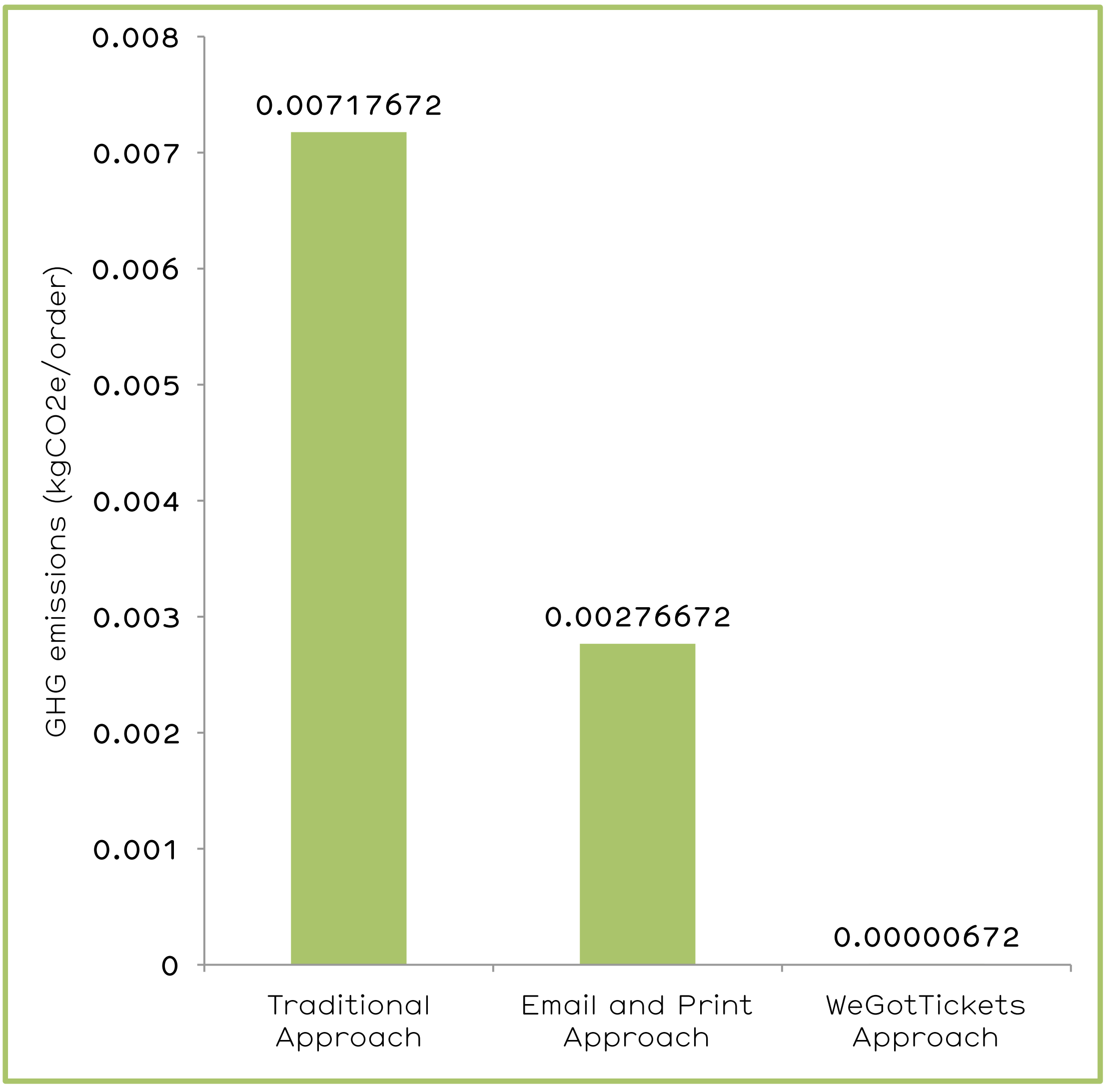

Figure 8: Comparison of Ticketing Approaches

The results show that 0.007g of carbon-equivalent emissions are released to deliver a ticket order via the WeGotTickets approach (electronically). If the customer prints their order email, then the associated emissions will rise to 2.83g, increasing by 400 times. This is compared to the traditional approach of ticket order delivery that has associated carbon-equivalent emissions of 7.24g, over 1000 times larger in environmental impacts than WeGotTickets' approach.

Based on the average ticket order, the ticketing approach of WeGotTickets reduces the environmental impacts of GHG emissions from a typical show by a factor of 1070 from traditional approaches to ticketing. This means that for the equivalent show, the WeGotTickets approach can fill a venue 1070 times before having the same environmental impact as one single show in the traditional framework.

7. Conclusions

WeGotTickets has successfully deployed a ticketing delivery system that dramatically reduces the environmental impacts of ticketing agencies. Customers do not suffer as a result and burdens are reduced throughout the life cycle of a ticket order. By removing the need for a ticket, in turn the need for paper and envelope production is removed, as well as delivery and logistics.

The nature of life cycle GHG emission studies means that assessments are an estimation of environmental impacts and should be seen as representative of the real situation while not being exact.

Some elements of the life cycle of a ticket will always remain variable in a study such as this. These may include customer travel to events, employees at ticketing agencies, differing printer characteristics of customers, computer use etc. It is important to note that assumptions have been made in order to conduct this comparative study.

While the end of life of a ticket can be considered variable, this study can be seen as a comparison of ticket delivery and hence, end of life aspects of the ticket order can be seen as comparable across the approaches. This is also relevant for other aspects of the life cycle of the approaches that may be missing such as computer life cycles within a ticketing agency and specific information regarding employees. Since this study can be seen as a comparison of three identical ticketing agencies conducting different approaches to tick order delivery, these aspects of the life cycle of a ticket order can be neglected since they are equal across the approaches. While the exact figure for GHG emissions may indeed be different in reality, for the sake of this comparative study, it is considered that the approach undertaken here is adequate.

8. References

[1] ISO, 14040: Environmental management–life cycle assessment—Principles and framework, vol. 3, no. 1. 2006.
[2] AEA, “2011 Guidelines to Defra/DECC’s GHG Conversion Factors for Company Reporting.” 2011.
[3] Hatch, “Digital invoicing & the environment. A Comparative Life Cycle Assessment (LCA),” 2008.

En-Count

En-Count is a sustainability consultancy based in Edinburgh, UK specialising in life cycle assessments. En-Count offers impartial carbon and life cycle impacts of products and services.