Learning legacy

Lessons learned from planning and staging the London 2012 Games

Reducing and compensating the Games carbon footprint

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Abstract

London 2012 was the first summer Games to attempt to map a complete carbon footprint of the Games over the entire project term, starting with a baseline reference footprint and monitoring reductions against this through several annual iterations.

This research summary seeks to draw together the achievements and lessons learned from developing and delivering London 2012's carbon management strategy, starting with a summary of the final carbon footprint of the Games and then focusing on three key areas; overlay, venue energy use and carbon compensation.

London 2012's estimated actual footprint (3.3MtCO_2e – 3.3 million tonnes of carbon dioxide equivalents) was calculated using data collected in the period up to and including Games time. This was within three per cent of the original estimate published in 2009 (3.4MtCO_2e). This small reduction masked two significant trends: a substantial increase in the footprint associated with spectators (due to increased numbers) and a substantial decrease in the footprint attributable to the Olympic Delivery Authority (ODA) and the London Organising Committee of the Olympic Games and Paralympic Games (LOCOG).

Those emissions 'owned' by LOCOG and the ODA made up 57 per cent (1.9MtCO_2e) of the 3.3MtCO_2e – a smaller proportion than the 66 per cent (2.3MtCO_2e) that had been anticipated in the reference footprint due to the reduction measures implemented by London 2012. LOCOG's contribution reduced from 400ktCO_2e to 311ktCO_2e with the biggest emissions resulting from venue energy use (60ktCO_2e) and overlay (47ktCO_2e). Substantial reductions were achieved in both of these emission source categories.

Also covered in this research summary is London 2012's approach to carbon compensation. This first attempt to quantify London's novel approach shows the significant benefits that a planned approach to carbon legacy can bring.

Lessons learned centre around the predominant sources of carbon emissions and how London's experience could help other events with their carbon management strategy.

‘London 2012 has never stated the aim to be ‘carbon neutral’. It believed this was a potentially misleading term.’

Background

London 2012’s action on climate change and commitment to deliver a low carbon Games responds to the One Planet Living® principle of zero carbon[1] (‘reducing carbon dioxide emissions by minimising building energy demand and supplying from zero or low carbon and renewable resources’), but went much further by addressing embodied impacts[a], operational and behavioural aspects.

London 2012’s carbon management strategy was set out in the second edition of the London 2012 Sustainability Plan which was published in December 2009[2]. The strategic approach for delivering a low carbon Games was based on the following hierarchy:

- **Avoid/eliminate:** use design to reduce or eliminate emissions at source.
- **Reduce:** optimise resource efficiency in energy use, transport, materials and work practices.
- **Substitute/replace:** introduce renewable energy and lower carbon strategies both on-site and through transport.
- **Compensate:** implement measures to deal with residual or unavoidable emissions and promote behaviour change.

This approach recognised that the London 2012 Games was a project, rather than a steady-state organisation. All carbon emissions caused by the project were arguably additional (that is, there is nothing against which to reduce), so the primary focus must be at the top end of the hierarchy – to avoid emissions in the first place.

This was to be achieved through scoping of the project and elimination of potential emissions through design and procurement processes. This was especially challenging because there were no accurate benchmark figures for projects of this nature.

The reduction and substitution elements were mainly about driving efficiencies and utilising new, low/zero carbon technologies wherever feasible and cost-effective. These elements are no different from any other organisational approach. However, London 2012 believes it set new benchmarks in carbon reduction for large-scale projects and regeneration projects.

London 2012 has never stated the aim to be ‘carbon neutral’. It believed this was a potentially misleading term. The reason for this was because there were no fixed boundaries on a project of this scale; any claim of carbon neutrality would be arbitrary and unrealistic to prove.

The uniqueness of the Olympic and Paralympic Games in terms of scale and reach does, however, offer opportunities for different approaches to compensate for unavoidable emissions. Instead of relying on conventional carbon offsetting schemes, the power of the Games to inspire change opened up a range of possible opportunities, such as knowledge transfer, reuse of assets and infrastructure, local energy retrofit schemes and behaviour change campaigns.

The work undertaken to measure, reduce and report on its carbon footprint is genuinely leading for a major international sporting event – albeit recognising the excellent work done in this field by other previous event organisers. Furthermore, London 2012 believed that the cumulative benefits of the legacy developments, wider adoption of its methods and practices, and behavioural change initiatives will fully justify its ambition to deliver truly sustainable Games.

[a]Embodied impacts relate to the direct and indirect carbon emissions associated with the entire production process, including manufacture, transportation and disposal of goods and materials.

'The aim of London 2012's carbon management strategy was to facilitate the delivery of a low carbon Games by setting out a 'route map' to minimise its carbon footprint.'

London 2012 Pre-Games Sustainability Report

Carbon footprint

London 2012 was the first summer Games to attempt to map a complete carbon footprint of the Games over the entire project term[b]. The carbon footprint was calculated as a forward looking estimate, a reference footprint, for the seven-year lifetime of the project, from winning the bid in 2005 to dissolution after the Games in late 2012.

Note that the term 'carbon footprint' here is used to refer to the whole basket of greenhouse gases covered by the Kyoto Protocol[3]. Although carbon dioxide is by far the most abundant climate-changing gas, London's carbon footprint was estimated using emission factors which included all relevant greenhouse gases.

The aim of London 2012's carbon management strategy was to facilitate the delivery of a low carbon Games by setting out a 'route map' to minimise its carbon footprint and to create a positive legacy of environmental improvements, behavioural change and knowledge transfer.

The specific goals of the strategy were to:

1. Develop a robust methodology for calculating an initial baseline carbon footprint of the Games (the reference footprint) and facilitate the ongoing monitoring of the footprint throughout the delivery of the London 2012 programme.
2. Inform carbon emission reduction and replacement strategies for London 2012 to contribute towards the staging of a low carbon Games and meeting agreed reduction targets.
3. Consider possible strategies for investing in carbon reduction projects and opportunities for leaving a beneficial carbon legacy.
4. Develop and showcase thought leadership and best practice in this emerging field, leaving a positive 'knowledge legacy' which will assist future events in minimising their carbon footprint.

Objective 1 was largely satisfied by the publication of the London 2012 carbon footprint study – methodology and reference footprint[4] in March 2010. This was written so as to deliver a knowledge legacy document; thereby contributing to objective 4. A number of legacy case studies have since been published which add further to this learning legacy, covering everything from the procurement and use of low carbon concrete[5] to sustainable transport management[6].

Recommendations driven by the carbon footprint study were also used to quantify and inform current and new reduction and replacement strategies, thus delivering against objective 2. These were set out in the revised London 2012 Sustainability Plan and reports – A Blueprint for Change (April 2011)[7] and Delivering Change (April 2012)[8].

Delivering Change also scoped out London 2012's novel approach to carbon compensation (objective 3).

Reference footprint

The London 2012 carbon management strategy introduced the concept of a reference footprint; a base case against which the success of actions to mitigate the footprint could be judged. This idea was adapted from the international Greenhouse Gas Project Protocol[9]. The concept was originally intended to provide a robust and credible baseline to gauge the avoided greenhouse gas emissions from mitigation projects. For example, projects used to generate tradable carbon credits.

Although there were many changes in the reference footprint since it was first estimated in 2009, the final Games actual footprint (3.3MtCO_2e) including all measured reductions was within three per cent of the original estimate (3.4MtCO_2e). However, this small decrease in the footprint masks two distinct trends:

– A substantial **increase** in the footprint of spectators and related impacts (such as accommodation)

[b] A complementary case study on the development and implementation of the London 2012 footprinting methodology is available on the Learning Legacy website

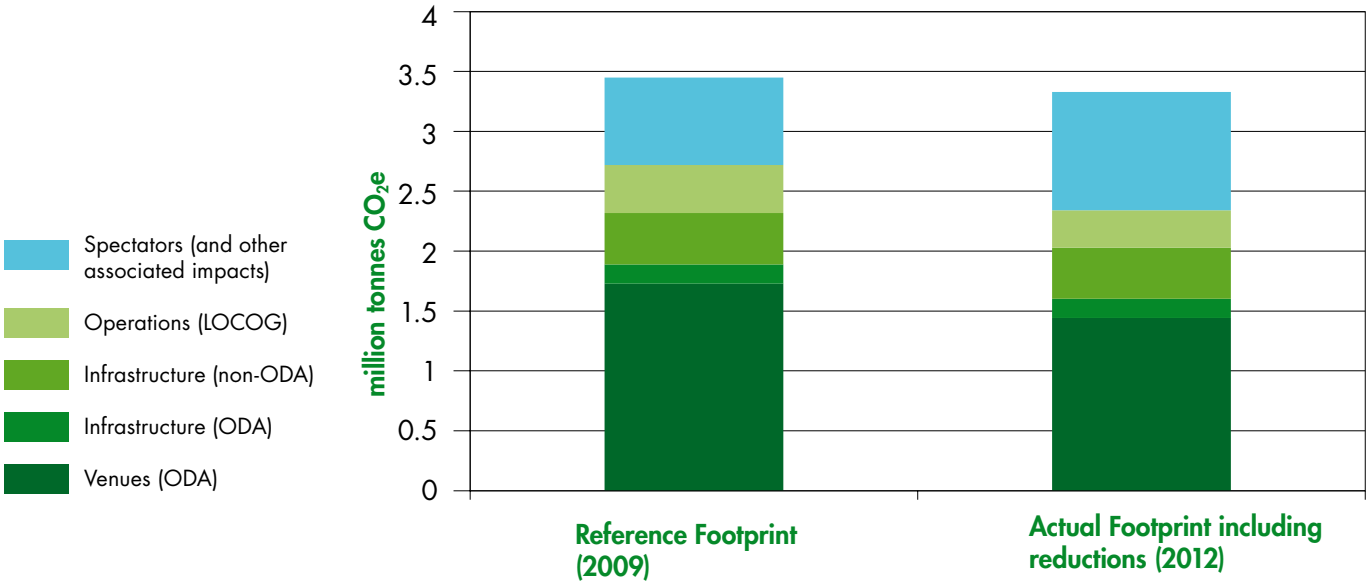
due to changing assumptions on ticket sales and visitors.

– A substantial **decrease** in the footprint attributable to the activities of the ODA and LOCOG.

The original reference footprint excluded some LOCOG owned emission sources[c] which were not anticipated at the time: the use of additional hotel accommodation, two hotel ships, and generators for temporary power. Some early emissions source estimates also proved to be exaggerated and were subsequently revised downwards. This notably affected the figures for overlay[d], IT and transport services. Arguably, the reference footprint could have been revised to take these into account. Had this been done the reference footprint would have increased by about 34ktCO_2e and the savings increased from three per cent to four per cent. There were some methodology changes between 2009 and 2012 due to updates made by the Department for Environment, Food and Rural Affairs (Defra) to the emission factor set which made a minor difference[10].

Figure 1 below shows a breakdown of the reference and actual footprints by main component. Table 1 provides the corresponding data showing percentage changes by component.

Figure 1: Reference footprint (2009) compared with estimated actual footprint (including reduction measures)



[c] Owned emission sources are wholly funded core activities where the entire associated carbon footprint is allocated to London 2012 (for example, office utility use, venue construction).

[d] Temporary construction works and facilities (otherwise known as 'overlay') supplemented to venues that are required to run the event (for example, portable buildings, tents, security screening areas, furniture, fences, sports surfaces, banners and flags).

‘Both the ODA and LOCOG delivered demonstrable carbon savings.’

Table 1: Breakdown of reference and actual carbon footprint

(000s tonnes CO_2e)	Reference footprint (2009)	Actual footprint including reductions (2012)	% change
Venues (ODA)	1,728	1,442	-17
Infrastructure (ODA)	161	159	-2
Infrastructure (non-ODA)	429	429	0
Operations (LOCOG)	400	311	-22
Spectators (and other associated impacts)	730	988	+35
Total	**3,448**	**3,329**	**-3**

Note: The data in this table is presented in thousands of tonnes of carbon dioxide equivalents ($ktCO_2e$) and is therefore subject to rounding errors.

Both the ODA and LOCOG delivered demonstrable carbon savings. The former delivered 15 per cent savings (calculated by averaging savings from infrastructure (ODA) and venues). The latter delivered 22 per cent savings. Had the reference footprint been revised to include the adjustments to the emission source figures (as set out earlier) the LOCOG savings would have increased to 28 per cent.

Note that there were many carbon reduction activities (particularly relating to infrastructure) that were not captured by the carbon management strategy. This was due to either a lack of available information or the absence of quality data which was considered to be sufficiently robust to meet the tough evidencing requirements set out in the London 2012 methodology.

Emissions from sources associated with the Games, predominately visitor-related, were significantly greater than were predicted in 2009. The success of London 2012 meant that more tickets were sold to more people resulting in increased visitor activity.

Note, however, that data on spectator activities was necessarily less certain than data for emission sources over which LOCOG and the ODA had more control. It was necessary, for example, to make assumptions about the passenger classes chosen by those international visitors flying to the Games as well as the number staying in different categories of accommodation, the type and quantity of meals purchased and so on.

Overview of Games operational reductions

Here the focus shifts to the main operational carbon savings within LOCOG's owned emissions. Table 2 below shows the breakdown of the original (2009) 400ktCO_2e and actual (2012) 311ktCO_2e 'Operations (LOCOG)' footprints.
The middle column shows the updated (2012) reference footprint including revisions and omitted emission sources.

Table 2: Operational carbon emissions within LOCOG's owned footprint

LOCOG – owned	Original (2009) reference footprint ($ktCO_2e$)	Revised (2012) reference footprint ($ktCO_2e$)	Estimated Actual footprint 2012 ($ktCO_2e$)	% change between 2012 reference and actual footprint
Venue energy use	15	91	60	-34
Overlay	152	131	47	-64
Furniture, Fixtures and Equipment (FF&E)	47	40	38	-5
Technology and services	50	39	37	-5
Transport services	34	13	11	-15
Travel grants	29	29	31	7
Games workforce and athletes	16	16	15	-6
Ceremonies and culture	8	8	5	-38
of which Torch Relay	3.5	3.5	1.0	-71
Other smaller items	51	51	51	0
Sub-total	**400**	**418**	**296**	
Additional accommodation	-	16	16	
Total	**400**	**434**	**311**	**-28 (-22 from 2009)**

Note: The data in this table is presented in thousands of tonnes of carbon dioxide equivalents ($ktCO_2e$) and is therefore subject to rounding errors.

The column on the far right shows the percentage variation between the revised reference footprint (2012) and the estimated actual footprint. All elements showed savings except for 'travel grants' and 'other smaller items'. The latter represented a collection of smaller emissions sources (for example, medical and security services, staff travel and offices and so on) which were not the subject of any explicit reduction commitments or repeated carbon measurement.

On the former, there was an increase in travel grants (LOCOG funding for athletes and team officials travelling to the Games). The number of grants was 43 per cent higher than the 2009 forecast, though most of the additional trips were in short-haul range. However, 11 per cent of grants were taken on Eurostar instead of air, providing some carbon savings.

Around 94 per cent of the carbon savings were generated from just two elements: venue energy use and overlay and these items are explored in more detail below.

‘A screening technique known as input-output (IO) analysis was used to estimate carbon emissions arising from the planned expenditure on overlay.’

Overlay

Reference footprint

In the absence of detailed commodities data, financial budgets were originally used to estimate the carbon impact of overlay and Furniture, Fixtures and Equipment (FF&E).

A screening technique known as input-output (IO) analysis was used to estimate carbon emissions arising from the planned expenditure on overlay. Although not available at the time of calculating the reference footprint in 2009, the emission factors needed for IO analysis are now incorporated into the Defra/ Department of Energy and Climate Change (DECC) annual conversion factors release.

This resulted in the low quality estimate contained within the 2009 reference footprint of 152ktCO_2e. This figure was based on the assumption that all items would be purchased.

By the time of the 2012 pre-Games update, the estimate had fallen to 131ktCO_2e largely as a result of reductions in the number of items to be procured.

Reduction measures

Two substantive actions were taken to reduce the footprint of overlay:

Reduce planned (physical) footprint of LOCOG venues by 25 per cent	This commitment impacted on the number and size of structures (temporary buildings and tents) hired. Data provided by London 2012 states that the floor area requirement was reduced, from a 2008 baseline[e], saving on rental requirements and freighting. Were these to have been purchased new, the savings in embodied carbon would have been around 15ktCO_2e. However, if they had been covered by the hiring strategy (which is more likely) then the savings would have been far more modest (81tCO_2e) – the avoided emissions relating to the reduced need for transportation of the structures to and from the Games. However, more significant savings did arise from the reduction in lighting requirements as a consequence of the smaller floor area (covered under ‘Venue energy use’ below).
Reduce LOCOG owned carbon emissions and minimise carbon footprint through hiring 85 per cent of overlay (excluding FF&E)	The decision to hire, rather than purchase, most structures and the majority of seating, boundary and services integration was the primary reason for the reduced footprint. When items are hired only the emissions associated with their transportation to and from site are accounted. The much larger embodied emissions linked to the manufacture of an item are excluded.

[e]Earlier reports put the estimated floor area saving at more than 90,000 square metres though these figures were not able to be validated further.

‘Although not a stated commitment, the principle of hiring items rather than purchasing them was successfully extended to FF&E, leading to significant further reductions.’

Although not a stated commitment, the principle of hiring items rather than purchasing them was successfully extended to FF&E, leading to significant further reductions. In addition, certain FF&E items were leased on a ‘buyback’ arrangement. Although this does not reduce the ‘owned’ footprint it does contribute to the overall carbon compensation strategy by ensuring that the items have a secured use beyond the Games.

Estimated actual footprint

Emission sources

An inventory of overlay items was collated using the structure defined within the LOCOG Venues and Infrastructure ‘kit of parts’ developed by Atkins and Populous. This provided a framework for data collection, minimised the likelihood of items being unknowingly omitted and ensured that all items were consistently catalogued. The categories used were as follows:

- Boundary
- Circulation – horizontal
- Circulation – vertical
- Field of Play
- Wayfinding
- Seating
- Services integration
- Structures
- Look
- Landscape
- Lighting
- Secure screening
- Street furniture
- Other works

Data quality

Given the huge diversity of items considered as overlay, and the number of suppliers involved, it proved impractical to catalogue each and every product. Furthermore, as the items were often specialist in nature and complex in design, there was no standardised approach to assessing their carbon footprint. For all items it was necessary to estimate weight and determine a representative carbon conversion factor.

There remained some data gaps, though, and the final carbon estimate was uplifted (by 15 per cent) to allow for missing data. Data quality (high, medium or low) for each emission source category is given below:

- Boundary (low/medium): data incomplete with data for gates, barricades and balustrades outstanding. Physical data estimates provided for fencing and barriers.
- Circulation – horizontal (high): physical estimates provided for all main items.
- Circulation – vertical (low): only data for lifts included. Data gaps for ramps, bridges and stairs.
- Field of Play (low/medium): data only available for Greenwich Park and Horse Guards Parade available.
- Wayfinding (low): only signage data available. Data gap for beacons and signboards.
- Seating (high): overall seat numbers provided.
- Services integration (low/medium): data on heating, ventilation, and air conditioning (HVAC), generators, cabling, information towers, closed-circuit TV (CCTV), electrical services and Uninterrupted Power Supply (UPS) systems provided. Data on fuel storage, telecoms mast, wastewater containment and water storage not available.
- Structures (high): data on portable buildings, tents, roof covers and ducting provided.
- Look (data gap).
- Landscape (data gap) – considered immaterial as mostly landscaping and planting.
- Lighting (data gap).
- Secure screening (data gap).
- Street furniture (data gap).
- Other works (data gap).

'Substantial footprint reductions were achieved within this category as a result of the commitment to hire at least 85 per cent of the overlay items.'

Note that the data collection effort was focused on those areas identified as most significant in an earlier screening study carried out when LOCOG's Temporary Materials Guidelines were prepared[11], namely: temporary buildings, serviced tents, roadways and seating. It is therefore expected that, although this more granular revision of the footprint has some omissions, the best available data for the largest impact categories has been sourced.

Calculation approach

For each emission source where inventory data was available, estimates were made of the following:

- Predominant material or product type → used to determine the carbon intensity and embodied emissions of the item.
- Ownership → used to determine whether or not to include embodied carbon emissions.
- Weight → used to calculate freight impacts and embodied emissions.
- Distance transported → used to calculate freight impacts.
- Mode of transport → used to calculate freight impacts.

The data model was constructed so as to allow for any of these parameters to be changed so that different reference and reduction scenarios could be modelled. Hence it was possible to establish a 'business as usual' case against which to quantify the actual carbon savings.

GHG conversion factors were sourced from:

- Defra/DECC's GHG conversion factors for company reporting (2011)
- Ecoinvent 2.2[f]
- Bath ICE[12]
- Footprinter[g]

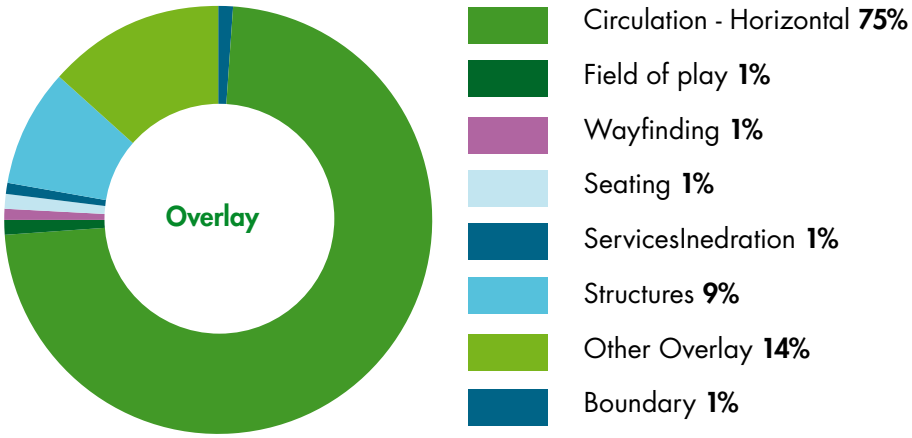
A bespoke Excel spreadsheet model was used and updated to account for the revised data.

Results

Substantial footprint reductions were achieved within this category as a result of the commitment to hire at least 85 per cent of the overlay items. Overall the footprint was reduced by 64 per cent when compared with the pre-Games reference footprint (from 131 to 47ktCO_2e). This includes the 15 per cent allowance for missing data.

The results show the predominance of structures and circulation – horizontal, which together amounted to more than three-quarters of the footprint – in both reference and estimated actual footprints. Figure 2 shows the breakdown of the estimated actual footprint and Figure 3 compares the updated 2012 reference footprint with the estimated actual footprint. Actual data is provided in Table 3.

Figure 2: Breakdown of overlay estimated actual footprint by emission source category



[f]Database with consistent and transparent, up-to-date Life Cycle Inventory (LCI) data: **www.ecoinvent.ch** .

[g]An online, searchable emission factor database: **www.footprinter.com** .

Figure 3: Overlay reference (2012) and estimated actual footprints showing impact of the reduction commitments (in tCO_2e)

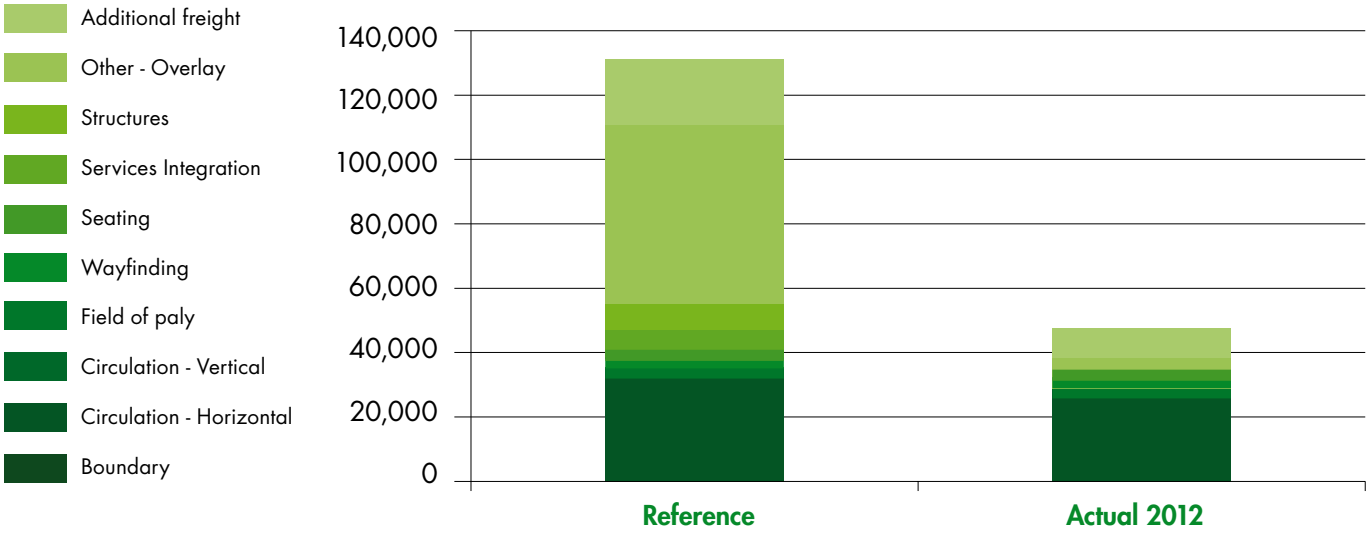


Table 3: Overlay reference (2012) and estimated actual footprints showing impact of the reduction commitments (in tCO_2e)

Overlay	Reference 2012 footprint ($ktCO_2e$)	Actual 2012 footprint ($ktCO_2e$)	% change between 2012 reference and actual footprint
Boundary	369	9	-98
Circulation – horizontal	35,168	35,140	-0.08
Circulation – vertical	185	2	-99
Field of Play	1,836	644	-65
Wayfinding	989	25	-98
Seating	6,639	21	-99.7
Services integration	9,794	526	-95
Structures	58,871	4,430	-92
Other – overlay	17,325	6,367	-63
Additional freight	81	0	n/a
Total	**131,255**	**47,163**	**-64%**

‘The potential significance of venue energy use was one of the triggers for the development of an energy conservation policy and action plan, which were implemented at all venues during the Games.’

Venue energy use

Reference footprint

Energy use at venues (gas, electricity and renewables) was originally estimated to have a footprint of 15ktCO_2e. This was based on early estimates provided by EDF Energy and assumed the use of grid electricity with a UK average carbon intensity[h].

Two significant changes to the energy emission sources occurred after the first (2009) reference footprint was published. Firstly, the use of generators was included (previously no estimates of generator use were available). Secondly, more accurate estimates of energy use were obtained from a range of providers. This resulted in a substantially higher post-2009 estimate of the impact of venue energy use. The 2012 reference footprint figure was 91ktCO_2e.

Reduction measures

This recognition of the potential significance of venue energy use was one of the triggers for the development of an energy conservation policy and action plan, which were implemented at all venues during the Games. A complementary case study has been prepared on managing energy consumption during the Games and is available on the Learning Legacy website.

Other successful Games-time reduction initiatives included:

Careful planning to minimise stored diesel and hence leftover fuel	To keep the prime and back-up generators ready for use there was a requirement for a substantial amount of bulk diesel storage. It was estimated pre-Games that as much as 2.7m litres could be left unused at the end of the Games. Carbon accounting rules dictate that the upstream emissions from purchasing this fuel should appear as part of LOCOG’s footprint even if the fuel remains unused. In the end only around 838,000 litres of diesel remained which, due to forward planning, was able to be sold on with a reasonable financial return.
Efficient cauldron design and use	Based on previous Games, it was estimated that the cauldron could have consumed up to 730,000m^3 of natural gas. Actual consumption was less than 300,000m^3.

Some of the reduction ideas described in Delivering Change (the April 2012 sustainability report) were not carried through. It is acknowledged, for example, that more could have been done on load-optimisation of generators to allow them to run more efficiently. Also, despite early efforts to procure biodiesel, none was able to be used during the Games.

[h]The average carbon intensity of the UK’s electricity system and is otherwise known as ‘grid average’.

Estimated actual footprint

Emission sources

Emission sources are listed below:

- Natural gas – cauldron
- Gas – other
- Grid electricity – EDF Energy supplied
- Grid electricity – other suppliers
- Diesel – generators (used for electricity generation)
- Combined Heating and Cooling (CHP) – local use of absorption and electric chillers and heating only

Data quality

The quality of the data varies by emission source. Note that at the time the footprint calculations were completed it was necessary to estimate final consumption as some activity was still ongoing in the Olympic Park. At the time of writing (November 2012) more up-to-date figures were available which differed little from those used in the reported footprint. The figures used in this report and the final figures on direct and indirect energy prepared to satisfy Global Reporting Initiative (GRI) requirements are included as Appendix 1.

Data quality (high, medium or low) for each emission source category is given below:

- Gas (high): estimated final consumption data was provided by LOCOG.
- Grid electricity (high): estimated final consumption data was provided by LOCOG.
- Diesel – generators (high): estimated final fuel consumption data was provided by LOCOG.
- Liquefied petroleum gas (high): estimated final consumption data was provided by LOCOG.
- Combined heat and power (CHP) – local use of heating and cooling (high): note that as the Olympic Park CHP is grid connected, the electricity sent to the grid is not included here. Only the cooling and heating used locally within the Olympic Park and Olympic and Paralympic Village is considered, including the biomass boilers.

With regard to other renewables, in addition to the CHP, miscellaneous other technologies were installed on the Olympic Park – including small-scale wind and solar photovoltaics (PVs). Only the installations in place at Games time are considered here.

Calculation approach

For each emission source where inventory data was available, estimates were made of the following:

- Natural gas: aggregated cubic metric gas consumption data was multiplied by the appropriate carbon intensity factor to determine the carbon footprint for on-Park and off-Park use.
- LPG: aggregated consumption data (in litres) was multiplied by the appropriate carbon intensity factor to determine the carbon footprint for on-Park and off-Park use.
- Grid electricity: aggregated kilowatt-hour electricity consumption data was multiplied by the appropriate carbon intensity factor to determine the carbon footprint for on-Park and off-Park use. Note that despite two-thirds of the electricity being from EDF Energy on a low carbon tariff, all electricity was assumed to be UK grid average carbon intensity in line with the UK Government's carbon accounting guidelines.
- Diesel – generators: aggregated diesel consumption was multiplied by the appropriate carbon intensity factor. Note that the calculations for the residual diesel (the unburned fuel that is left over in the bulk tanks) include only the upstream emissions.
- CHP and renewable: output from on-Park renewables up until the end of the Games was ~60 MWh from PVs (with estimated generation of ~30MWh from wind turbines, 3.6GWh from biomass boiler and 16.5GWh from CHP). Fuel use for CHP is included in the gas consumption, while savings through displaced electricity

'Energy consumption was lower than forecast, saving money and carbon.'

generated by PVs and wind turbines are accounted through reduced grid and generator electricity consumption.

– GHG conversion factors were sourced from:

– Defra/DECC's GHG conversion factors for company reporting (2011)

A bespoke Excel spreadsheet model was used and updated to account for the revised data.

Results

Energy consumption was lower than forecast, saving money and carbon. Electricity use was 25 per cent lower and use of diesel was 54 per cent lower. As a result of these and other savings, the estimated actual footprint was 34 per cent lower (a reduction from 91ktCO_2e to 60ktCO_2e).

Further information is available in the complementary case study on managing energy consumption during the Games and is available on the Learning Legacy website. Figure 4 provides the breakdown of the estimated actual footprint by emission source category. Figure 5 compares the updated 2012 reference footprint with the estimated actual footprint. Actual data is provided in Table 4.

Figure 4: Venue energy use estimate actual footprint (ktCO_2e) by emission source

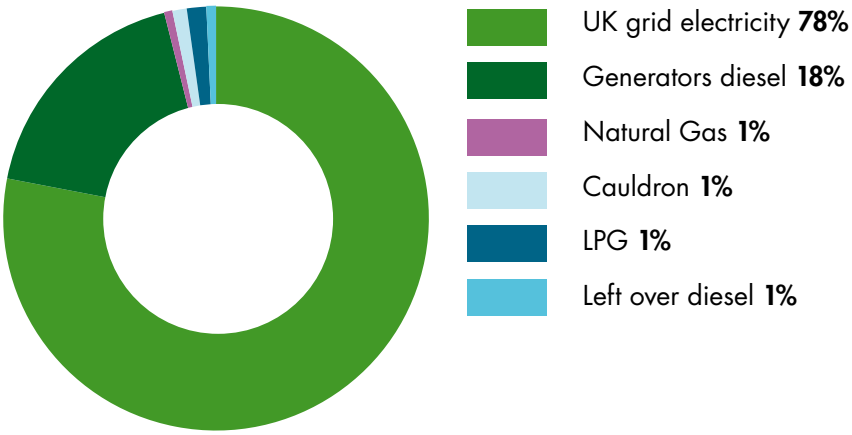


Figure 5: Venue energy use 2012 reference and estimated actual footprints showing impact of reduction measures (in tCO_2e)

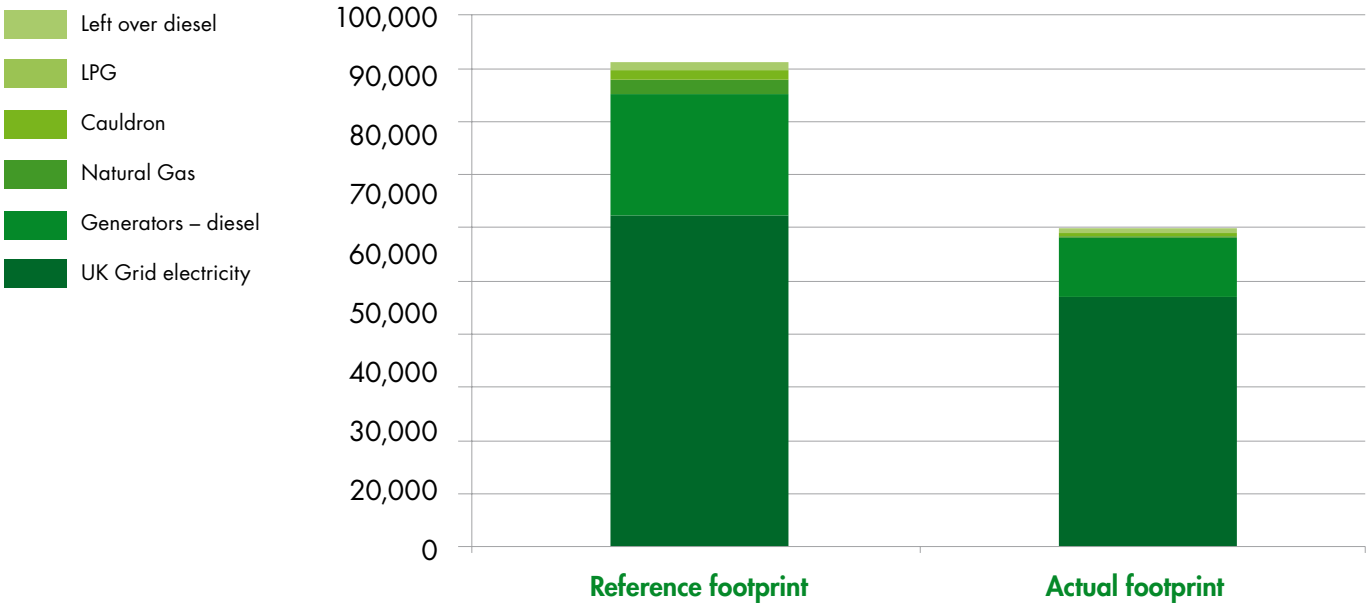


Table 4: Detailed figures showing additional split into on-Park and off-Park consumption and savings by source

Overlay	Reference footprint (2012)			Estimate actual footprint			Savings	
(tCO_2e)	On-Park	Off-Park	Total	On-Park	Off-Park	Total	Total	% change
UK grid electricity	49,988	12,060	62,048	34,832	12,063	46,895	15,153	-24
Generators – diesel	6,283	16,698	22,981	4,322	6,529	10,851	12,130	-53
Natural gas	2,128	592	2,721	369	11	380	2,341	-86
Cauldron	1,616	0	1,616	655	0	655	960	-59
LPG	757	791	1,549	608	280	888	661	-43
Leftover diesel	0	0	0	176	266	441	-441	n/a
Total	**60,773**	**30,142**	**90,915**	**40,962**	**19,149**	**60,111**	**30,804**	**-34**

Carbon compensation

Inevitably, there will always be a residual footprint caused from hosting any major global event such as the Games. London 2012's innovative approach to compensating for this carbon was described in its Pre-Games Sustainability Report (Delivering Change, published in April 2012).

London 2012 was keen to use the opportunity presented by hosting the Games to deliver carbon benefits which leave an enduring legacy while recognising that such compensating measures cannot be considered as direct carbon savings.

London 2012's carbon compensation strategy encompassed the following five areas:

- Transfer of knowledge and best practice case studies
- Reuse of assets and infrastructure including donations to local communities
- Local energy efficiency and retrofit projects
- Behaviour change campaigns
- Partner carbon offset initiatives

Presented here is the first attempt to quantify these compensation measures. In doing so it is acknowledged that such estimates are fraught with problems, carrying high levels of uncertainty and raising issues of additionality. However, even orders of magnitude indications of the likely benefits from carbon compensation measures present useful legacy learning.

Such measures necessarily cut across the responsibilities of the ODA and LOCOG as each may be involved at different stages in the sourcing, management and use or delivery of an asset or programme. As such, compensation measures should be seen in the context of the whole London 2012 footprint rather than applying to any individual component.

Sufficient information was able to be gathered to estimate five examples of carbon compensation:

Carbon offsetting (BP Target Neutral)	To try and compensate for the carbon arising from travel and increase awareness of the carbon impact of travel, London 2012's offset partner, BP Target Neutral, initiated free carbon offsetting to spectators and teams. This covered more than 500,000 individual return journeys.
IT equipment reuse	The majority of technology items (PCs, laptops and servers) were bought and then operated under a lease-back arrangement or pre-sold prior to the Games to maximise reuse to businesses and the community. In total, more than 30,000 items were reused in charities and educational establishments, the Glasgow 2014 Commonwealth Games or sold on to staff. Estimated residual financial value was used to calculate the remaining impact which has effectively been saved from reuse of purchased items.
Temporary venue reuse/recycling	Several London 2012 temporary venues were designed to be dismantled and taken back by suppliers, for reuse in other locations or other applications, or recycled. These include the two wings of the Aquatics Centre, the Water Polo Arena, Beach Volleyball courts and the Basketball Arena.
End of life management of FF&E and overlay	Although much FF&E was purchased, most was subject to resale or reuse arrangements with suppliers, thereby saving materials from early disposal. Most overlay equipment was leased (see 'Overlay' section above) but some materials were passed on for further use. More than 27,000 tonnes of overlay and FF&E assets were reused: everything from sand to furniture. Additional detail on reuse initiatives can be found in a suite of case studies and micro-reports on the Learning Legacy website.
Renewables systems legacy	Renewables installed for London 2012 will continue to generate energy for at least 25 years into the future. These include on-Park photovoltaics, wind turbines and a CHP plant providing electricity back into the grid as well as heat and cooling to Park venues.

The estimated whole life savings from these compensation measures is summarised in Table 5 below.

Table 5: Summary of carbon compensation benefits

Compensation area	$ktCO_2e$
Carbon offsetting (BP Target Neutral)	99
IT equipment reuse	4
Temporary venue reuse/recycling	19
End of life management of FF&E, equipment etc	35
Renewables systems legacy	78
Total estimated compensation	237

As stated, many carbon-saving projects have not been included due to a lack of information. These include a host of partner programmes which were aimed at avoiding carbon emissions (directly or by encouraging lifestyle changes) such as those by EDF Energy, Coca-Cola, UPS and others. Similarly, no account has been taken of the many public transport infrastructure projects inspired by the Games which have the potential to reduce the carbon footprint of travel within the city. It is also difficult to quantify the legacy value of the carbon methodology developed by London 2012 which is already being used by Sochi 2014, the America's Cup and has been specified by Rio 2016. The positive impact that London's carbon management strategy will have on these and other future events is simply unknown and probably unknowable.

However, even the highly conservative estimate of the scale of London 2012's compensation efforts summarised in Table 5 highlights the importance of considering legacy from a carbon perspective.

Although increased carbon emissions are an inevitable consequence of staging a world-class event, what the compensation approach taken by London has demonstrated is that it is possible to substantially reduce the net impact by careful post-Games planning and by investing in carbon savings elsewhere.

Recommendations for future projects

Elevated carbon emissions are an inevitable consequence of staging any world-class event. The challenge is to anticipate which activities are likely to have a significant footprint early enough to avoid or reduce them. Forward planning is also necessary to ensure that after the event the impact is mitigated as far as possible through effective compensation.

Lessons related to London 2012's carbon methodology are detailed in a complementary case study which is available on the Learning Legacy website.

The recommendations given here will therefore focus on how the findings from London 2012's footprint, and particularly those arising from LOCOG's activities, could inform future events:

– Whereas the focus of past event footprinting exercises has been on operational elements (energy use, ground transport and so on), the broad scope of London's carbon footprint has highlighted the importance of considering the bigger picture (for example, construction, overlay, technology and the associated supply chains). Construction alone was responsible for two-thirds of London 2012's footprint. Only when emissions sources are identified and measured can effective carbon management take place.

– Without intervention from LOCOG, the 'hidden', embodied carbon emissions which occur in the production of temporary overlay, technology equipment and the provision of third-party services would have far exceeded the emissions from fuel use – electricity, gas, petrol and diesel – at Games time by a ratio of 2:1. Strategies to minimise these embodied emissions include hiring the necessary items (outright or on a lease-back arrangement) or procuring low carbon alternatives which have an identified use post-event.

– Many equipment and service providers were unable to provide data on the carbon emissions associated with their London 2012 contract. Even where they already annually reported their corporate carbon emissions they were unable to apportion these to individual contracts. This is a learning lesson for both suppliers and future event organisers. The latter should clearly specify the required metrics in procurement contracts.

– London 2012's largest direct source of carbon emissions arose from energy use. UK carbon accounting rules prevented the inclusion of low carbon grid electricity as a reduction measure on grounds of additionality. However, the use of green electricity has much to commend it in terms of stimulating demand and raising awareness of the benefits of a low carbon energy supply. This is an example of where London 2012 could have done more in terms of public engagement to parallel the carbon footprinting work.

– A comprehensive approach to compensation is an essential element of any carbon management strategy. There is a clear need for additional guidance for organisations wishing to compensate their unavoidable or residual carbon emissions. With more robust guidance London 2012 could have been better at collecting data on compensation projects, but even the conservative figures presented in this report show that carbon legacy planning is critical in mitigating the net environmental impact of any event.

Appendix 1: Direct and indirect energy consumption

This table shows the direct and indirect energy consumption figures for 2012 (prepared by LOCOG to satisfy Global Reporting Initiative purposes[13]) and how they compare to those used in analysis to prepare this research summary. There are some small differences but these are not significant in the final results.

Emissions source	Type	Unit	Total volume	kWh	Venue energy – LOCOG GRI	Venue energy – used in this report	Transport services – LOCOG GRI	Transport services – used in this report	Additional accommodation – LOCOG GRI	Other
Direct energy consumption[1]										
Temporary generators	Diesel	litre	3,019,964	11,234,266[2]	3,019,964	3,025,489				
Non-road mobile machinery[3]	Diesel	litre	582,769	6,410,454						582,769
	Petrol	litre	3,930	35,370						3,930
	LPG	litre	994	6,958						994
	Fuel oil	litre	92,115	1,105,380						92,115
Vehicles	Diesel	litre	3,217,982[4]	35,397,802			3,217,982	3,383,521		
	Petrol	litre	219,026[5]	1,971,234			219,026			
Buggies and boat fuel	Diesel[6]	litre	8,836	97,196			8,836			
	Petrol[7]	litre	166,160	1,495,440			166,160			
Accommodation ships	Heavy fuel oil	kg	850,000	10,200,000						850,000
Cauldron	Natural gas	m^3	295,556	3,289,538						295,556
Catering	Natural gas	m^3	175,118[8]	1,949,064	175,118	171,495				
	Propane	m^3	527	5,867	527	529				
Indirect energy consumption										
Corporate offices		kWh	12,300,000[9]	12,300,000						12,300,000
Operational sites, competition and non-competition venues[10]		kWh	75,192,774	75,192,774	75,192,774	78,991,139				
Total estimated direct energy consumption (kWh)				**73,198,570**						
Total estimated indirect energy consumption (kWh)				**87,492,774**						

Notes:

1. Carbon Trust 2011 conversion factors – based on calorific value of fuel type.
2. Assume 3.72 kWh (electrical) consumed per litre of fuel – conversion factor from Pre-Games Sustainability Report.
3. Includes fuel used by LOCOG contractors and suppliers in overlay works.
4. Bus/coach and car fleet for officials, athletes, press and staff – all buses and coaches were diesel and estimated 80 per cent contractor bus and car fleet fuel use as diesel.
5. Used in car fleet from commercial forecourts – estimated 20 per cent petrol cars.
6. Boats at Weymouth and Portland.
7. Golf buggies and boats at Eton Dorney, Hyde Park and Weymouth and Portland.
8. This covers all competition and non-competition venues.
9. Estimated according to 2011 data – data from landlords' agents not available in time for reporting purposes.
10. Includes electricity data for all competition and non-competition venues, supplier and overlay works.

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