CARBON FOOTPRINT METHODOLOGY FOR THE OLYMPIC GAMES

CO$_2$

CH$_4$

CFCs

HCFCs

SF$_6$

N$_2$O

PFCs

UN Climate Change welcomes this important effort from the International Olympic Committee which aims to align relevant stakeholders in their efforts to address the mitigation of climate change. Written for the Organising Committees of the Olympic and Paralympic Games, and pertinent for other major sports events, this living guide is a useful tool to enable organisations to more effectively develop a carbon management plan to measure and minimise their greenhouse gas emissions.

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Acronyms and abbreviations

CFCs
Chlorofluorocarbons

CH$_4$
Methane

CO$_2$
Carbon dioxide

CO$_2$-eq
Carbon dioxide equivalent

DEFRA
United Kingdom Department for Environment, Food and Rural Affairs

ELCD
European Reference Life Cycle Database

FA
Functional Area (organisational division with an Organising Committee of the Olympic and Paralympic Games)

HCFCs
Hydrofluorocarbons

LCA
Life Cycle Assessment

IDEA
Inventory Database for Environmental Analysis

IBC
International Broadcast Centre

IF
International Federation

IT
Information technology

GHG
Greenhouse gas

GWP
Global warming potential

IOC
International Olympic Committee

kWh
Kilowatt hour

MJ
Megajoule

MPC
Main Press Centre

Mt
Metric tonne

MWh
Megawatt hour

Nm$_3$
Normal cubic metre

N$_2$O
Nitrous oxide

NOC
National Olympic Committee

NPC
National Paralympic Committee

O$_3$
Ozone

OBS
Olympic Broadcasting Services SA – Host Broadcaster organisation for all Olympic Games, Olympic Winter Games and Youth Olympic Games

OCOG
Organising Committee of the Olympic and Paralympic Games

OTR
Olympic Torch Relay

pers.km
Person multiplied by kilometre (personal transport unit)

PFCs
Perfluorocarbons

PTR
Paralympic Torch Relay

SDGs
Sustainable Development Goals

SF$_6$
Sulfur Hexafluoride

UN
United Nations

CARBON FOOTPRINT METHODOLOGY FOR THE OLYMPIC GAMES

Terminology and definitions

Carbon footprint
(Or GHG inventory) The actual amount of GHG emissions of a given system/project/organisation

Carbon footprinting
The process of measuring the carbon footprint of a given system/project/organisation

Carbon footprint reduction plan
Based on the *Initial carbon footprint*, the OCOG defines and implements an action plan to minimise and mitigate the Games GHG emissions

Carbon management plan
Complete plan to measure, minimise and mitigate GHG emissions

Carbon offsetting
The action of compensating GHG emissions of a given system by purchasing carbon credits from another system

Carbon reduction
The action of reducing GHG emissions of a given system by implementing solutions within the scope of a given system

Data owner
Responsible persons within OCOG or external organisations having access to data needed for the Games carbon footprint

Games delivery partners
Organisations working hand in hand with the OCOG to deliver the Games. Usually includes host city authorities and the organisation in charge of delivering permanent infrastructure for the Games (e.g. Solideo for Paris 2024)

OCOG Workforce
OCOG staff, volunteers and contractors

Officials
Technical officials, referees (via IFs)

Overlay
Additional infrastructure, installations and equipment added to an existing, new or temporary venue to make the venue "Games-ready". It is also frequently applied to describe a complete 'turnkey' re-usable venue or facility solution

Primary data
Data directly measured and collected by the OCOG and its partners/suppliers. By definition, primary data have a high level of quality

Secondary data
Data that the OCOG is unable to collect directly and that have to be estimated by other means (e.g. assumptions, literature review, case studies and expert judgement)

Sponsors
National sponsors and TOP partners

The Games initial carbon footprint
(Or baseline) First measure of the Games GHG emissions, completed during the Games planning phase, essentially based on bidding or planning documents

The Games actual carbon footprint
Measure of the Games GHG emissions, completed after the Games, and essentially based on monitored data

1   Introduction

1.1   Context and background

Climate is one of the five focus areas of the IOC Sustainability Strategy (January 2017). It addresses our long-term strategic intent for 2030 that effective carbon reduction strategies are in place for operations and events, and that they are aligned with the objectives of the Paris Agreement on climate change. Our strategy also requires that adaptation to the consequences of climate change is taken into account in the planning of sports facilities and events.

With regard to the Olympic Games, our strategy sets out the following four requirements:

- Organising Committees for Olympic Games (OCOGs) and host cities to minimise the Olympic Games' carbon emissions;
- OCOGs to compensate their 'direct'/ 'owned' emissions;
- OCOGs and host cities to promote low carbon solutions for and through the Olympic Games in the host country; and
- Candidate cities, OCOGs and host cities to take into account potential consequences of climate change when selecting Olympic Games location.

Furthermore, within the sustainability section of the IOC Host City Contract – Operational Requirements (July 2018), there is a requirement related to the theme of climate, which states:
i.   in collaboration with the host city, develop a carbon management plan to measure and minimise the Games' greenhouse gas emissions;
ii. promote low carbon solutions for and through the Olympic Games in the host country;
iii. compensate the greenhouse gas emissions caused by the OCOG's own activities; and
iv. integrate the potential consequences of climate change as part of infrastructure planning, including in the selection of venue locations.

This Guide has been developed to assist and facilitate OCOGs in addressing the measuring part of point (i) above. For further details on the rationale for climate as a sustainability focus area, please refer to the IOC Sustainability Strategy: https://www.olympic.org/sustainability.

1.2   The New Norm

In February 2018 the IOC published a comprehensive set of recommendations to reduce the cost and complexity of the Games and to improve operational efficiency and sustainability. This was called "Olympic Agenda 2020 – The New Norm".

One of the key consequences of The New Norm is that future editions of the Games are more likely to be based on concepts that utilise existing venues and infrastructure and temporary structures, even if that means spreading events over a wider geographical area, than the more compact Games model we have seen in recent decades.

We also expect to see cases where new venues are designed and built for their long-term purpose and then "pre-fitted" for the Games as a first user. This will move the debate away from Games-led development, to one where the Games will be accommodated within the strategic plans of the host territories and thereby supporting long-term sustainable development goals.

In terms of carbon emissions, this new approach will mean considerably less impacts from construction of permanent facilities on account of the Games, but some increase in the operational carbon footprint. This increase in operational carbon emissions can be expected if there are a larger number of temporary structures and a more dispersed configuration of venue locations, all of which will have to be serviced. For the purposes of this Guide, it also means that the OCOG will have an even larger scope of responsibility for the Games footprint than has previously been the case.

1.3   Purpose and scope of this document

Carbon footprinting is normally applied to organisations, products or services. The Games is a singular, large-scale project that contains elements of each of these and usually involves multiple public and private organisations as 'delivery partners'. Therefore, we have developed this carbon footprint methodology to take account of the special circumstances of both the Olympic Games and Paralympic Games as a project.

Since the mid-2000s it has become standard practice for OCOGs to measure the carbon footprint of their respective Olympic and Paralympic Games projects. However, the methodologies used have been inconsistent, which lessens the transfer of knowledge potential from one Games to another, as well as causing successive OCOGs to start

01 Identification of carbon experts to support the IOC to compile methodology.

02 Assessment of methodologies used by previous Games.

03 Consultation of OCOGs (2012-2028) to collect their needs and expectations.

04 Development of a draft methodology consistent with the GHG Protocol and ISO 14064. Quality control conducted by Quantis scientific director.

05 Review of the draft methodology by OCOGs (2012-2028) and by event and climate experts.

06 Revisions of the draft methodology and publication of the final version.

Figure 1-1: Process for the establishment of the methodology

from scratch. Furthermore, the timing and application of the footprint data – often too late in the Games-planning cycle – have lessened their effectiveness in terms of achieving significant lowering of carbon emissions.

One thing is clear however; the importance of having a reliable quantitative basis for developing carbon management strategies early in the Games planning cycle. The challenge in this is that OCOG sustainability teams are new into post and may be struggling to understand who does what, who owns which data and how best to influence early decision-making.

The purpose of this document is to help shorten the inevitable learning curve by providing OCOGs with detailed guidance on how to measure the carbon footprint of their Games project. This will help reduce early workload and speed up the process of developing an effective carbon management strategy.

More specifically we have three objectives:
- To present the carbon footprint methodology and its application to the Games;
- To ensure consistently high quality carbon footprinting by OCOGs; and
- To ensure clear, accurate and relevant communication and reporting.

1.4 Intended audience

This Guide is primarily aimed at the OCOG's sustainability team and the internal and external stakeholders who will play an important role in collecting data, calculating the footprint and monitoring results. These may include public and private delivery partners responsible for any Games-related venues and infrastructure, specialist consultants, expert advisory groups and assurance bodies.

The content can also benefit other audiences, such as:
- Olympic Games candidate cities, in order to plan initiatives related to the carbon management plan of the Games; and

- other event organisers interested in measuring the carbon footprint of their event.

1.5 Process for developing the methodology

This Guide has been produced by the IOC. Specialist consultants Quantis International[1] were commissioned to develop and draft the methodology and this was reviewed by IOC advisors and other subject matter experts. Consultees included sustainability team members from various OCOGs.

The process to establish the methodology followed the pathway illustrated in Figure 1-1 above.

1.6 Use of this document

Climate science is a fast-evolving discipline and current best practice is not a fixed state. It is also true that each edition of the Olympic and Paralympic Games creates new challenges and lessons to learn. Therefore, it is important to us that we assess and review the application of this carbon footprinting methodology on a regular basis.

However, to achieve consistency, we recommend that once an OCOG has started using this methodology, it continues to use the same version, even if updates are issued in the interim. In such circumstances, it will be important to state clearly which version of the methodology is being used and if any variants have been incorporated.

1.7 Feedback

As part of our commitment to continual improvement, we welcome feedback both from practitioners who have utilised the Guide and from subject-matter experts and other interested parties, with a view to improving future editions. If you do not have a direct relevant contact at the IOC, please send any questions and/or comments to sustainability@olympic.org.

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[1] *Quantis International. www.quantis-intl.com*

2   Methodological principles

2.1   Greenhouse gases

The term "carbon footprint" can be misleading, as a proper carbon footprint includes gases other than carbon dioxide, including some gases which do not contain any carbon atoms. These are "greenhouse gases", so-called because of their role in absorbing and emitting thermal radiation in the atmosphere. A more correct term is "GHG inventory". The list of greenhouse gases is provided by the IPCC Fifth assessment report[2].

Most greenhouse gases are naturally present in the atmosphere but their concentrations have increased since the industrial revolution through man-made processes, to levels threatening the stability of climate patterns, hence the common terms "global warming" and "climate change". The main source of emissions is the combustion of fossil fuels (oil, coal and natural gas). Agriculture, deforestation and refrigerant fluid leaks are also important sources.

Each greenhouse gas is characterised by its global warming potential (GWP), which is determined by the greenhouse effect and its lifetime in the atmosphere. Since carbon dioxide (CO_2) is by far the main contributor to global warming – about 75 per cent – the global warming potential of greenhouse gases are measured relative to the mass of CO_2, and are thus expressed as CO_2-equivalent (CO_2-eq).

The most common anthropogenic GHGs are listed in Table 2-1.

The Games' carbon footprint should include, when possible, all GHGs listed by the IPCC. However, for the sake of pragmatism and as carbon footprint tools and software do not include all GHGs listed by the IPCC, the Games' carbon footprint must include at least the three most common GHGs, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The results should be expressed in kg CO_2-eq or t CO_2-eq (tonnes CO_2 equivalent).

2.2 Carbon footprinting: the basics

A carbon footprint, or a greenhouse gas (GHG) inventory, maps the GHG emissions of an organisation, a service or a product, applying the life cycle approach. In the case of the Olympic and Paralympic Games, we are dealing with an entire project within a defined timescale, which presents specific characteristics that are detailed further on in this Guide.

A carbon footprint can be calculated by performing (according to international standards) a life-cycle assessment (LCA) with a focus on GHG emissions. The LCA approach is used to evaluate the impacts associated with products, organisations and services over their life-cycles, from the extraction of raw materials, through transportation, production, distribution, use and end-of-life treatment. These different steps are called 'life cycle stages'.

Main GHG	Chemical formula	Evolution of troposphere concentration since 1750	GWP 100 years (conversion factor)*	Contribution to climate change*
Carbon dioxide	CO_2	+40%	1	76%
Methane	CH_4	+150%	28	16%
Nitrous oxide	N_2O	+20%	298	6%
Artificial gases	SF_6, CHCs, PFCs, HCFCs	N/A	Variable	2%

*Table 2-1: Main greenhouse gases. *Source: IPCC 5th assessment report*

[2]https://www.ipcc.ch/report/ar5/

01 MEASURE   **02 UNDERSTAND**   **03 TAKE ACTION**   **04 INSPIRE**
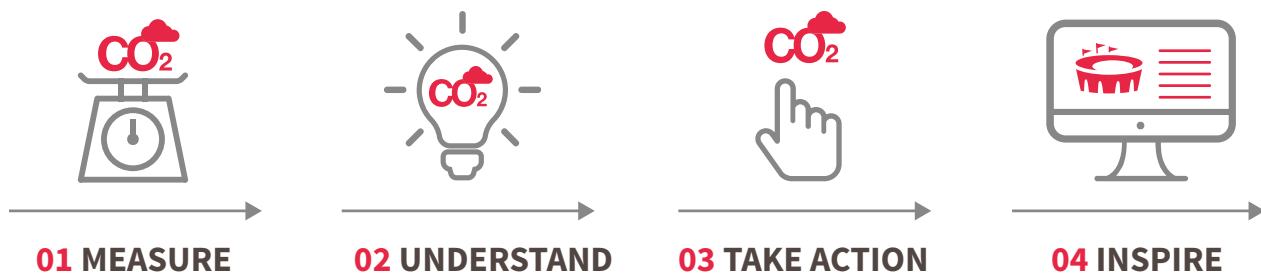
Figure 2-1: Carbon footprint – the first of a four-step process

2.3 Rationale for carbon footprinting

Throughout each life-cycle stage there is a potential to reduce impacts and improve performance, whether applied to organisations, services or products. Carbon footprinting, and more generally LCA, identifies opportunities to achieve this. The results can be used to support decision-making, but also enhance the credibility of marketing and communication efforts on sustainability, as they will be backed by factual information. In this way carbon footprinting can be viewed as the first part of a four-stage process, as illustrated above, and explained hereafter:

1. Measure
The carbon footprint consists of measuring GHG emissions of the organisation, service or product being assessed: it produces a robust quantitative evaluation of a key aspect of your environmental impacts.

2. Understand
This measurement is necessary to evaluate the overall climate impacts of the organisation, service or product, and to understand which activities contribute most to these impacts, which activities contribute less, and which parameters influence the impacts of these different activities.

3. Take Action
Understanding the most significant activities is key in guiding decision-makers to take actions that will reduce your GHG emissions. The top priority should be to focus on activities that have the highest contribution to the carbon footprint. The potential effectiveness of reduction measures can also be assessed using the carbon footprint methodology. This will help you to select the most cost-effective actions with the highest reduction potential. The measurement of your global GHG emissions is also essential for setting science-based targets and joining the global efforts to reduce GHG emissions around the world and to align with a 2°C global warming scenario, as highlighted in the Paris Agreement on Climate Change.

4. Inspire
By communicating your efforts, both internally and externally, you will contribute to overall efforts to raise awareness about sustainability. A carbon footprint can be used for communicating a sustainability plan based on solid metrics. Further, it can be used to assess and communicate the success of an action plan or to report the evolution of your GHG emissions over time.

2.4 Key elements of carbon footprinting

Carbon footprinting has four key elements:

1. Scope definition
The reasons for calculating the carbon footprint are described, as well as the system boundaries i.e. the processes included in the assessment and potential assumptions and limitations of the study.

2. Data collection
The data and information related to the organisation, product or service being studied are collected from different sources. Typical data to collect include raw materials used, water and energy consumption, transportation modes and distances, waste generation and treatment.

3. Data modelling
The data collected in the previous step are "translated" to GHG emissions, based on emission factors, GHG emissions per unit of input (e.g., expressed in kg CO_2-eq/unit of input). These factors are usually available in different databases (see section 4.3.1). The data translated to GHG emissions using the emission factors can be summed up, and the results of the carbon footprint is expressed in kg CO_2-eq or tonne CO_2-eq.

01
SCOPE DEFINITION
Defining the scope of the project, the limit of the system, the activities to be included or excluded

02
DATA COLLECTION
Monitoring and collecting physical data needed for the modelling

REFINEMENT

04
INTERPRETATION
Use the results to define an action plan, to communicate, etc.

03
DATA MODELLING
Using the data to model the carbon footprint
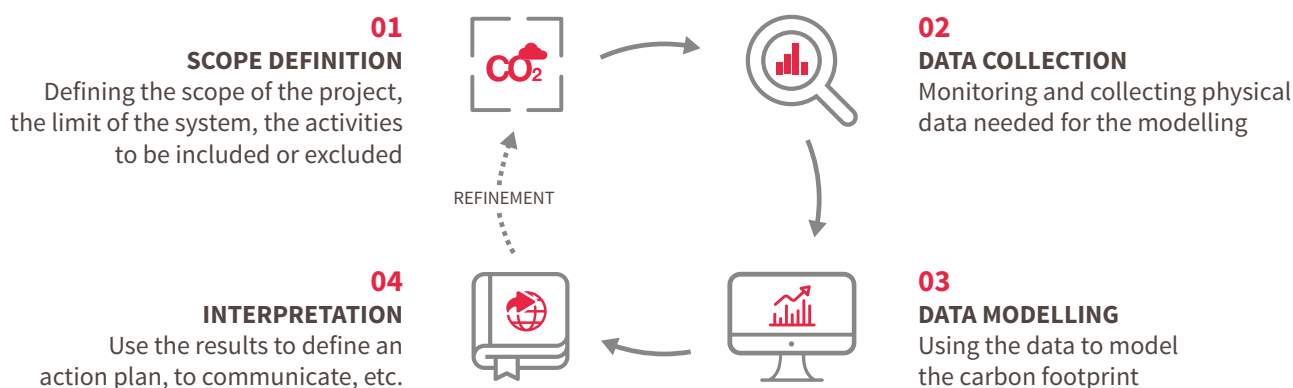
Figure 2-2: The four key steps of carbon footprinting

4. Interpretation:

Based on the results, activities that contribute most to the total carbon footprint can be identified:

- The data related to these contributing activities are the top priority for refinement and improvement of the assessment.
- In turn this leads to the identification of priority actions for reducing the carbon footprint.
- Results can also be used for communication and reporting.

Always keep in mind that calculating and assessing a carbon footprint is an iterative process that can be done several times. A first version should result in a simplified (screening) evaluation based on assumptions and/or rough estimations for missing data. This is essential for identifying the main contributors to the total carbon footprint, and in turn selecting the top priority data to refine. This first stage is also key to understand data gaps or where data quality is poor.

Data quality can be very variable. Ideally the footprint should be compiled from real measurements, but typically one may have to make assumptions, estimates and use proxy indicators in the absence of direct values. At the early stages in particular, there may be serious gaps in information about venue designs, levels of services, numbers of people involved etc.

Successive iterations will lead to a refinement of the calculated footprint and more detailed data are collected for the most significant activities. These iterations are necessary to improve the accuracy and quality of the results.

More detailed information on each of these key elements is given in Chapter 4.

2.5 A carbon footprint methodology specific for the Games

As we have explained above, carbon footprinting is normally applied to organisations, products or services. The Games is a singular, large-scale project that contains elements of each of these and usually involves multiple public and private organisations as 'delivery partners'. Therefore, we have developed this carbon footprint methodology to take account of the special circumstances of both the Olympic Games and Paralympic Games as a project.

2.5.1 The Games as a project

Measuring the carbon footprint of the Games presents some particular challenges. First, the event is some years in the future, while the carbon footprinting work has to be initiated early in the planning phase. Whereas most normal organisations present their carbon footprint as a factual retrospective account of what they have done during a given reporting period – and from this they can set future targets – for the Games the nature of the footprint is a forward-looking estimation of anticipated impacts.

Aside from any Games-related construction projects in the early years, the vast majority of carbon emissions will occur in the year of the Games. This means that the carbon footprinting exercise is essentially a form of impact assessment all the way up to Games-time and only afterwards does the final calculation become a report.

Lack of high quality data at the beginning may impact the accuracy of the initial carbon footprint exercise, but despite this it should be useful to highlight potential areas where GHG emissions could be avoided or reduced, so that these can be taken into consideration in decision-making processes.

Delivering the Games requires input from multiple organisations and thus responsibility for some of the major sources of GHG emissions may be shared by more than one entity. This can present specific challenges in terms of defining scope and allocating responsibilities.

Another key question relates to scope, especially in relation to the development of new permanent venues and infrastructure. What is often unclear is whether these activities are truly Games-related (i.e. necessary for staging the Games), or have been brought forward to take advantage of hosting the Games but would have happened in any case at some point in the future. It is therefore crucially important to define what is included in the scope of the Games carbon footprint and who owns (i.e. is responsible for) these emissions.

The OCOG is the lead organisation in terms of planning and staging the Games and this Guide is focussed on the OCOG being the responsible body for the carbon footprint calculation and development of the carbon management strategy for the Games. However, we recognise that often there will be key elements of the project managed by public agencies and/or private developers, as well as the IOC through its wholly-owned subsidiary, Olympic Broadcasting Services (OBS) and it is important to be able to capture the GHG emissions caused by these activities.

In addition there are many potential sources of GHG emissions that would only have occurred because of the Games, but over-which the organisers have little control and varying degrees of influence. These include spectator travel and accommodation, hospitality and promotional activities of National Olympic Committees (NOCs), other sports bodies and sponsors within the host territory during the Games.

Often, these items are hard to calculate because of the difficulty in obtaining reliable data and because they are usually planned at relatively short notice. Nevertheless, they are obviously a factor of what makes up the entirety of the Games, and therefore must be considered.

What is most important from the perspective of external stakeholders, notably NGOs, media and the general public, is that you provide as an accurate as possible picture of the GHG emissions related to the Games project. People are not interested in the minutia of organisational divisions of responsibility. Thus whether it is down to the OCOG or a delivery partner, ultimately the GHG emissions are associated with the Games. Therefore the carbon footprint needs to be presented externally in the context of the Games, not of individual organisations, even though internally there will need to be clear allocations of responsibility.

2.5.2 Compliance with internationally recognised standards

Carbon footprinting is an internationally recognised methodology and various standards exist for the application of these methodologies to products, services or organisations. The methodology proposed in this Guide is inspired by and consistent with three existing international standards: the GHG Protocol, ISO 14064 and the European Commission's Organisation Environmental Footprint (OEF).

These widely used standards are aimed at guiding the carbon footprint calculation of organisations. However, as these standards were not developed with sports events in mind, they are not necessarily well-adapted for this purpose. As a result, we have based the methodology presented in this Guide on the principles of these standards, but with specific adaptations for the Games.

These principles are explained in Table 2-2 below.

Principle	Definition
Relevance	Ensure the GHG inventory appropriately reflects the GHG emissions of the Games and serves internal and external decision-making processes. Identify any contentious carbon accounting issues early on to allow time for research, debate and consensus building. Document the decision-making process.[3]
Completeness	Account for and report on all GHG emission sources and activities within the chosen inventory boundary and in the year that the emissions occur. Disclose and justify any specific exclusion.
Consistency	Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.
Accuracy	Ensure that the quantification of GHG emissions is based on reasonable assumptions and that uncertainties are reduced as much as possible. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance with respect to the integrity of the reported information.
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies, assumptions and data sources.

Table 2-2: Carbon footprint principles. Source: inspired by the GHG Protocol

If some information is found to be lacking in this Guide, please refer back to the international standards listed above and their underpinning principles.

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[3] *The carbon conversion factors used should be responsive to local circumstances. Rules about how to account, for example, renewable energy are not universal. These can change as new guidance emerges and may differ within, and between, countries.*

2.5.3 Legacy

There is much attention given these days to Games legacy in terms of lasting environmental, social, sporting, cultural and economic benefits arising from having hosted the Games. In carbon accounting terms, legacy benefits are lasting carbon savings as a result of Games-funded projects or initiatives. To count towards legacy they must be additional (see 2.5.4).

Unless there is a long-term programme after the Games are over to measure legacy carbon savings, the information is likely to be lost. Therefore, in establishing legacy programmes where there might reasonably be carbon savings, organisers should incorporate requirements and methodologies to enable this information to be captured during the implementation phase of the programmes concerned.

2.5.4. Additionality

There is often confusion as to what is truly related to the Games and this can arise in two ways. First, there may be claims that certain infrastructure developments (e.g. utilities or transport infrastructure, and upgrading and repairs to public spaces and buildings) were done to prepare for the Games. Some of these may have been previously planned and then accelerated on account of the Games, others may simply be new schemes arising because of the city's changed context as a host for the Games. There may also be a political dimension, whereby public authorities and/or developers use the forthcoming Games as a lever to gain funding for schemes, even though from a Games organisation perspective, such works are unnecessary. Depending on how these projects are portrayed, there could be pressure to include the carbon impacts in the Games carbon footprint.

Secondly, and in contrast, there can be situations where carbon saving initiatives are claimed as Games benefits, when technically they are outside of scope. For example creation of green spaces and reforestation projects might be attributed as Olympic-related, but if they were pre-planned and funded from entirely different sources, it would not be permissible for the Games organisers to claim the carbon benefits.

Green energy schemes have proven controversial in past Games. If Games venues are drawing power from the public grid, the carbon emissions should be based on the carbon intensity of the grid mix. Buying 'green energy' certificates does not change anything unless the suppliers are adding new installed renewable energy capacity.

Such questions of additionality are complex and can lead to considerable debate with stakeholders and subject matter experts. The golden rule is therefore to be clear and strict about what is within scope of the Games carbon footprint, and equally to be rigorous in determining genuine additionality for any carbon benefits being claimed (see Table 2-2 – Relevance).

2.5.5 Keeping the main purpose in mind

Carbon accounting is a technical discipline. In a project as complex as the Olympic and Paralympic Games, with such a wide scope, multiple delivery partners and a long time frame, it would be easy to become lost in minute details.

It is therefore always important to remember the real purpose of this exercise. It is about minimising the GHG emissions caused by planning and staging the Games. The carbon footprint is intended as a tool to facilitate decision-making for this purpose. Given resource and time constraints, there needs to be a pragmatic balance between achieving technical accuracy and the practical ability to avoid and minimise GHG emissions.

3 Calculating the Games carbon footprint: organisational aspects

This section explains how the OCOG, as an organisation, should devise a carbon management plan in order to calculate the carbon footprint of the Games and to deliver the required outcome. This section proposes a calendar, with three successive and mandatory outputs. It also provides advice about the processes to monitor and for which to collect data. Finally, it provides recommendations about reaching the expected level of quality by implementing a sound review process.

The technical aspects concerning the calculation of the carbon footprint are addressed in section 4.

3.1 Development of the Games carbon management plan

Within the Host City Contract – Operational Requirements (June 2018), there is a specific requirement for the OCOG to develop a "carbon management plan".

> **Extract of the Host City Contract – SUS 05 – Carbon management plan**
>
> In collaboration with the host city, develop a carbon management plan to measure and minimise the greenhouse gas emissions in all activities related to the Games, including actions to:
>
> • promote low carbon solutions for and through the Games in the host country; and
> • compensate the greenhouse gas emissions caused by the OCOG's own activities.

This reflects the four elements described in section 2.4: measure, understand, take action and inspire. The carbon footprint calculation forms the "measure" part of this sequence. However, it is not a single, one-off measurement, but in fact is part of an iterative process that is integral to fulfilling the requirement for a carbon management plan.

To begin with, a first screening assessment of the carbon footprint should be calculated based on easily accessible data and/or proxies. This will allow the main elements of the carbon footprint to be identified, including the priority data to be collected and refined, and the data gaps to be filled for the second iteration (detailed carbon footprint).

With each successive iteration of the carbon footprint, it should be possible to identify more specific emission avoidance and reduction opportunities. These will form a "carbon footprint reduction plan" – the "take action" part of the overall carbon management plan.

This iterative process may have several intermediate stages but the essential components are described below:

• The *Initial carbon footprint* will normally be based on the bid concept and commitments, and should be calculated early enough in the planning process to provide a basis to inform key decision-making about confirming venue locations, design briefs and procurement strategies. It will also provide know-how to the OCOG to improve the quality of the subsequent phases.
• The *Carbon footprint reduction plan* builds upon information from the Initial footprint and is used to identify strategic approaches, key measurements and targets for carbon emissions avoidance and reduction. This should be done while maintaining a close dialogue with the IOC, for example, in the case when carbon reduction opportunities would require changes in IOC requirements or bid commitments.
• The *Actual carbon footprint* simply measures the true footprint of Games, and provides the basis for determining the benefits of the *Carbon footprint reduction plan*.

These three main components of the Games carbon management plan may either form a series of stand-alone publications, or they can be integrated into other sustainability reports such as the Games sustainability plan, the pre-Games sustainability report and the post-Games sustainability report.
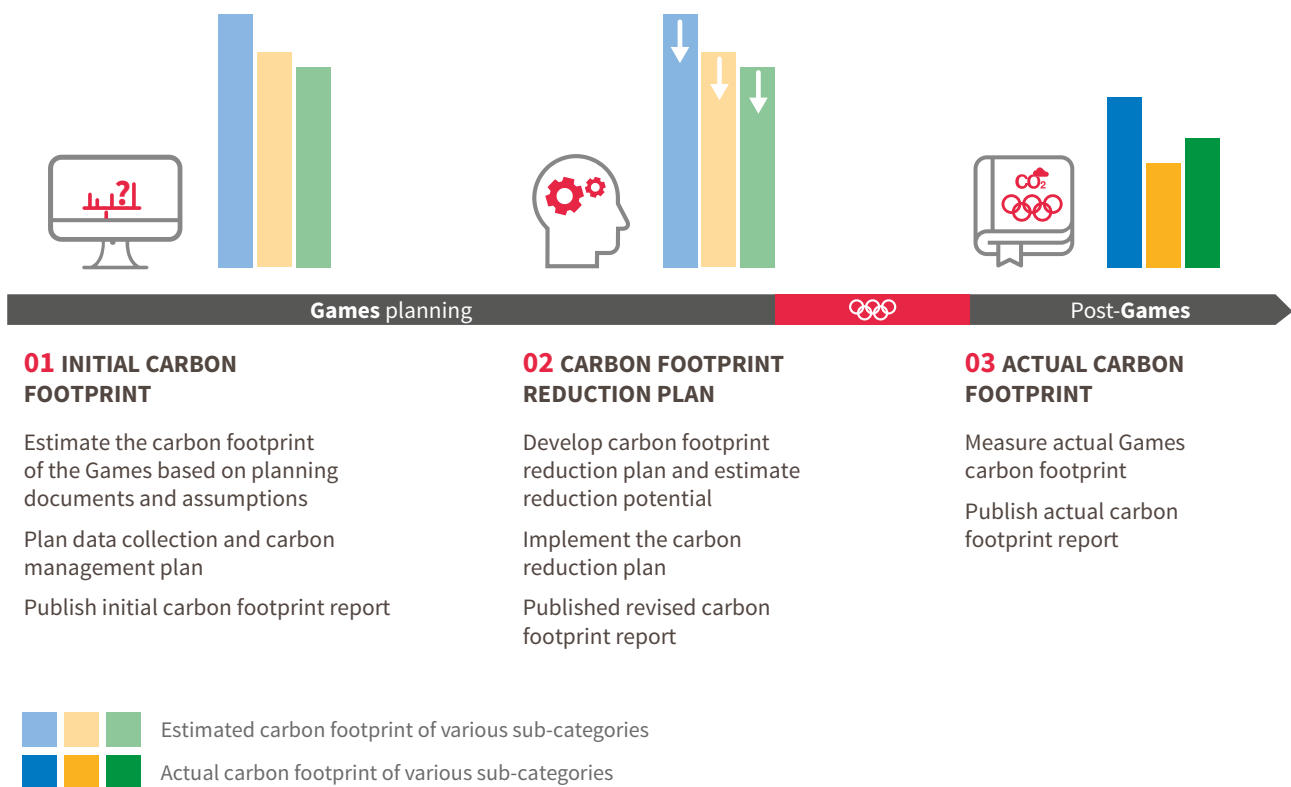
Figure 3-1: Main components of the Games carbon management plan

01 INITIAL CARBON FOOTPRINT

Estimate the carbon footprint of the Games based on planning documents and assumptions

Plan data collection and carbon management plan

Publish initial carbon footprint report

02 CARBON FOOTPRINT REDUCTION PLAN

Develop carbon footprint reduction plan and estimate reduction potential

Implement the carbon reduction plan

Published revised carbon footprint report

03 ACTUAL CARBON FOOTPRINT

Measure actual Games carbon footprint

Publish actual carbon footprint report

Estimated carbon footprint of various sub-categories

Actual carbon footprint of various sub-categories

3.1.1 Initial carbon footprint

The *Initial carbon footprint* should be calculated as early as possible in the Games planning phase. This will be based on forecasts rather than actual results (*ex ante*). In addition to providing a first estimate of GHG emissions, this will serve three other purposes:

- identify which data should be monitored for subsequent phases of the carbon management plan;
- define internal responsibilities and organisational processes in order to monitor and collect such data; and
- provide information needed to develop the *Carbon footprint reduction plan*.

An explanation of how to use the *Initial carbon footprint* results is detailed in section 4.4.

The *Initial carbon footprint* should start sufficiently early in the planning phase to provide a basis for informing key decisions. Unless there has already been sufficient work done in this area during the candidature phase (pre-host city election), it is likely this will require a good year to 18 months to identify data requirements and sources, pull together expert teams, complete the initial calculations and obtain management and delivery partner approvals. The aim should be to complete the initial footprint by Games minus 5 years and not later than 4 years before the Games.

It is preferable to have an early estimate, albeit with caveats on data quality and gaps, rather than leave it too late because of an obsession with technical accuracy.

Subsequent iterations can modify the footprint as new and better data become available.

3.1.1.1 Method and data

Some GHG emissions can be calculated based on activities that are already occurring such as those related to energy use at the OCOG's headquarters or staff travel, although these will be negligible compared with the Games-time GHG emissions. Most emissions can only be estimated, as they are based on activities that will occur in the future, such as catering and transport services during the Games. The *Initial carbon footprint* must therefore be based on information and data from planning documents, including candidature documents, and reference cases, such as previous Games and other studies on venues, events and other projects in the host country or region.

The *Initial carbon footprint* should normally be calculated based on the bid concept at the time of being elected host city. Where carbon-saving measures have already been included in the candidature, they should be considered as your starting point – i.e. it would be wrong to claim them again later on as new carbon-saving initiatives in your carbon management plan.

If there have been some alterations of venues to be used for the Games and/or new sports have been included which require different venues, the *Initial carbon footprint* should reflect as best possible the actual Games masterplan. This will serve as your baseline.

It may be of interest to be able to show the carbon impact of the venue changes from bid concept to optimised masterplan – usually driven by cost savings, operational efficiencies and legacy concerns – as these are likely to show carbon savings, albeit as a happy by-product of the changes, rather than a specific motivation for them.

This does not exclude the potential for further venue alterations later on in the planning phase. Where such changes occur, these should be captured in future iterations of the carbon footprint and the effect of such changes should be clearly stated.

3.1.1.2 Outcome

- **Publication of the Initial carbon footprint.**
  The draft carbon footprint should be provided to the IOC for review and comment. Following IOC approval, it may also be released publicly, either as a stand-alone document or incorporated into the first edition of the Games Sustainability Plan. The publication should emphasise the preliminary nature of the carbon footprint and that it is a forward projection, not an actual result.

- **Project management plan.**
  The knowledge acquired throughout the process of the first footprint calculations will help towards the development of subsequent phases of the project. A project management plan should be prepared to define the following main tasks:

  – technical requirements: generation of a comprehensive list of data to collect, including the expected data owner;
  – project governance: naming of a person in charge of organising the data collection; this person will connect with each data owner, including those outside of the OCOG;

– schedule: defining of a timeline for data collection, including for emissions occurring during the planning stage;
– processes: organising the data collection (tools, methods, quality control); and
– resources: budget and staffing.

This work will drive the expected level of quality through the rest of the carbon footprinting exercise.

3.1.2 Carbon footprint reduction plan

The objective here is to inform decisions that will lead to a decrease in the carbon footprint of the Games. These decisions include the activities under direct control of the OCOG, but also those of other delivery bodies and partners, on whom the OCOG may exert a direct or indirect influence.

Identifying potential emission reduction opportunities should be constantly in mind throughout the whole footprinting process. It is not necessary to wait until the *Initial carbon footprint* has been established, although this will give a clearer idea of the main areas to focus on for the *Carbon footprint reduction plan*.

3.1.2.1 Content

Even though the *Initial carbon footprint* is a preliminary estimate and it will have a number of assumptions and caveats, it should be useful as a tool to help the OCOG and other stakeholders make decisions that will contribute to reducing the environmental impacts of the Games.

The *Carbon footprint reduction plan* should draw on the findings from the *Initial carbon footprint* to identify and set targets for carbon saving opportunities, especially regarding venue design, materials selection, procurement strategies and initial plans for Games operations.

There are many variables to consider, so the plan is likely to include a range of scenarios offering different levels of carbon reduction potential. These should be evaluated in order to select the scenarios having the most cost-effective potential for achieving carbon reduction targets.

The development of the *Carbon footprint reduction plan* should be the responsibility of the OCOG's sustainability team, working alongside other Functional Areas[4] (FAs) and with counterparts on other delivery bodies and partners. It will need to be signed off by senior management in the key parties involved.

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[4]Examples of key FAs/Departments to involve in this process include, but are not limited to, Venues & Infrastructure, Villages, Transport, Energy, Logistics, Food and Beverage, Ceremonies, Procurement, Commercial, Brand Identity and Look of the Games and Technology.

While the *Carbon footprint reduction plan* will provide a collective strategic approach for minimising GHG emissions related to the Games, specific implementation of the recommended actions will need to be through integrating measures into detailed action plans owned by different departments and functions. For example, low carbon options for transport will need to become part of the mandate of the Transport FA (and possibly the city transport authority as well), and coordinated with Commercial and Procurement departments, so that sponsorship and purchasing decisions are fully aligned with the sustainability objectives.

This is most readily achieved through an effective management systems approach, which ties neatly to the OCOG's obligations under the Host City Contract – Operational Requirements to operate according to the ISO 20121 standard for Event Sustainability Management Systems.

3.1.2.2 Outcome

- **Publication of the Carbon footprint reduction plan.**
  This should be pitched as a strategic plan covering the whole Games programme, and setting out objectives, action areas and targets for avoiding/reducing GHG emissions, along with timelines and responsibilities. This could be a stand-alone document, or it may be integrated into the overall Games Sustainability Plan if the timelines coincide. However, the *Carbon footprint reduction plan* will be quite a detailed document, so it might be best as a distinct piece of work. Alternatively, it could be combined with an update of the *Initial carbon footprint* using the latest data available. In whichever form, the *Carbon footprint reduction plan* should be finalised by no later than Games minus 3 years.

- **Implementation of the Carbon footprint reduction plan.**
  Within the OCOG, the list of measures identified in the *Carbon footprint reduction plan* should be developed further into specific action plans for individual FAs and supported by appropriate monitoring and evaluation processes before, during and for two-three months immediately post-Games. Key delivery bodies and partner organisations should develop their own action plans and these should be aligned as best possible with the overall Games carbon management plan.

3.1.3 Actual carbon footprint

This is where we switch from predicting potential impacts to being able to report real results. The main objectives are:

- to report the carbon footprint of the Games based on measured data; and
- to contribute to building the knowledge and know-how around the Games carbon footprint for future OCOGs and their partners.

3.1.3.1 Content

While the *Initial carbon footprint* is mainly based on assumptions or financial data, the *Actual carbon footprint* should be largely based on physical data, measured throughout the planning and staging of the Games, including the immediate post-Games decommissioning and dissolution phase.

Compiling the *Actual carbon footprint* consists of three successive steps:

1. Data monitoring: Once the *Initial carbon footprint* has been completed, it will be possible to define a comprehensive list of data that needs to be collected for calculating the *Actual carbon footprint*. The OCOG's sustainability team will be responsible for determining what data are needed and from where they can be sourced. As soon as the OCOG has reached a sufficient level of maturity in terms of management system processes and IT systems, data collection processes can be put in place and tested. The earlier this is achieved, the better, to enable successful capture of GHG emissions occurring during the planning and staging of the Games.

2. Measuring the Actual carbon footprint: Most, if not all, methodological questions should be resolved ahead of the Games in order to reduce as much as possible the workload during the busy months prior to, during and immediately after the Games. Ideally, tasks occurring after the Games should be limited to collecting a final set of data identified earlier (from suppliers, sponsors, other functional areas and delivery bodies), and then processing these data and calculating the *Actual carbon footprint* of the Games. Data available and collected during the Games planning and development phase should be modelled before the Games. This will reduce the workload after the Games, but also increase the quality of the carbon footprinting process through 'learning by doing' – for example, correcting data inconsistencies and plugging gaps where data are missing.

3. **Reporting:** The results of the *Actual carbon footprint* should be published as part of the post-Games Sustainability report, normally within six months following the end of the Paralympic Games.

The post-Games period presents some significant challenges, as the OCOG disbands rapidly and many data owners may have left shortly after the end of the Games. Even among other delivery bodies and partner organisations that are ostensibly permanent and not going through dissolution like the OCOG, their Games personnel may be redeployed and data monitoring systems turned off.

To anticipate such challenges in collecting final data, it will be important to understand dissolution timelines for each data-owning FA/organisation, and ensure that you have identified key personnel who will remain after the Games and that they are adequately briefed/trained to provide the necessary data and have the remit to do so.

These processes should be tested in the run up to the Games. By doing this, you should gain a reasonably accurate and up to date snapshot of the likely results, and ensure that everyone is capable of doing their tasks.

Another way to save time and minimise risk is to draft the *Actual carbon footprint* before the Games. The final version of the report can then be compiled quite quickly – effectively just dropping in new data and updating analysis and commentary.

3.1.3.2 Outcome: publication of the Actual carbon footprint

The *Actual carbon footprint* report should contain:

- A first section dedicated to the carbon footprint results. A reporting template is available in Appendix 1 (section 6), providing the information needed to ensure that the report has a sufficient level of clarity, accuracy and completeness; and
- A second section should present the successes and difficulties in the implementation of the *Carbon footprint reduction plan*. Showcasing success stories and the associated GHG savings is always useful, and it is even more informative if you can openly highlight the difficulties encountered throughout the process, how they were addressed and identify possible improvements. This will help future OCOGs and other event organisers avoid the same difficulties and hopefully achieve more significant carbon savings.

3.2 Carbon management plan: detailed schedule

A typical calendar of the main activities is represented in Figure 3-2, illustrating when each publication milestone should be achieved. This is intended to be illustrative and the exact form and timing of any publications should be coordinated with your key stakeholders and agreed with the IOC, so that it fits best with the Games' sustainability milestones.
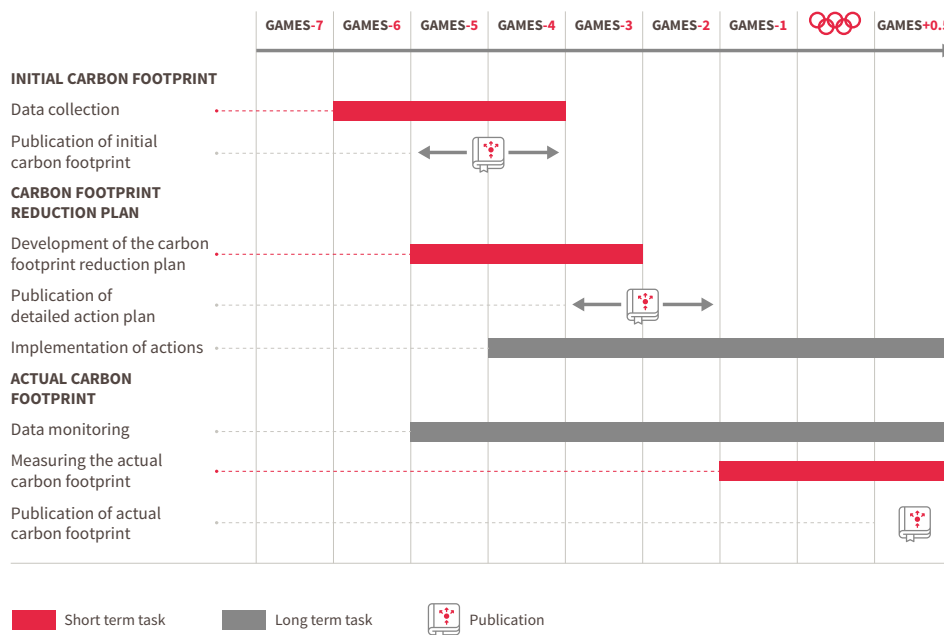
Figure 3-2: Calendar of the Games carbon management plan

3.3   Resource requirements

This work will require time, personnel and budget. It will also depend on effective project management and coordination across a number of organisations from the outset.

We recommend the project is managed by the OCOG Sustainability FA, with a dedicated team-member assigned to lead the work. This role should be in post within two years of the OCOG's creation. Key tasks for the project manager will be:

- Identifying data owners and building a network of contacts across key FAs and with other delivery bodies and partner organisations;
- Establishment of specialist carbon advisory group, drawing upon external expertise from academia, business, NGOs and government agencies,
- Coordination of data gathering;
- Procurement of specialist consultants to do the carbon footprint calculations and managing the contractual relationship with those appointed to do the work;
- Mapping roles and responsibilities as part of the development of the *Carbon footprint reduction plan*;
- Determining data requirements for each FA and external partner;
- Establishing internal processes to ensure efficient measurement and monitoring of data, and coordinating with external data providers (e.g. venues, sponsors, transport authorities and other delivery bodies);
- Providing content for sustainability strategies and progress reports, and for stand-alone carbon reporting as appropriate; and
- Ensuring the required data can still be collected through the post-Games dissolution phase, in order to guarantee an accurate *Actual carbon footprint* calculation.

We would not normally expect the OCOG to have the in-house capacity to do the detailed calculations for the carbon footprinting. It should therefore be supported by experienced carbon or life-cycle assessment specialists, by contracting some aspects of the work to external consultants.

In terms of budget implications, the direct costs to be considered are headcount for the OCOG sustainability manager for this project and consultant support. All other costs associated with implementing GHG emissions avoidance and reductions should be integrated into the relevant functional budgets and managed through core processes such as venue design and procurement.

Although most carbon saving measures should lead to an overall cost saving for the OCOG, this may not be true in the case of certain individual FA budgets, and it will be important to understand overall lifetime costs as part of making purchasing decisions. Many of the carbon saving initiatives may arise via commercial partners and therefore sustainability requirements should form part of sponsorship negotiations.

The project timescale is from the establishment of the Sustainability FA, through to the disbanding of the function following completion of the post-Games sustainability report and any learning legacy case studies.

3.4   Data collection: organisation for an important but complex process

Data collection is a critical element of delivering a high quality Games carbon footprint. However, it is usually the most challenging aspect of the carbon footprint process.

The main difficulties identified are:

- Data monitoring must be carried out over an extended period, typically up to seven years covering the time from host city election to a few months after Games have ended. As the OCOG grows and other partners come on board, it becomes more difficult to follow who is doing what and to maintain contact with data owners. The latter may change as individuals take on different responsibilities and increased workloads. It requires continual effort to ensure data collection is actually done and transmitted to the sustainability team;
- There will be many data sources from within the OCOG and among external stakeholders responsible for key Games deliverables. A complex coordination plan must be put in place to ensure efficient exchange between all stakeholders;
- Data owners need to be well briefed on the requirements and data collection methods, to ensure that good quality data are obtained;
- Although the *Initial carbon footprint* will help identify most data needed for the project, the constant development of the Games project will inevitably mean that additional information is needed during the later stages. The challenge for the Sustainability FA and the project manager is to be aware of new initiatives and identify potential carbon footprint implications. This requires proactive engagement across the organisation (and with partners) to minimise the risk of surprises; and
- Some data may not be shared due to confidentiality reasons.

It is not reasonable to expect to capture every item, or to be able to measure the Games carbon footprint with total precision. However, with strong project management and data management processes in place, one can anticipate that the significant GHG emissions will be identified and measured.

The following elements can facilitate the data collection process and the data quality:

- Use the *Initial carbon footprint* to identify and characterise (e.g., type of data, units, timeline, data owner) as accurately as possible the data requested for the *Actual carbon footprint*;
- Identify and connect with each person having access to the requested data, including external staff; this is the so-called data owner;
- Provide a data collection template, for example, based on information provided in Appendix 2 (section 7), to relevant functional areas and data owners;
- Educate data owners about the aim, need and methodology of carbon footprinting, in order to enhance proactivity and engagement, for example through workshops;
- Carefully plan the monitoring and data collection: identify data owners, define responsibilities and deadlines, be reactive and offer support to data owners; and
- Apply the approach "learning by doing" by calculating an intermediate carbon footprint between the *Initial carbon footprint* and the *Actual carbon footprint*.

3.5 Review and validation

3.5.1 By the IOC

The IOC will review drafts of the *Initial carbon footprint* report and the *Carbon footprint reduction plan*, in order to provide comments and recommendations before the public release. In particular, we will verify that the reporting is aligned with the framework provided in Appendix 1 (section 6), that statements are in line with the principles of this methodology, and that bid commitments are being upheld.

3.5.2 By an external technical advisory group

It is worth establishing a technical advisory group, comprising external experts and relevant stakeholders in this field. Not only will this encourage strong engagement from important stakeholders, but also it should help improve the quality and credibility of the Games carbon management plan. Such a group can also be asked to validate methodological choices and to review the progress made.

Optionally, a certifying body can be hired to participate in the project. Usually this would be to validate methodology rather than a detailed audit of the calculations. However, given the existence of this standardised methodology and broader requirements linked to the ISO 20121 certification, additional carbon-specific assurance may not be necessary. Ultimately, any decisions regarding additional levels of verification and assurance will be based on the climate of stakeholder opinion – and possibly even regulatory requirements – in the host city/country.

4 Calculating the Games carbon footprint: technical guidance

Section 2.4 describes the four key steps of carbon footprinting. This chapter provides detailed guidance on what is involved in each of these steps.

4.1 Step 1: Scope definition

This section describes what needs to be taken into account to calculate the carbon footprint of the Games: types of emissions (direct and indirect), geographical boundaries, time periods and which specific activities should be included.

4.1.1 General principles for defining the GHG emissions to be included in the carbon footprint

The carbon footprint methodology follows the life-cycle approach, accounting for all life cycle stages of the activities considered: extraction of raw materials, transportation, production, distribution, use and end-of-life treatment.

4.1.1.1 Direct and indirect emissions

The definition of the system boundaries includes all direct and indirect emissions related to the Games, corresponding to the GHG Protocol terminology, Scope 1, 2 and 3:

- Scope 1: direct emissions from fuel combustion in owned machines, devices and vehicles;
- Scope 2: indirect emissions from purchasing energy, in particular electricity, steam, heat or cooling; and
- Scope 3: indirect emissions from upstream and downstream activities, such as travel, purchased goods and services.

Direct emissions are under the full control of the organisation, while indirect emissions are not. However, as indirect emissions can sometimes be several times higher than direct emissions and can be influenced by the OCOG, a comprehensive carbon footprint must include these emissions in the scope of the study.

4.1.1.2 Geographical boundaries

Indirect emissions may occur at a large distance from the Games host cities. As they are included within the scope of the project, no geographical boundaries are defined. The processes are taken into account wherever the activities take place.

4.1.1.3 Time boundaries

The time period includes the full lifespan of the Games project from the point of being elected host city, throughout the (normally) seven years leading up to the Games, and through to the post-Games dissolution phase. The latter may not be a precise end point. Sometimes the legal dissolution of the OCOG can be over a year after the end of the Games, but in terms of meaningful GHG emissions, it is generally safe to assume all activities will have ceased by three to four months following the end of the Paralympic Games (see Figure 4-1 over page).

If there are significant venue conversion works being undertaken after the Games as part of legacy plans, these may take considerably longer. However, they will not be the responsibility of the OCOG, and it should be up to the organisation(s) delivering these works (or 'legacy owners') to account for any further GHG emissions (see also section 7.2.2.1).

4.1.1.4 Determination of which activities should be included, and which should not

The Games carbon footprint comprises all GHG emissions that can causally be attributed to the Games. A proportion of these, but by no means all, will be directly due to the activities of the OCOG.

Other emission sources will be the result of activities by other Games stakeholders, such as delivery bodies responsible for building venues and infrastructure, security services, commercial partners, broadcasters and Olympic Family (the IOC, National Olympic Committees, International Federations and all their associated athletes, technical officials and support personnel). Although these are outside the direct control of the OCOG, wherever there is some form of contractual relationship or official function, there is potential for the OCOG to wield some influence.

There are also emission sources that are clearly due to the Games but over which the OCOG will have little or no influence, such as the long distance travel of spectators and their spending activities in the host city (accommodation, food, buying official merchandise). If these can be measured with any degree of accuracy, they should be included in the carbon footprint calculations.
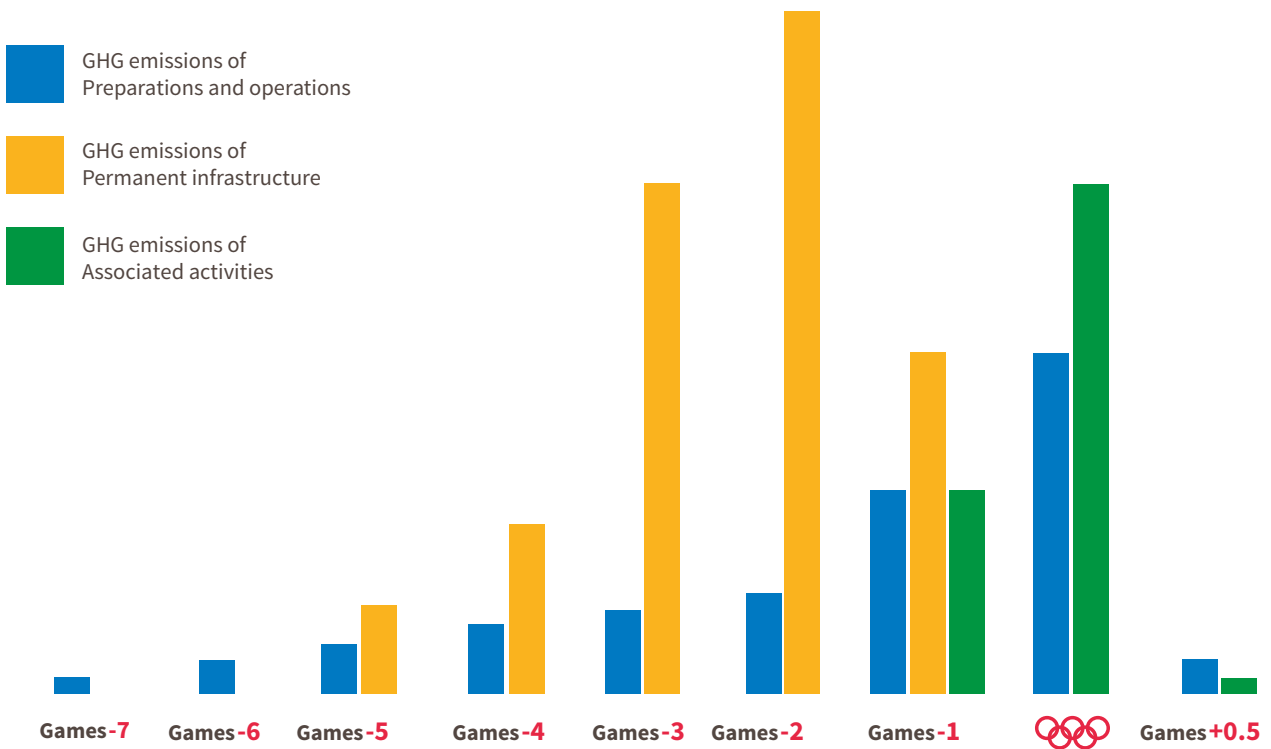
Figure 4-1: Schematic timeline of the Games GHG emissions

The following decision tree can be used to determine which emission sources should be included in the Games carbon footprint:
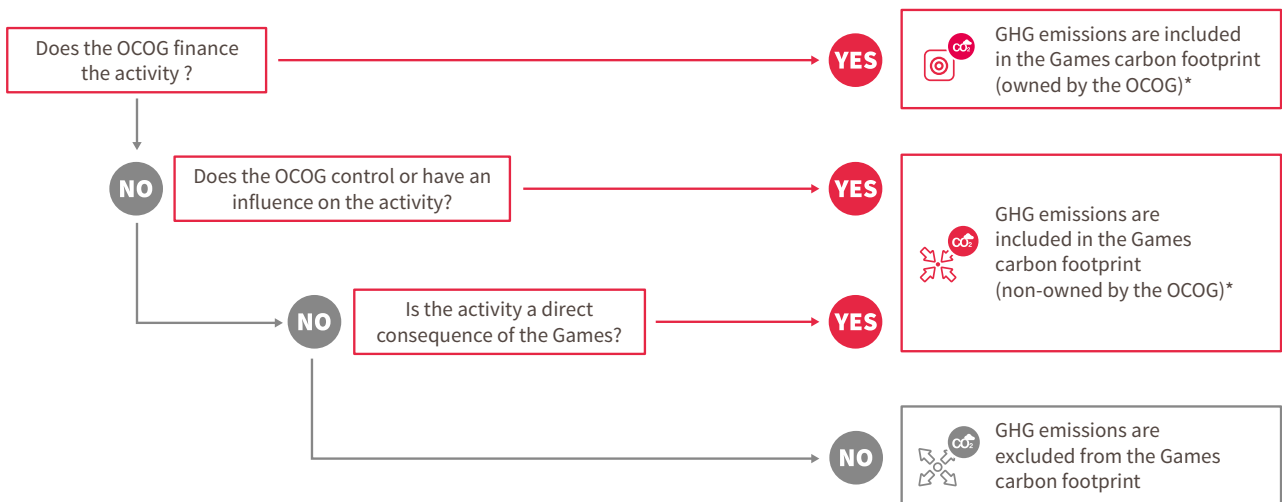
*If the answer is YES but the emissions cannot be estimated with any reasonable degree of accuracy, these may be excluded from the carbon footprint calculation. However, their omission must be clearly explained and justified in the carbon footprint report.

Figure 4-2: Activities included in the Games carbon footprint

Press and broadcasting is a complex area. A large part of the on-site broadcasting activities, including all the live TV feed, are delivered by OBS. Since the IOC has taken responsibility for its own carbon footprint, what is fully paid for and directly managed by OBS is included in the IOC's carbon footprint calculations. There will need to be close liaison between OBS and the OCOG to make sure that all relevant GHG emissions are accounted for and there is no double counting.

There are also Rights Holding Broadcasters (RHBs) from different countries active in the host city during the Games, as well as significant numbers of 'non-accredited' media. This is a constituency similar to spectators in that there is relatively little influence that can be exerted on their carbon emissions, other than through the work space and other services that the OCOG or host city authorities provide.

Remote production of TV and other media content is even harder to measure. Media channels will also develop various side activities within their respective regions or countries, such as special TV shows, events and contests, all of which are related to the Games but have to be treated as out of scope of the carbon footprint, as they would be impractical to monitor. Emissions related to these activities are therefore excluded from the Games carbon footprint.

Excluded activities or processes

The basic rule is to include any activity, process or material for which the information is available, according to previous explanations.

However, if the impact is foreseen to be negligible (materiality threshold) or the modelling is unfeasible, some activities can be excluded from the project scope. Such exclusions must be listed and explained in the carbon footprint reports.

The following section details a reporting framework structured in two dimensions i.e.:

- First dimension: classification by sphere of activity; and
- Second dimension: classification by sphere of responsibility, or ownership of emissions.

4.1.2   First dimension of reporting framework: classification by sphere of activities

Games-related GHG emissions are classified according to three main spheres of activity:

1. Preparation and operations: includes everything that is needed to organise and operate the Games.

2. Permanent infrastructure: includes the construction of permanent venues and all related urban and transport infrastructure built specifically for the Games.

3. Associated activities: includes activities that are clearly due to the Games taking place but are not part of construction or organisational activities. For example, this includes spectator travel and accommodation during the Games, but not their accommodation for other purposes such as pre- or post-Games tourism. By definition, as this sphere of activities does not have a principal organiser (or owner), it is much harder to capture relevant information and may therefore be challenging to calculate.

The categories included in the scope of these three main spheres of activities are shown in Figure 4-1 and are described in more detail in Appendix 2 (section 7).

Important note: The activities presented below are not comprehensive. Additional activities related to the Games and for which data are available should be added, even if not funded or controlled by the OCOG.

Preparations and operations		Construction of permanent infrastructure	Associated activities (not funded by OCOG and delivery partners)
Office headquarters	Waste management	Competition venues	Uniforms (other)
Logistics	Security	Non-competition venues	Travel to the host country and venues (spectators, other)
Overlay and temporary structures	Transport services to venues	Venue-related urban and transport infrastructure	Travel to torch relays (spectators, other)
Look of the Games	Public transport to venues		Accommodation (spectators, other)
Energy use	Accommodation		NOCs/NPCs houses, IFs and commercial partners pavilions
Sports equipment	Travel		Cities activities
Electronic equipment and IT services	Live Sites		
Uniforms			
Merchandising			
Catering			
Ceremonies			
Torch relays			

Table 4-1: Categories of the Games carbon footprint

4.1.3 Second dimension of reporting framework: classification by sphere of responsibility

Here we distinguish between emissions related to activities that are included in the Games budget (i.e. funded by the OCOG and its delivery partners), where there is the highest level of control and/or influence, and those associated Games-related activities that are not funded by either the OCOG or its delivery partners.

For activities that are co-funded by the OCOG and other entities (e.g. public authorities), divide the emissions according to the financial contribution. For example, if 20 per cent of an infrastructure is funded by the OCOG, and 80 per cent is funded by the host city, then the emissions must be distributed proportionally between the two responsibility spheres. Please refer to Table 4-2 below.

Responsibility spheres	OCOG influence level	Description	Example
Owned by the OCOG	High	Core activities, wholly funded by the OCOG Effectively under control of OCOG decision-making, but some commercial contractual restrictions may limit certain choices	Installation of venue overlay Venue electricity consumption during the Games Catering for workforce and athletes
Owned by Games delivery partners	Medium	Activities funded by other Games delivery partners – public agencies, transport authorities and OBS. OCOG influence likely to depend on contractual or official relationship	New permanent infrastructure needed for the Games Broadcasting services
Not owned by the OCOG or delivery partners	Low	Activities closely associated with the Games, with external funding (limited or no contractual relationship with the OCOG)	Spectator travel and accommodation Pre-Games training camps for national teams Sponsor showcasing and NOC hospitality houses

Table 4-2: Responsibility allocation rules for owned by the OCOG and non-owned by the OCOG emissions

4.2 Step 2: Data collection

Once the activities to be included in the carbon footprint have been identified and listed, the next phase consists of collecting the data. The main questions are:

• What data sources can be used and where can they be found?
• What are the data to be collected?

4.2.1 Data sources: where to find the data to be collected?

When possible, the use of primary data should be favoured. Primary data are data that can be directly measured or collected. Project documents and raw data from internal FAs, project teams and main partners and suppliers are the principal sources of information. By definition, primary data have a high level of quality and are the most accurate and the most representative within the specific context of the Games.

Only when primary data are not available may secondary data sources be used. These include estimations, statistics, data from previous Games, documentation from the City, State or Federal Government and agencies, or published data sets.

When neither primary nor secondary data are available, default data are provided in Appendix 2 (section 7) and in Appendix 3 (section 8) for some of the activities.

In all cases, the presentation of carbon footprint calculations must include clear explanation of the source of the data used, any assumptions made and an evaluation of the quality/reliability of the data.

Appendix 2 (section 7) provides examples of data sources, but these are only indicative, as each Games and each OCOG will have their own specific contexts and it is not practical to provide a definitive list of relevant FAs and supplier categories.

For the *Initial carbon footprint,* much of the required data can only be approximated since there are too many unknown aspects 5 years prior to the event. Most of the data will thus be based on estimates or secondary data. The data quality at this stage is quite low, but this is not problematic since the main objective of the *Initial carbon footprint* is to identify the priorities for carbon impact reduction and the most important data to collect for the *Actual carbon footprint*.

The *Actual carbon footprint* will normally be calculated from primary data collected by the OCOG before, during and up to three months or so after the Games.

4.2.2 What are the data to be collected?

There are two types of data to be collected when calculating a carbon footprint:

1. Physical flows, such as kg of cotton used for merchandising, tonnes of waste incinerated, litres of diesel consumed for generators, MWh of electricity from the grid used at competition venues during the Games.

2. Financial flows, such as the total budget for the overlay, or the total budget for sports equipment. The accuracy of the carbon footprint calculated based on financial flows is generally lower compared to the footprint calculated with physical flows, but these types of data are necessary when physical flows are unknown or too complex to be modelled.

The description of the data types to be collected for each category are given in section 7 (physical data or financial data, amount of energy consumption, amount of material, etc.), together with detailed examples of flows (kWh of electricity consumed, kg of cotton, kg of steel, etc.). It is highly recommended to report all the data used in the carbon footprint in tabular format as presented in section 7, and to keep track of all the sources and assumptions. The types of flows and/or the units of the data may need to be adapted in order to apply the emission factors (or database):

• **Type of flow.** For example, the data related to uniforms is provided in number of pieces, but the database requires units to be expressed in the mass per type of material. One or more additional operations will be necessary to convert the number of uniforms into masses of cotton, polyester, and viscose. This can be done by considering the mass and composition of each item of the uniforms.

• **Unit.** For example, the data for diesel consumption of generators is provided as litres of diesel, but some database require units of diesel consumption to be expressed in MJ. The litres of diesel need to be converted to MJ of diesel by using the appropriate conversion factor, usually the lower heating value (LHV) of diesel.

4.3 Step 3 – Data modelling

The carbon footprint calculation of the Games consists of:

- Multiplying each flow described above by its specific emission factor; and
- Summing the intermediate results to obtain the total footprint per category, per sphere of activity or per sphere of responsibility and finally the total carbon footprint.

4.3.1   Emission factors and existing databases

The GHG emission factor of a specific activity or product represents the sum of all the GHG emissions to air related to this activity or product, which is then converted to kilograms of carbon dioxide equivalent (CO_2-eq).

For calculating this emission factor per activity or product, there are two stages:

1. Calculating the comprehensive list of GHG emissions related to the activity

- Applying the life-cycle approach means that for each activity considered, all identifiable upstream activities must be considered.

For example, when considering the environmental impacts of transportation to the Games, not only are the direct emissions of the truck or airplane considered, but the impact of additional processes and inputs needed to produce the fuel are also included, as well as the impacts for producing the truck or the plane. In this way, the production chains of all inputs are traced back to the extraction of raw materials.

- It is not necessary to trace and collect all the information and inputs in the value chain of all products and activities included in the Games carbon footprint; several databases exist that include generic sets of data for specific products and activities and for various countries.

2. Converting this list of GHG emissions into kilograms of carbon dioxide equivalent (CO_2-eq) using a specific methodology entitled "characterisation method"

The characterisation methodology to be used must be the latest method published by the IPCC, which uses the global warming potential (GWP) for a 100-year time horizon.

Databases of generic datasets and emission factors

A list of databases is available on the GHG Protocol website: http://www.ghgprotocol.org/life-cycle-databases. Some of the data are already expressed as emission factors in kg CO_2-eq (e.g. DEFRA database), others (e.g. ecoinvent) regroup inventory datasets that need to be converted into kg CO_2-eq using a characterisation methodology.

For calculating the Games carbon footprint, the following databases are recommended:

- Ecoinvent, ELCD , U.S. LCI database, GaBi, IDEA or other reviewed national or regional datasets.
- For food and beverage, specific food databases should be used, such as the World Food LCA Database (https://quantis-intl.com/tools/databases/wfldb-food/) which includes over 50 different products and 30 countries, or AGRIBALYSE (http://www.ademe.fr/agribalyse-r) which includes 25 types of plant-based products and 14 types of animal products.
- For transport by plane, it is recommended to use the DEFRA database, developed by the UK Department of Environment, Food and Rural Affairs. The DEFRA database is particularly suitable for more up-to-date datasets for Scope 1 and 2 categories, as well as for transportation activities, for which it provides cabin class specific data.
- When financial flows are used instead of physical flows, "input/output (I/O)" databases can be used.

Some default emission factors to be used for specific activities are presented in section 8.

They are classified for the following activities and are presented together with the default data to be used:

- Materials and waste
- Transport by plane
- Accommodation
- Catering

4.3.2 Tool for calculating the carbon footprint

Once the databases have been selected, the next step is to multiply each flow collected in the previous step by its specific emission factor and sum up the intermediate results. Although not mandatory, it is recommended to delegate this task to LCA practitioners or LCA experts, since it can be quite complex and requires expertise for selecting the correct datasets and/or emission factors and ensure coherence with the units. It will also simplify the interpretation of data collected and of the results.

The carbon footprint can be calculated using an Excel file. However, the use of a LCA or carbon footprint tool would simplify this task. Most such tools include LCA databases. In this way calculations are simplified by only needing to enter the quantity for each flow and linking it to the appropriate emission factor from the database(s).

There are various tools for calculating LCA/carbon footprints. Only a few of them are free (such as OpenLCA); for most commercial tools, there is usually a free demonstration version available which can help the user decide on the suitability of the tool for a particular application.

Some LCA tools are listed below (the list is not comprehensive):

- SimaPro, available at: www.simapro.com
- GaBi, available at: www.gabi-software.com/international/index
- OpenLCA (free LCA tool), available at: www.openlca.org
- Umberto available at: www.ifu.com/en/umberto/?

4.3.3 Additional modelling rules for specific topics

In some cases, it is necessary to define specific modelling rules, to be applied in the study. This is the case for the following topics:

- Electricity, in particular defining rules for the electricity mix to consider, and defining rules for calculating the emission factor for a renewable electricity mix.
- Bio-based materials (wood, bio-fuels, cotton, etc.), in particular defining rules on how to consider the biogenic carbon, which is the carbon that is incorporated into the biomass during growth (carbon uptake, the result of the photosynthesis effect) and which can be released during decomposition or combustion at the end-of-life.

- Rented material, in particular defining rules for modelling its GHG emissions compared to purchased material.
- Financial flows, in particular defining rules to use emission factors from database with current monetary value in the specific host country of the Games.

The rules for these topics are described in section 9.

4.4 Step 4 – Interpretation

4.4.1 Identify key data to be collected for carbon footprint refinement

For the Games, the *Initial carbon footprint* calculated at the onset of the Games planning will be mainly based on assumptions and statistics and therefore includes a high uncertainty. This first calculation may be considered as a 'screening carbon footprint'.

This screening step is essential to:

- Identify the data to be collected; and
- Identify the high priority data to be collected.

This will facilitate the subsequent data collection steps for future iterations of the carbon footprint. In particular, an analysis of the screening carbon footprint should enable you to identify activities that contribute most to the carbon footprint, together with the key parameters that influence the results. Future iterations of the carbon footprint should focus on these larger impacts and give lower priority for activities that have a small contribution to the footprint, unless they have a particularly symbolic value (e.g. flame for the Olympic Torch), or present significant reputational risks. This specific analysis will guide the sustainability strategy towards efficient reduction measures.

4.4.2 Reduce the GHG emissions

Hundreds of measures could be put in place to reduce the Games carbon footprint. However, it is not feasible, from a time commitment and economic point of view, to implement all measures. It is therefore necessary to identify those which will have the greatest effect in reducing the GHG emissions and to set up the *Carbon footprint reduction plan* based on these measures.

The concrete steps to reducing the Games carbon footprint are the following:

- **Identify potential reduction measures.** There are several ways of identifying measures or actions that could reduce the Games carbon footprint; some can be found in literature or documentation from previous Games. It is also worthwhile to organise workshops with those involved in the process of providing data (staff from the different FAs, suppliers and partners), to help identify best practices. Priority should be given to reduction measures for activities that have a high contribution to the Games carbon footprint;

- **Calculate the reduction potential of these measures.** The GHG emissions reduction potential of the different measures are calculated using the carbon footprint methodology and are called sensitivity analyses; and

- **Set the action plan (select the measures to be put in place).** The reduction measures can then be classified according to their potential for decreasing GHG emissions. Other parameters are important to consider when choosing the measures, such as their relative ease to implement (feasibility and cost effectiveness) and their value for raising awareness about climate change (awareness potential). The latter relates to measures that most readily get noticed, either for their symbolic nature, or for being easy to communicate, even if their absolute value in terms of GHG emission reductions is minor.

A materiality assessment could also be carried out to capture the subjective needs and perception of the different stakeholders; measures that address the stakeholders' expectations could then be assessed according to priority.

As an example, Figure 4-3 presents an analysis of the different measures (scenarios) according to three parameters: the GHG emissions reduction potential, the awareness raising potential, and the feasibility level. According to the principle of Transparency, the GHG emissions reduction potential is expressed relative to the total Games carbon footprint. In addition, it can also be expressed relative to the category, the sphere of responsibility or the sphere of activity.
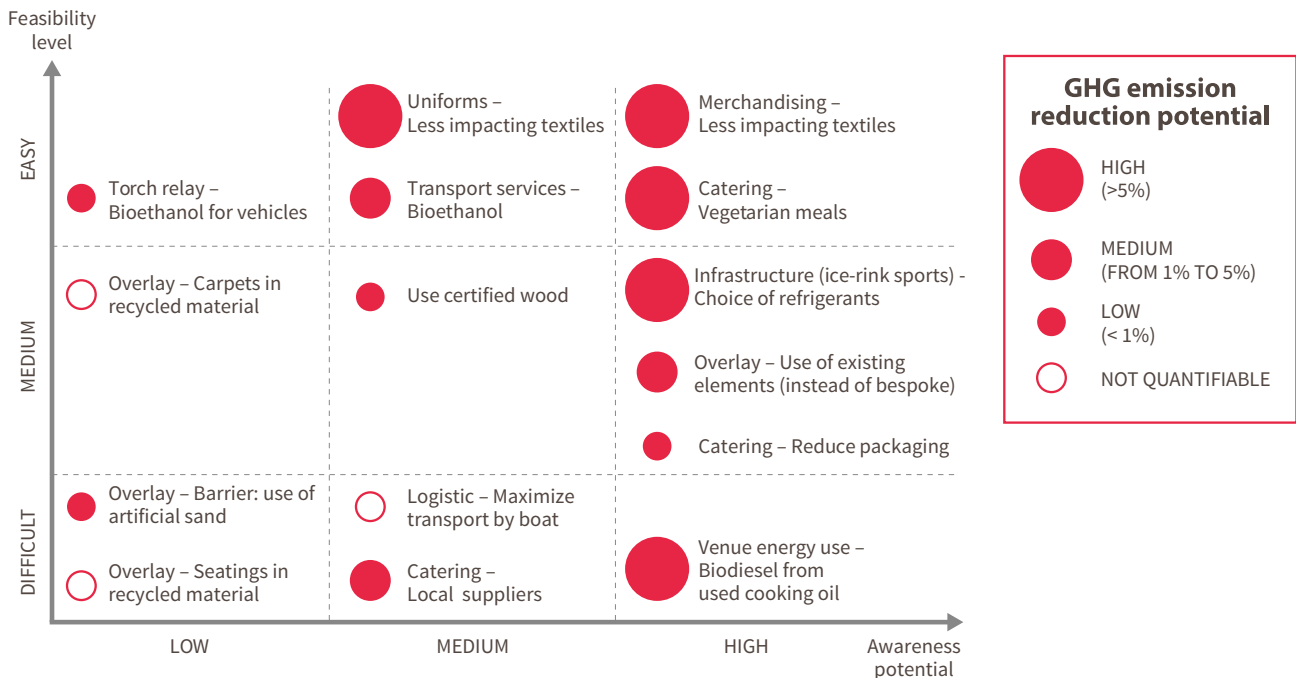
Figure 4-3: Reduction measures decision matrix. Assessment of the GHG emission reduction potential, the awareness potential and the feasibility level of the different measures

4.5 An example to illustrate the main steps to calculate a carbon footprint

The table below provides an example of the specific steps that are needed to calculate the carbon footprint of a simple activity, in this case the T-shirts sold as official licensed merchandise.

Steps	Example	Steps of the carbon footprint (see Figure 2-2)
1. Define the activity to model	Sell T-shirts (official merchandising) This activity will go under the category "Preparations and operations – Merchandising" (section 7.1.9)	**Step 01.** Scope – Identify the activity according to organisational boundaries
2. Define the responsibility allocation	According to the model in place, for example "non-owned by the OCOG" for the case where the OCOG procures an official licensee	**Step 01.** Scope – Identify the allocation rule according to the responsibility of entities
3. Determine the amount required for the Games	20,000 T-shirts = 5,000 kg of T-shirts	**Step 02.** Data collection
4. Determine the adequate process to model the activity	Production and weaving of organic cotton	**Step 02.** Data collection
5. Model the associated impact using emission factors from existing databases coupled with impact assessment methodology	Cotton cultivation and yarning EF = 15 kg CO_2-eq /kg cotton yarn Weaving process EF = 12 kg CO_2-eq / kg weaved cotton fabric *(Source: ecoinvent v2.2 coupled with IMPACT 2002+ vQ2.2)*	**Step 03.** Modelling – Select data-base and corresponding emission factors
6. Calculate the carbon footprint using steps 3 and 4	20,000 T-shirts corresponds to: 5,000 kg * (15 kg CO_2-eq + 12 kg CO_2-eq) = 135,000 kg CO_2-eq	**Step 03.** Modelling

Table 4-3: Example to measure the carbon footprint of licensed T-shirts

5 Communication and reporting

It is important to communicate the results of efforts made to reduce the carbon footprint both internally and externally. Internally it is good for OCOG staff to be engaged in the approach and understand its objectives. This can be done via workshops or by circulating infographics. External communication is also important, not only through publication of reports, but also by creating a dedicated webpage, creating interactive tools or apps (carbon footprinter), and having on-site activities at Games-time to raise public awareness.

The Games carbon footprint must be published as a formal report. This can be a stand-alone document or, as has been done previously, integrated into the Sustainability Plan for the Games. Updates may be incorporated within the pre-Games and post-Games sustainability reports.

Formal reporting is essential for providing the credible underpinning for any wider communications efforts related to the Games carbon management plan. It is also valuable for knowledge transfer purposes from one Games to another, and to other events.

5.1 Communication principles

The golden rules for communicating about the Games carbon footprint are transparency and honesty, in order to avoid any risks of greenwashing or overstatement. To avoid confusion, data and numbers must be presented separately between the three main sphere of activities – Preparations and operations emissions, permanent infrastructure emissions and associated activities emissions. A clear explanation must be given for any excluded categories.

For example, if the OCOG communicates about carbon offsetting, it is important to clarify whether the offsetting is limited to OCOG-owned emissions or if it covers the entire Games carbon footprint. When purchasing carbon credits, statements such as "zero carbon", "carbon-free" or "carbon neutral" should not be used as they can be misleading. Instead use statements such as "carbon credits were purchased to offset 100 per cent of the preparation and operations emissions".

5.2 Essential information to be reported

The *Initial carbon footprint* and *Actual carbon footprint* reports must be written in a clear and accessible style, that can be understood by non-specialists. Keeping this in mind, it should include a chapter summarising the OCOG's methodological approach, referencing this guidance for full details of the methodology. In addition to the local language, all formal reports must be issued in English for the benefit of international audiences and knowledge transfer to future OCOGs, candidate cities and host cities.

The *Initial carbon footprint* report, the *Actual carbon footprint* report and other intermediary publications should include the information listed in the following sections.

5.2.1 General

- Date the carbon footprint was calculated
- Contact information of parties involved in the calculation
- Changes since previous inventory and explanation for such changes
- Review statement by external panel of experts (optional)
- Main limitations of the study

5.2.2 Scope

- Description of the approach: main principles, timeframe and calculation methodology (with reference to the present document for full detailed description of the methodology)
- Clear description of the Games project being assessed in the carbon footprint
- Clear and comprehensive diagram with categories included in the scope
- Comprehensive list of the activities excluded from the scope and the associated reason or justification

5.2.3 Data and assumptions

- LCI databases used, name and version number
- LCA software used and version number (when relevant)
- Comprehensive tables of data used for the calculations and corresponding sources, assumptions and limitations (in particular data missing)
- Data quality assessment

5.2.4 Results

- Carbon footprint results, displayed per sphere of responsibility or per sphere of activity and per category. Example of reporting tables are available in Appendix 1 (section 6)
- When relevant (especially for the *Carbon footprint reduction plan*), sensitivity analysis for reduction measures, with:
  – List of reduction measures
  – Description of the approach for selecting the measures and related documentation (such as decision matrix and/or materiality matrix)
  – Data used for the calculation of reduction potential of each measure and corresponding sources and assumptions
  – Potential GHG emissions reduction for each measure

6 Appendix 1: Templates for presenting the carbon footprint results

The carbon footprint report should include a tabular presentation in accordance with the main categories of activity and responsibility as shown in the template below.

Sphere of activities	Sphere of responsibility			Total (t CO_2-eq)
	Owned by the OCOG (t CO_2-eq)	Owned by Games delivery partners (t CO_2-eq)	Not owned by the OCOG or delivery partners (t CO_2-eq)	
Preparations and operations				
Construction of permanent infrastructure				
Associated activities				
Total				

Table 6-1: Summary reporting table for the Games carbon footprint (Games GHG emissions, per tonne CO_2-eq)

For the *Initial carbon footprint* and subsequent iterations these data will represent projections of estimated GHG emissions. The *Actual carbon footprint* calculated after the Games is the only time where this table will include data reporting emissions that have actually occurred.

A more detailed table for presenting estimates/results of the Games carbon footprint broken down into activity categories should be produced using the following template (see next page).

Sphere of activities	ID	Categories	Sphere of responsibility			Total (t CO_2-eq)
			Owned by the OCOG (t CO_2-eq)	Owned by Games delivery partners (t CO_2-eq)	Not owned by the OCOG or delivery partners (t CO_2-eq)	
Preparations and operations	1.1	Office headquarters				
	1.2	Logistics				
	1.3	Overlay and temporary structures				
	1.4	Look of the Games				
	1.5	Energy use				
	1.6	Sports equipment				
	1.7	Electronic equipment and IT services				
	1.8	Uniforms				
	1.9	Merchandising				
	1.10	Catering				
	1.11	Ceremonies				
	1.12	Torch relays				
	1.13	Waste management				
	1.14	Security				
	1.15	Transport services to venues				
	1.16	Public transport to venues				
	1.17	Accommodation				
	1.18	Travel				
	1.19	Live Sites				
Construction of permanent infrastructure*	2.1	Competition venues				
	2.2	Non-competition venues				
	2.3	Venue-related transport and urban infrastructure				
Associated activities (not funded by OCOG)	3.1	Uniforms (other)				
	3.2	Travel to the host country and venues (NOCs, spectators, other)				
	3.3	Travel to torch relays (spectators, other)				
	3.4	NOCs/NPCs houses, IFs and commercial partners pavilions				
	3.5	City activities				
Total	NA	NA				

*Table 6-2: Detailed reporting table for the Games carbon footprint per category (Games GHG emissions, per tonne CO_2-eq). *Where possible, itemise individual construction projects*

7 Appendix 2: Categories and calculation methods

This section presents a clear definition of each category describing the activities that are included or excluded, together with the data to be collected.

Data recording templates are provided here for each category as a general framework to indicate the most likely types of data required and from where they can be sourced. Inevitably, the list of activities and data shown here cannot be exhaustive, as each edition of the Games is different in terms of number and configuration of venues, organisational structure and a wide variety of special features and activities. Project managers should therefore ensure that the data collection template is as complete and accurate as possible for their particular situation.

Likewise, although we have indicated the most appropriate allocation of responsibility according to what is normal practice at the Games, there will always be some grey areas and variations from Games to Games. Therefore it is important for the OCOG to verify these allocations according to its own particular circumstances.

Where relevant, some default data are provided, together with specific emission factors.

7.1 Preparation and operations

This sphere of activity includes everything that is needed to prepare and stage the Games, including OCOG corporate activities before the Games, overlay and sports equipment, energy consumption and waste management, and also catering, uniforms, accommodation and travel to the Games funded by the OCOG, and Games fleet transport services (including buses provided by the OCOG for media, sponsors, VIPs and spectators). These activities will largely be under the responsibility of the OCOG, but some will fall within the responsibility of the IOC and other delivery partners.

7.1.1 Office headquarters

7.1.1.1 Category description

This category includes the activities of seven years of preparation by the workforce located in the OCOG offices and those of its delivery partners, i.e. the energy consumption (electricity, energy for heating), the production and consumption of goods (paper, food, etc.), and transport services for the staff prior to the Games (e.g. mini-buses and pool cars).

Over the period it is likely that there will be more than one office location used. All sites used as corporate offices should be included in this category.

If there are separate office headquarters established for any specific Games delivery body responsible for construction of venues and infrastructure, these should be captured too. The same data template can be used but the figures would be allocated to the delivery bodies, not under the OCOG's responsibility.

Normally, however, staff working for public agencies and other types of delivery partners, are likely to be based at their usual offices, so there is no additional carbon impact to be considered – and in any case it would be impractical to separate this out from the rest of their organisation's footprint.

Excluded from this category:

- Business travels paid by the OCOG (this is included in the category "Preparations and operations – travels");
- Electronic equipment for the OCOG (this is included in the category "Preparations and operations – electronic equipment and IT services"); and
- Office spaces used by staff at Games venues (these are captured under venue operational categories).

7.1.1.2 Data to be collected

The GHG emissions are calculated as follows:

- The GHG emissions of energy consumption are calculated based on the total amount of energy consumed for each type of energy (electricity, biodiesel, etc.).
- The GHG emissions generated by the production/consumption of goods are calculated based on the total amount of material used per type of material (paper, food, etc.).

7.1.1.3 Emission factors

The emission factor used for consumption of diesel, natural gas or other energy sources must account for the production and the combustion of those fuels on site.

Parameter	Unit	Amount	Number of years	Source	Comment
Offices – floor area					
Offices used during ~7 years	m²		10	OCOG functional area: HQ administration, Facilities Management + delivery partners	
Offices – energy consumption					
Electricity	kWh/ year Or kWh/ m²			OCOG functional area: HQ administration, Facilities Management + delivery partners	Can be estimated based on average electricity consumption per m² of average office in the country and surface of offices
Natural gas (heating)	MJ/ year Or MJ/ m²				Can be estimated based on average energy consumption for heating per m² of average office in the country and surface of offices
Other energy source	MJ/ year Or MJ/ m²				
…					
Offices goods consumption (paper, catering, office supply, etc…)					
Paper (virgin)	kg/year			OCOG functional area: HQ administration, Facilities Management + delivery partners	
Paper (recycled)	kg/year				
…					
Food	kg/year				
Coffee and tea	kg/year				
…					
Water consumption	L				
Waste – to recycling	Tonnes				Can be split by type of waste
Waste – to incineration	Tonnes				
Waste – to composting	Tonnes				
Waste – to landfill	Tonnes				
…					

Table 7-1: Data recording template for OCOG and delivery partners offices. The reporting should be split by organisations

7.1.2 Logistics

7.1.2.1 Category description

This category includes the freight transport and the storage of goods and materials:

- The transport of several types of equipment such as furniture, sporting and technology equipment, but also uniforms and merchandise, the transport of horses and competition boats to the venues when relevant, inbound and outbound flows to and from the venues, crew movement and special projects;
- The energy consumption in warehouses used for the Games (prior, during and after the Games); and
- The total fuel consumption for venue and warehouse logistics operations on site (i.e., fuel consumed by logistic vehicles on site).

7.1.2.2 Data to be collected

The GHG emissions are calculated as follows:

- The GHG emissions generated by the transport of materials and equipment are calculated based on the weight of material transported multiplied by the total distance travelled (expressed in tonne.km).
- The GHG emissions related to warehouse storage are calculated based on energy consumption in the warehouses (mainly electricity, but also fuel for heating for example).
- The GHG emissions generated by fuel consumption for logistic vehicles used on site (in venues or in warehouses) are calculated based on the total amount of fuel consumed for each type of fuel (petrol, diesel, biodiesel etc.).

If biofuels are used, apply the methodology described in section 9.3.

The data collection has been divided into several steps:

- Transport of material and equipment:
  – Supply of material to the Games warehouses
  – Supply of material from the warehouses to and from venues
  – Special transport (e.g. horses and/or competition boats);
- Storage in warehouses; and
- Fuel consumption of vehicles in venues and warehouses.

1. Transport of material and equipment: supply to warehouses

Type of material (furniture, sport equipment, technology, etc...)	Origin	Type of vehicle (freight ship, truck, plane)	Type of fuel	Weight of material	Average distance per trip (one way)	Source
Unit	[-]	[-]	[-]	[tonnes]	[km]	
Furniture	Europe	Freight ship				OCOG functional area: Logistics
Furniture	From the country of the Games	Truck				
...						

Table 7-2: Data recording template for logistic – Transport of material and equipment: supply to warehouses

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2. Transport of material and equipment: supply to and from venues

Type of material (furniture, sport equipment, technology, etc…)	Origin	Type of vehicle (freight ship, truck, plane)	Type of fuel	Weight of material or Total number of trips	Average distance per trip (one way)	Source
Unit	[-]	[-]	[-]	[tonnes] or [unit]	[km]	
Furniture	Europe					
Furniture	From the country of the Games				3	OCOG functional area: Logistics
…						

Table 7-3: Data recording template for logistic – Transport of material and equipment: supply from and to venues

3. Specific transport: horses and competition boats

As explained on the previous page, the GHG emissions related to transport are calculated based on the weight of material transported multiplied by the total distance travelled (expressed in tonne.km). In most cases, goods transportation is modelled assuming by default that loads are limited by weight on board. But in particular cases of low-density "goods", such as horses or competition boats, the limitation comes from volume. This supposedly happens at a density below 250 kg/m^3 for trucks, below 150 kg/m^3 for planes, and below 400 kg/m^3 for cargo ship[5]. In such case, a factor reflecting the increase of number of trucks or planes needed for the same t.km service must be adopted. This factor is called "large volume factor" (LVF).

Weight [tonnes] *Large volume factor [-] *distance [km] = x [tonne * km]

• Transport of horses

For modelling the transport of horses by plane and by truck, use the following default data.

Parameter	Value
Average weight per horse (including additional material of the horse)	1 tonne
Large volume factor to apply to transport of horses by plane (expressed in tonne.km)*	1.5
Maximum number of horses in one truck of 32t	8 horses/ truck

Table 7-4: Default data for transport of horses

*Considering an average weight of 1 tonne per horse (and additional material) and an average volume of 10 m^3 per horse (container of 3.18 * 2.44 * 2.44 for 2 to 3 horses, + material), the density for the transport of horses by plane is 1,000 [kg]/10 [m^3] = 100 [kg/m^3]. The transport by plane is therefore considered to be "volume-limited", and a corrective factor of 150 [kg/m^3]/100 [kg/m^3] must be applied.*

[5] Those limits of density were calculated based on the average load capacity of the vehicle (truck, plane or freight ship) expressed in tons or kg divided by its average storage volume available.

GHG emissions of transport of horses by truck should be calculated based on total distance travelled by trucks rather than based on weight multiplied by distance per trip, using the maximum number of 8 horses per truck.

- Transport of competition boats

For modelling the transport of competition boats by cargo ship and by truck, use the following default data.

Parameter	Value
Average weight of sailing boats	0.3 tonnes
Average weight of rowing and canoe boats	0.1 tonnes
Density for the transport of competition boats by cargo ship	200 [kg/m^3]
Large volume factor to apply to transport of competition boat by cargo ship*	2
Large volume factor to apply to transport of competition boat by truck	1.25

Table 7-5: Default data for transport of competition boats

The density for the transport of competition boats by cargo ship is 200 [kg/m^3]. The transport by cargo ship is therefore considered to be "volume-limited", and a corrective factor of 400 [kg/m^3]/200 [kg/m^3] must be applied.

4. Storage in warehouses

Type of energy	Unit	Amount	Number of years	Source
Warehouses – surface				
Warehouse A used during X years	m²		X	OCOG functional area: Logistics
Warehouse B used during Y years	m²		Y	
...				
Warehouse energy consumption				
Electricity	kWh/ year Or kWh/ m²			OCOG functional area: Logistics
Natural gas (heating)	MJ/ year Or MJ/ m²			
Other energy source	MJ/ year Or MJ/ m²			
...				

Table 7-6: Data recording template for logistic – storage in warehouses

For calculating the GHG emissions related to storage, if no primary data are available on energy consumption, it can be calculated based on the warehouse surface and an average default energy consumption per year (or quarter) and per square metre of warehouse.

Parameter	Value	Source
Electricity consumption at warehouse	Electricity: 30 kWh/m².year, or 7.5 kWh/m².quarter Heating: 360 MJ bought (burnt in boiler) or 10 Nm$_3$ natural gas/ m²·year	European Commission, PEFCR Guidance document, – Guidance for the development of Product Environmental Footprint Category Rules (PEFCRs), version 6.3, December 2017.

Table 7-7: Default data of warehouse storage

5. Fuel consumption for venues and warehouses logistic operations

Type of fuel	Unit	Amount	Source
Petrol	litres		OCOG functional area: Logistics
Diesel	litres		
LPG	litres		
Biodiesel from cooking oil	litres		
...			

Table 7-8: Data recording template for logistic – fuel consumption for venues and warehouses logistic operations

7.1.2.3   Emission factors

For transport of goods by plane (freight flights), use the emission factors presented in section 8.2. For other types of transport and for energy consumption at warehouses, use country-specific emission factors and/or emission factors specific to the database selected for this category.

Note: The emission factor used for consumption of diesel, natural gas or other energy sources must account for the production <u>and</u> the combustion of those fuels on site.

7.1.3   Overlay and temporary structures

7.1.3.1   Category description

This category includes the overlay required for all Games competition and non-competition venues, and any temporary structures that are built only for the Games and dismantled afterwards.

Since it can be sometimes difficult to separate overlay and temporary structures, these two activities are merged in the same category. However, if they can be logically separated for a particular edition of the Games, it would be preferable to do so.

The transport of the materials to warehouses and venues is not included in this category, but in the category "Preparations and operations – Logistics".

7.1.3.2   Data to be collected

The GHG emissions generated by the category "Preparations and operations – overlay and temporary structures" are calculated based on the amount per type of material (wood, plastic, metal etc.). The GHG emissions of the delivery transport to venues are calculated based on the distance travelled and the transport mode.

If bio-based materials (e.g. bamboo, wood) are used, apply the methodology described in section 9.3.

For a more detailed reporting, the data can be split by venue.

Type of item	Unit	Amount	Material	Origin (production place) or total distance to the host city	Transport mode	Source	Comment
Carpets	kg		E.g. Virgin PP	E.g.: China	E.g. cargo	OCOG functional area: Venue Development, Procurement, Logistics, Villages OCOG functional area: Venue Development	Weight of carpet can be estimated based on surface of carpet, and average density of carpet (e.g. 380 g/m²)
Wood	kg		Type of Wood				
Metals	kg		Type of metal				
Plastics	kg		Type of plastic				
Cabling	kg						
Temporary tent structure	kg		Steel				Weight of steel for tent structures can be estimated based on weight of steel per m² of temporary tent
Temporary tent cover	kg		PVC				Weight of cover (PVC) for all the tent structures can be estimated based on weight of cover per m² of temporary tent
...							

Table 7-9: Data recording template for overlay – Physical flows

If data are not available for physical flows, it is possible to estimate GHG emissions based on financial flows. In this case, the list of data to be collected is much shorter, but the accuracy of the carbon footprint calculated based on financial flows is generally lower compared to the footprint calculated with physical flows.

Parameter	Unit	Amount	Origin/distance and transport mode	Source
Budget for overlay (competition and non-competition venues)	Million $ (for example)		Insert details of place of origin (city/country) and mode(s) of freight transport used	OCOG functional area: Venue Development, Finance
...				

Table 7-10: Data recording template for overlay – Financial flows

7.1.3.3   Emission factors

If the GHG emissions are calculated based on financial flows, use the following emission factor.

Parameter	Emission factor	Unit	Source
Overlay – Sector OECD "Manufacturing (including furniture)"	0.491	kg CO_2-eq/USD 2004*	Simmons, Gonzales and Lewis (2006) Methodology for determining global sectoral material consumption, carbon dioxide emissions and Ecological Footprints.

Table 7-11: Emission factors for overlay

*Please refer to section 9.4, which explains how to take account of inflation and currency conversion rates so that the emission factors are applied accurately in present day values.

7.1.4 Look of the Games

7.1.4.1 Category description

This category includes the materials used for dressing Games venues and public areas across the city and co-host cities with a single brand identity: the "Look of the Games". Typical items included in the Look programme are flags, banners, fence coverings, building wraps, facias and decals. The transport of the material needed for the Look of the Games to warehouses and venues is not included in this category, but in the category "Preparations and operations – Logistics".

7.1.4.2 Data to be collected

The GHG emissions generated by the category "Preparations and operations – Look of the Games" are calculated based on the amount per type of material.

7.1.4.3 Emission factors

Use country-specific emission factors, or emission factors that are specific to the selected database for this category.

Type of material	Unit	Amount	Type of material	Source	Comment
Look materials for venues					
Printed material – Fabrics	kg		E.g. Polyester	OCOG functional area: Look of the Games	Weight of fabrics can be estimated based on surface of fabrics, and average density of fabrics (e.g. 250 g/m²)
Printed material – Polypropylene	kg		E.g. Virgin PP		Weight of polypropylene can be estimated based on surface of polypropylene panels, and average density of polypropylene
...					
Look materials for event promotion (city, public transport)					
...				OCOG functional area: Look of the Games	
Other					
LED Twin pack electricity consumption	kWh		E.g. National electricity mix	OCOG functional area: Look of the Games	
...					

Table 7-12: Data collection template for Look of the Games

Note: The OCOG may develop a common template and "kit of parts" for municipal authorities to create their own Games branded dressing for their respective towns and cities in the host country, and which conforms to the brand identity requirements of the Look programme. It will be difficult to obtain accurate data on the amount of materials used in this way and this may be considered an "associated activity" rather than core Games preparation.

7.1.5 Energy use

7.1.5.1 Category description

This category includes the energy use for the entire period when competition and non-competition venues are under the OCOG's operational control. Normally these should correspond to the periods covered by the respective venue use agreements for each site:

- Sport competition venues;
- Sport non-competition (training) venues;
- Media venues (IBC, MPC and ancillary media facilities);
- Olympic Village(s); and
- Other support venues (e.g. transport depots, warehouses, server centres, Uniform Distribution and Accreditation Centre, ceremony studios and rehearsal sites…).

7.1.5.2 Data to be collected

The GHG emissions related to venue energy use are calculated based on the type and amount of energy used on site. If biofuels are used, apply the methodology described in section 9.3.

Where possible record data for each venue separately. In some cases it may be difficult to obtain actual energy use figures if these have not been specified in the Venue Use Agreements. Thus, even in situations where the OCOG is renting a venue and energy costs are integrated into the overall hire fee, there should still be a requirement for energy data covering the entire exclusive use period.

If there are periods of non-exclusive use, for example if some overlay is being installed while the venue owners are still using the site for other purposes, it will be impractical to capture separate energy use data. Usually this will not be a major gap and can probably be ignored, but it is worth being aware of the possibility.

7.1.5.3 Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

The emission factor used for consumption of diesel, natural gas or other energy sources must account for the production and the combustion of those fuel on site.

Type of energy	Unit	Amount	Source
Electricity from the grid	kWh		OCOG functional area: Venue management Energy
Generator – Conventional diesel	litres		
Generator – Average biodiesel	litres		
Natural gas (heating)	MJ or Nm_3		
Other energy source	MJ		
…			

Table 7-13: Data recording template for energy use at all Games venues

7.1.6 Sports equipment

7.1.6.1 Category description

This category includes the material for sports equipment.

The transport of sports equipment to warehouses and venues is not included in this category, but in the category "Preparations and operations – logistics".

7.1.6.2 Data to be collected

The GHG emissions generated by the category "Preparations and operations – sports equipment" are calculated based on the amount per type of material (wood, plastic, metal etc).

If no data are available for physical flows, it is possible to estimate GHG emissions based on financial flows. In this case, the list of data to be collected is much shorter, but the accuracy of the carbon footprint calculated based on financial flows is generally lower compared to the footprint calculated with physical flows.

Parameter	Unit	Source
Budget for sport equipment (Cash)	Million $ (for example)	OCOG functional area: Sport
Budget for sport equipment (Value-in-Kind)	Million $ (for example)	
...		

Table 7-14: Data recording template for sport equipment – Financial flows

7.1.6.3 Emission factors

If the GHG emissions are calculated based on financial flows, use the following emission factor.

Parameter	Emission factor	Unit	Source
Sport equipment - Sector OECD "Manufacturing (including furniture)"	0.491	kg CO_2-eq/USD 2004*	Simmons, Gonzales and Lewis (2006) Methodology for determining global sectoral material consumption, carbon dioxide emissions and Ecological Footprints

Table 7-15: Emission factor for sport equipment

*Please refer to section 9.4, which explains how to take account of inflation and currency conversion rates so that the emission factors are applied accurately in present day values.

7.1.7 Electronic equipment and IT services

7.1.7.1 Category description

This category includes all electronic devices that are used by staff, technicians and officials to prepare and host the Games, including the data servers.

The transport of electronic equipment to warehouses and venues is not included in this category, but in the category "Preparations and operations – logistics".

7.1.7.2 Data to be collected

The GHG emissions relative to electronic equipment are calculated based on the type and total number of electronic items.

Type of energy	Unit	Amount	Source
Smartphones	Number of items		OCOG functional area: Telecoms
Switches	Number of items		
Routers	Number of items		
...			
Desktop	Number of items		OCOG functional area: Technology Systems
Notebook and tablet	Number of items		
Reprography	Number of items		
Server	Number of items		
...			
Barcode reader	Number of items		OCOG functional area: Venue Technology Services
Audio board	Number of items		
Video board	Number of items		
TV	Number of items		
Webcams	Number of items		
Other (projector, DVD players, DVD recorders, etc.)	Number of items		
...			

Table 7-16: Data recording for electronic equipment and IT services

7.1.7.3 Emission factors

Use the country-specific emission factors and/or emission factors specific to the selected database.

7.1.8   Uniforms

7.1.8.1   Category description

This category includes all uniforms funded by the OCOG, the delivery partners and the city. It includes in particular the uniforms provided to the workforce (staff, technical officials, volunteers and contractors[6]), to the city volunteers and other uniforms as well as, for example, the bibs provided to accredited media.

The costume used for the ceremonies are not reported here, but in the category "Preparations and operations – ceremonies" (see section 7.1.11).

Many stakeholders have uniforms paid for by other entities, such as NOCs. These uniforms are not included here, but in the category "Associated activities – uniforms (other)".

The transport of uniforms to warehouses and venues is not included in this category, but in the category "Preparations and operations – logistics".

7.1.8.2   Data to be collected

GHG emissions are calculated based on the total number of uniforms distributed during the Games and the type of textiles used. If natural fibres are used (e.g. bamboo or cotton fibres), apply the methodology described in section 9.3.

Data on uniforms not funded by the OCOG should be estimated based on a few representative sample groups. For example, data provided by 2 to 3 main NOCs can be considered as a representative average for the teams.

Parameter	Amount	Weight per item	Total weight	Source
	[nb]	[kg/item]	[kg]	
Pieces of uniform made with natural textile (eg. Cotton, …)				OCOG functional area: People Management IOC, NOCs, etc.
Pieces of uniform made with synthetic textile (eg. polyester, …)				
Pieces of uniform made with unknown type of fibre				
…				

Table 7-17: Data recording template for uniforms

7.1.8.3   Emission factors

Use emission factors specific to the database selected for this category.

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[6]Contractors uniforms can be included in these category or in the category "Associated – uniforms (other)". Their uniforms are usually not directly funded by the OCOG, but their costs are wrapped-up in the respective contracts.

7.1.9 Merchandise

7.1.9.1 Category description

This category includes all licensed merchandise sold in the official Games retail outlets.

The transport of merchandise to warehouses and venues is not included in this category, but in the category "Preparations and operations – logistics".

7.1.9.2 Data to be collected

The GHG emissions of merchandise production are calculated based on the amount per type of material (textile, metal, plastic etc.). If bio-based materials are used (e.g. bamboo, cotton fibres), apply the methodology described in section 9.3.

Type of item	Amount	Weight per item	Type of material	Source
	[nb]	[kg/item]	[-]	
Commemorative coins			Metal (Steel)	OCOG functional area: Licensing
Stamps			Paper	
Pins			Metal (Steel)	
Publications			Recycled paper	
Gifts and novelties			Plastic (PVC)	
Apparel/sportswear			Organic cotton	
Apparel/sportswear			Polyester	
...				
Shoes				
Socks and underwear				
Bed sheets and towels				
Sarongs				
Glasses				
Bag/backpack/purse				
Stationery				
Mug/ceramics/cup				
Umbrella/parasol /beach chair				
Plush toys				
...				

Table 7-18: Data recording template for merchandise

7.1.9.3 Emission factors

Use emission factors specific to the database selected for this category.

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7.1.10 Catering

7.1.10.1 Category description

This category includes food and beverage for workforce, athletes and media, delivered inside the Games perimeter. Food and beverage sold to spectators inside the perimeters of venues are also included.

In addition to food and beverage production and cooking, packaging production and delivery transport are included.

Meals purchased outside of the Games perimeter, for example in city restaurants, are not included. Breakfasts taken at hotels are included in the categories "Preparations and operations – accommodation" and "Associated activities – accommodation (spectators, other)".

7.1.10.2 Data to be collected

The GHG emissions are calculated as follows:

- The GHG emissions generated by the category "Preparations and operations – catering" are calculated based on the amount of food and beverage per type of product (white meat, red meat, vegetables, sandwiches, alcoholic beverages, etc.).
- The GHG emissions related to energy and water consumption for meals preparation must also be included, except if it is already included in the category "Preparations and operations – energy use" (applies only to food cooked on site).
- In addition to GHG emissions related to food production, the GHG emissions of the delivery transport to venues and Olympic Village are calculated based on the distance travelled for delivery and the transport mode.

For more detailed reporting, it is possible to split the category "Preparations and operations – catering" into several subcategories, for example catering sold to spectators at venues, catering at Olympic Village, etc.

The methodology described in section 8.4 must be applied to this category.

Type of food	Amount	Distance for delivery	Mode of transport	Energy source for food preparation	Energy consumption for food preparation	Source
	[kg]	[km]	[-]	[-]	[kWh/ kg]	
Red meat						OCOG functional area: Food and Beverage
White meat						
Fish						
Vegetables						
Pasta						
Bread						
Dairy products (cheese, yogurt)						
...						
Alcoholic beverages – Beer						
Alcoholic beverages – Wine						
Non-alcoholic beverages – Juices						
Non-alcoholic beverages – Packed water						
...						

Table 7-19: Data recording template for Food and Beverage within Games venues

If no primary data are available, use the following averages. However these proxy data can be used only for the *Initial carbon footprint*. Primary data must be collected to calculate the *Final carbon footprint*.

Category of visitor	Parameter	Value
Athletes, NOCs	Amount of food per person per day[7]	2 average meals
	Amount of beverage per person per day	1 litre of non-alcoholic beverage 0.5 litres of alcoholic beverage
Workforce	Amount of food per person per day	2 average meals
	Amount of beverage per person per day	1 litre of non-alcoholic beverage 0.5 litres of alcoholic beverage
Press and broadcast members	Amount of food per person per day	1 cold or hot snack
	Amount of beverage per person per day	0.5 litres of non-alcoholic beverage
Spectators	Amount of food per person per day	1 cold or hot snack
	Amount of beverage per person per day	0.5 litres of non-alcoholic beverage

Table 7-20: Default data for catering

7.1.10.3 Emission factors

If the default data provided above are used, apply the default emission factors provided in section 8.4.

[7] *The breakfast is already included in "accommodation".*

7.1.11 Ceremonies

7.1.11.1 Category description

This category includes all the consumables (e.g., medals, costumes, stages, decor etc.) necessary for staging the opening, closing and medal ceremonies organised by the OCOG. The consumables for the Olympic and Paralympic Torch relays are not included in this category but are included in the category "Preparations and operations – torch relays".

7.1.11.2 Data to be collected

The GHG emissions are calculated based on the amount per type of material (textiles, metals, wood, etc.). If bio-based materials (e.g. bamboo, cotton fibres) or biofuels are used, apply the methodology described in section 9.3.

Item	Material	Number of items	Weight per item	Source
	[-]	[unit]	[kg]	
Olympic Games – Gold medals	Silver + x g gold			OCOG functional area: Ceremonies
Olympic Games – Silver medals	100% Silver			
Olympic Games – Bronze medals	100% Bronze			
Paralympic Games – Gold medals	Silver + x g gold			
Paralympic Games – Silver medals	100% Silver			
Paralympic Games – Bronze medals	100% Bronze			
Olympic Games – Costumes opening ceremony	Textile (x % cotton, y % polyester)			
Olympic Games – Costumes closing ceremony	Textile (x % cotton, y % polyester)			
Paralympic Games – Costumes opening ceremony	Textile (x % cotton, y % polyester)			
Sceneries opening ceremony	Wood			
…				

Table 7-21: Data recording template for ceremonies – Consumables

7.1.11.3 Emission factors

Use emission factors specific to the database selected for this category.

7.1.12 Torch relays

7.1.12.1 Category description

This category primarily focuses on the Olympic Torch Relay (OTR), which has the most significant impacts, but should also account for GHG emissions related to the Paralympic Torch Relay (PTR).

For the OTR, this category includes the transport of the Olympic flame from where it is lit in Ancient Olympia, Greece, the 5-6 days torch relay within Greece conducted by the Hellenic Olympic Committee, ending in Athens, where the Olympic flame is handed over to the OCOG, and its onward travel from Athens to the host country. Other aspects to be included are the transfer of the OTR team from one section of the relay route to another, the fuel consumption of the vehicles accompanying the torchbearer (the caravan), the accommodation and catering of the core team during the torch relay, the transport of torchbearers from their home to the relay route, the production of the torch, and the consumption and combustion of fuel for torch flame. Much of the caravan comprises sponsor vehicles, by definition not funded by the OCOG. However, for the sake of simplicity their emissions should be included in this category and the sphere of responsibility is "Non-owned by the OCOG and delivery partners".

The transport of spectators to the relay route is not included in this category but is included in the category "Associated activities – Transport to torch relay (spectators, other)".

7.1.12.2 Data to be collected

The GHG emissions are calculated as follows:

- The GHG emissions of the transportation of the Olympic flame to and from Athens (Greece) and other transportation by plane from one section of the relay route to another is assessed based on the number of persons multiplied by the distance they travelled, hence person * km, denoted pkm or personkm.
- The GHG emissions of the fleet are calculated based on the total fuel consumption by all the caravan vehicles. This fuel consumption can also be assessed taking into account the total distance of the torch relay, and the number of vehicles per type of vehicle (cars, buses, motorbike, etc.).
- The GHG emissions for accommodation and catering of the core team are calculated based on the total number of nights and total amount of food and beverage consumed. This can be assessed by taking into account the total number of days of the torch relay and the number of people in the core team.
- The GHG emissions for transport of torchbearers from their home to the relay route are calculated based on the total number of torchbearers, the distance from their home to the course and the mode of transport.
- The GHG emissions related to the production of the torches are calculated based on the total amount of materials used to produce all the torches.
- The GHG emissions related to the production and combustion of the fuel of the flame (torches, portable cauldron, fixed cauldron) are based on the type of fuel and the total amount of fuel.

The data collection has been divided into several steps:

- Transport of the Olympic flame to and from Athens by plane and other flights from one section of the relay route to another;
- Fuel consumption of the fleet vehicles;
- Accommodation, food and beverage for the team;
- Transport of torchbearers to and from the relay route; and
- Torch production and fuel consumption.

1. Transport of the Olympic flame to and from Athens by plane and other flights from one section

Origin	Destination	Mode of transport	Number of passengers	Average distance per trip (one way)	Source
[-]	[-]	[-]	[pers]	[km]	
Athens	Country of the Games	Plane			OCOG functional area: Torch relay
...					

Table 7-22: Data recording template for torch relay – Transport of the Olympic flame to and from Athens by plane and other flights from one section of the relay route to another

2. Fleet vehicle – Fuel consumption

Type of vehicle	Number of vehicles per type of vehicle	Total fuel consumption per type of vehicle	Total distance travelled by the fleet	Source
[-]	[Unit]	[litres]	[km]	
Funded by the OCOG				
Bus/coach				OCOG functional area: Torch relay
Van				
Passenger car				
Motorcycle				
...				
Not funded by the OCOG (sponsors vehicles)				
Bus/coach				OCOG functional area: Torch relay
Van				
Passenger car				
Motorcycle				
...				

Table 7-23: Data recording template for torch relay – Fleet vehicles

If no primary data are available for the total distance travelled by the fleet, use an average default distance of 25,000 km[8].

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[8]This is based on Sydney 2000 (13,200 torch bearers, 27,000 km in Australia), Atlanta 1996 (12,500 torch bearers, 27,000 km). Please refer to the IOC Fact Sheet – the Olympic Torch Relay.

3. Accommodation and food and beverage

- Accommodation

Number of persons		Duration of the torch relay	Source	Comment
Under the responsibility of OCOG	Associated responsibility (sponsors, etc.)	[days]		
			OCOG functional area: Torch relay	Consider one overnight per pers. day

Table 7-24: Data recording template for torch relay – Accommodation

The following data are required for estimating the GHG emissions of one overnight stay.

Parameter	Unit	Amount	Source
Electricity	kWh/night		Primary data from hotels, or statistical data from the country of the Games.
Fuel for hot water	MJ/night		
Water	L/night		
Waste (municipal waste)	kg/night		
Food	kg/night		

Table 7-25: Data recording template for overnight stays

If neither primary nor secondary data are available on the energy and goods consumption per overnight stay, use the default data provided in section 8.3.

- Food and beverage

Type of food	Unit	Amount	Source
Red meat	kg		OCOG functional area: Torch relay
White meat	kg		
Vegetables	kg		
Pasta	kg		
Bread	kg		
Dairy products (cheese, yogurt)	kg		
...			
Alcoholic beverages – Beer	litres		
Alcoholic beverages – Wine	litres		
Non-alcoholic beverages – Juices	litres		
Non-alcoholic beverages – Packed water	litres		
...			

Table 7-26: Data recording template for torch relay – Catering of the core team

If neither primary nor secondary data are available, use the following data together with the general data collected in Table 7-19 on the total number of people in the core team and total duration of the torch relay. These data can be used only for the *Initial carbon footprint*. Primary data must be collected to calculate the *Actual carbon footprint*.

Parameter	Value
Amount of food per person.day*	1 hot snack 1 average meal
Amount of beverage per day	0.7 litre of water 0.3 litre of non-alcoholic beverage

Table 7-27: Default data for food consumption at torch relay.
*Breakfast already included in accommodation

4. Transport of torchbearers to and from the relay route

Origin	Number of person	Mode of transport	Cabin class	Average distance per trip (one way)	Source
[-]	[pers]	[-]	[-]	[km]	
Local		Passenger car	n/a		OCOG functional area: Torch relay
Local		Public transport	n/a		
Local		...			
National		Coach	n/a		
National		plane	Economy		
National		...			
International		Train	1st class		
International		Plane	Business		
...					

Table 7-28: Data recording template for torch relay – Transport of torchbearer to and from the relay route

5. Torch production and use

Parameter	Material	Unit	Amount	Unit	Weight	Source
Torch	Aluminium/ other metal	Unit		kg/torch		OCOG functional area: Torch relay
Fuel for combustion of torches	Propane/ butane	litres		n/a	n/a	
...						

Table 7-29: Data recording template for torch relay – Torch production

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7.1.12.3 Emission factors

The emission factor used for the consumption of diesel for the vehicles of the fleet must account for the production and the combustion of fuel in vehicles.

For the food and beverage consumed by the core team, when default data provided above are used, apply the emission factors provided in section 8.4. Please note that these data can be used only for the *Initial carbon footprint*. Primary data and corresponding emission factors must be collected to calculate the *Actual carbon footprint*.

For transport by plane of torch bearers, use the emission factors presented in section 8.2.

For other activities, use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.1.13   Waste management

7.1.13.1   Category description

This category includes the treatment of the different categories of waste and the transport of waste from sites to treatment locations.

7.1.13.2 Data to be collected

The GHG emissions are calculated as follows:

- The GHG emissions of waste management are calculated based on the amount per type of waste and the type of treatment (recycling, landfilling, incineration).
- The GHG emissions of transport of waste to treatment are calculated based on the mode of transport and the distance travelled.

- **Waste treatment**

Type of material	Total weight	Waste treatment: recycling	Waste treatment: Incineration	Waste treatment: Landfilling	Source
[-]	[pers]	[-]	[-]	[km]	
Municipal waste					OCOG functional area: Sustainability, Cleaning and Waste or primary data provided by host city
Paper and board					
Wood					
Plastic					
…					

Table 7-30: Data recording template for waste management

If primary data are not available, the national rates for the different types of waste treatment can be used. For example, statistics on waste treatment in different countries are available at https://unstats.un.org/unsd/ENVIRONMENT/wastetreatment.htm.

- **Transport of waste to treatment locations**

Type of waste treatment	Location of treatment place	Mode of transport (type of vehicle)	Total weight of waste	Average distance travelled (one way)	Source
[-]	[kg]	[-]	[kg]	[km]	
Incineration					OCOG functional area: Sustainability, Cleaning and Waste or primary data provided by host city
Recycling					
Composting					
Landfilling					

Table 7-31: Data recording template for waste management – Transport to treatment places

7.1.13.3 Emission factors

The default emission factors to be used for waste treatment are presented in section 8.1 "Recycled materials and waste recycling".

7.1.14 Security

7.1.14.1 Category description

This category includes all security activities under the responsibility of the OCOG. Normally this is restricted to in-venue security operations and equipment, such as Vehicle Screening Areas, People Screening Areas, venue perimeter security, CCTV etc. Typically the OCOG will contract with specialist security agencies for this work.

Where items, such as screening equipment, perimeter lighting, cameras, barriers and vehicles etc., are specifically procured for security operations and can be identified separately from general overlay and equipment categories, these should be included here and data both for production and operation should be captured. Items such as uniforms, food and beverage and accommodation provided for security personnel will normally be included within those specific categories, but can be included here if it is practical to do so.

Security outside of the Games venues is normally a matter for state security services. In theory, these should be included in a dedicated category in the sphere "Associated emissions". However, as these data are typically highly confidential, it is likely they will have to be excluded from the carbon footprint of the Games. An estimated figure based on certain assumptions might be worth including for the sake of completeness, but this is not going to be an area where carbon footprint data will influence decision-making.

7.1.14.2 Data to be collected

GHG emissions are calculated based on the total distance travelled by security vehicles or total fuel consumption of security vehicles and based on the production of security equipment.

If biofuels are used, apply the methodology described in section 9.3.

Type of vehicle	Number of vehicles per type of vehicle	Type of fuel	Total fuel consumption per type of vehicle	Total distance travelled by the fleet	Source
[-]	[Unit]	[-]	[litres]	[km]	
Passenger car		Diesel			OCOG functional area: Security
Passenger car		Petrol			
Passenger car		Bioethanol			
Hybrid passenger car car		Petrol			
Van < 3.5t		Diesel			
…					

Table 7-32: Data recording template for security – Security vehicles

Parameter	Unit	Amount	Rented or purchased	Source
Security scanners	unit			OCOG functional area: Security
X-Ray (hand luggage)	unit			
...	unit			

Table 7-33: Data recording template for security – Security material

The modelling of the GHG emissions of purchased equipment, for which 100 per cent of the GHG emissions related to the production have to be allocated to the Games, or of rented equipment, which is used for several other occasions during and after the Games must be done according to section 9.2.

7.1.14.3 Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.1.15 Transport services to venues

7.1.15.1 Category description

This category includes all transport organised by the OCOG in dedicated vehicles for accredited groups, during the Games, between Olympic and Paralympic venues. Among other groups using this service, there are athletes, IF officials and media (non-comprehensive list).

The use of other transport solutions is not included in this category, but in the category "Preparations and operations – public transport to venues" (see section 7.1.16).

7.1.15.2 Data to be collected

The GHG emissions are calculated based on the total distance travelled during the Games by each type of vehicle. If biofuels are used, apply the methodology described in section 9.3.

Type of vehicle	Number of vehicles per type of vehicle	Type of fuel	Total fuel consumption per type of vehicle	Total distance travelled by the fleet	Source
[-]	[Unit]	[-]	[litres]	[km]	
Passenger car		Diesel			OCOG functional area: Transport
Passenger car		Petrol			
Passenger car		Bioethanol			
Hybrid passenger car		Petrol			
Van < 3.5t		Diesel			
...					

Table 7-34: Data recording template for security – Security vehicles

7.1.15.3 Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

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7.1.16 Public transport to venues

7.1.16.1 Category description

This category includes the use of public transport by various stakeholders, in particular by the workforce (staff, contractors and volunteers), and also potentially by other groups such as media.

The use of the dedicated transport services organised by the OCOG is not included here, but in the category "Preparations and operations – transport services to venues" (see section 7.1.15).

The use of public transport by spectators is not included here, but in the category "Associated activity – transport to the host country and venues (spectators, other). (See section 7.3.2.)

7.1.16.2 Data to be collected

The GHG emissions are calculated based on the total number of people taking public transport to travel to competition or non-competition venues, the mode of transport and the average distance travelled to their workplace, i.e. number of persons multiplied by the distance they travelled by mode of transport, hence person * km, denoted pkm or personkm.

Use only primary or secondary data specific to the country of the Games for this category: if no primary data are available, use secondary data such as national statistics on commuting transport, i.e. the average distance for each mode of transport.

Type of workforce	Amount	Number of days in the Games city	Source
[-]	[pers]	[days]	
Number of volunteers			OCOG functional area: Transport
Number of staff			
Number of contractors			
...			

Table 7-35: Data collection template for daily commuting of workforce during the Games

Mode of transport	Modal split	Average distance of transport (one way)	Source
[-]	[%]	[km]	
Bus			OCOG functional area: People Management, survey, national statistics for mode of transport
Subway			
Train			
Passenger car			
Motor cycle			
...			

Table 7-36: Data collection template for daily commuting of workforce during the Games

7.1.16.3 Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.1.17 Accommodation

7.1.17.1 Category description

This category includes the number of nights spent in hotels that were reserved and funded by the OCOG and delivery partners (e.g. accommodation for IOC members, guests, workforce, media).

Nights spent in the Olympic Village or any other supporting venue are not included in this category since building construction and energy consumption are already taken into account in the categories "Construction of permanent infrastructure – non-competition venues" and "Preparations and operations – energy use".

Nights reserved and paid for by clients on their own are not included in this category but are included in the category "Associated activities – accommodation (spectators, other)".

7.1.17.2 Data to be collected

The GHG emissions related to accommodation are calculated based on the number of nights per type of accommodation.

Type of accommodation	Number of overnights	Source
[-]	[unit]	
Hotel – medium hotel		OCOG functional area: Accommodation
Hotel – luxury hotel		
Bed and breakfast		
...		

Table 7-37: Data collection template accommodation funded by the OCOG

The following data should be collected to estimate the GHG emissions of one overnight stay per type of accommodation.

Parameter	Unit	Amount	Source
Electricity	kWh/overnight		Primary data from hotels, or statistical data from the country of the Games.
Fuel for hot water	MJ/overnight		
Water	litres/overnight		
Waste (municipal waste)	kg/overnight		
Food	kg/overnight		

Table 7-38: Data recording template for overnight

If neither primary nor secondary data are available on the energy and goods consumption per overnight, use the default data provided in section 8.3.

7.1.17.3 Emission factors

Use the default emission factors provided in section 8.3.

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7.1.18 Travel

7.1.18.1   Category description

This category includes national and international travel financed by the OCOG and the delivery partners during the preparation of the Games and during the Games.

During the years of preparation of the Games, all travel done by the OCOG and the delivery partners, in direct relation for the Games, are included. It also includes any other travel financed by the OCOG.

During the Games, any travel to and from the host city, directly financed by the OCOG and the delivery partners, are included. This could cover travel from special guests to the Games.

The transport of any other groups, financed by their own organisations, is not included here but in the category "Associated activities – transport to the host country". Local travel during the Games is not included here, but in the category "Operations and preparations – transport services" and "Operations and preparations – public transport".

7.1.18.2   Data to be collected

The GHG emissions are calculated based on number of persons per point of origin and per mode of transport multiplied by the distance they travelled, hence person * km, denoted pkm or personkm. The three parameters that need to be taken into account are thus:

- Number of people per point of origin coming to the Games whose ticket is paid for by the OCOG;
- Mode of transport (including occupancy rate for car travel as well as class type for planes); and
- Distance travelled from point of origin to host city.

Origin	Number of persons	Mode of transport	Cabin class	Average distance per trip (one way)	Source
[-]	[pers]	[-]	[-]	[km]	
Europe					OCOG functional area: Relation services
North America					
…					

Table 7-39: Data recording template for transport of Olympic family to and from the Games

7.1.18.3   Emission factors

For transport by plane, use the emission factors presented in section 8.2. For other types of transport, use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.1.19 Live Sites

7.1.19.1   Category description

This category includes the materials and energy consumption related to Live sites in host cities and any other side events organised by the OCOG.

Events organised by the host city are not included here, but in the category "Associated activities – city operations".

Please note that Live Sites often have elements managed by the OCOG and others that are managed by the host city authorities. Therefore, the allocation may need to be split proportionally according to organisational involvement.

The GHG emissions of freighting the materials are calculated based on the distance travelled and the transport mode, and should be reported in the category "Preparations and operations – logistics".

7.1.19.2   Data to be collected

The GHG emissions are calculated based on:

- The amount per type of material (giant screen, wood, plastic, metal etc.); and
- The type and amount of energy used on site.

If bio-based materials (e.g. bamboo, cotton fibres) or biofuels are used, apply the methodology described in section 9.3.

Type of item	Unit	Amount	Material	Origin (production place) and transport mode	Source	Comment
Carpets	kg		Virgin PP	From the country, by truck	Live Sites	Weight of carpet can be estimated based on surface of carpet, and average density of carpet (e.g. 380 g/m²)
Wood	kg		Type of Wood			
...						
Temporary tent structure	kg		Steel			Weight of steel for tent structures can be estimated based on weight of steel per m² of temporary tent
...						

Table 7-40: Data recording template for side events – Materials

Type of energy	Unit	Amount	Source
Electricity from the grid	kWh		Host city, Entity in charge of side events, etc.
Generator – Conventional diesel	litres		
Generator – Bio-diesel from cooking oil	litres		
Generator – Average bio-diesel	litres		
Natural gas (heating)	MJ or Nm_3		
Other energy source	MJ		
...			

Table 7-41: Data recording template for side events – Energy use

7.1.19.3 Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.2   Permanent infrastructure

This category includes the construction of permanent venues and all related urban and transport infrastructure specifically required for the Games, and that would not otherwise have been built and/or completed in the Games timeframe.

We do not include in this category any construction of venues and infrastructure that were already planned irrespective of being awarded the Games and that are completed and used prior to the Games.

Likewise we exclude projects that have been accelerated because of the Games but which are not required for Games operational purposes. This is a common situation and may be regarded as the catalytic effect of the Games, whereby public authorities and developers are able to bring forward plans that might otherwise have taken several years more to achieve.

It is not always black and white whether something should be included in the scope of the Games carbon footprint. Public transport and road infrastructure projects sometimes fall into the grey area of being Games-related or not. The candidature to host the Games specifies the operational plans for Games-time transport. This will usually comprise a combination of existing transport infrastructure, plus any currently planned infrastructure due to be completed within the timeframe. There may also be some additional works (such as accessibility improvements, line upgrades or new stations) specifically necessary for the Games. If so, these would need to be included.

Any additional new public transport infrastructure that happens to come on line before the Games would not be counted within the Games carbon footprint, even if it becomes part of revised operational plans. This is because the new infrastructure, while beneficial, is not strictly necessary for operating the Games.

Another example is where municipalities often undertake urban 'beautification' initiatives and upgrades to infrastructure and amenities in anticipation of the Games. These will very likely add to the positive impression of the host city for visitors and create a sense of civic pride for local people.

There is a risk in such situations that the Games carbon footprint could become inflated by numerous collateral activities, all of which are 'nice to haves' but none of which are strictly necessary. The fundamental test for inclusion in the Games carbon footprint is therefore whether the item/activity in question is (a) necessary for hosting the Games and (b) determined by Games organisers or delivery bodies using Games-specific budgets over-which they have control.

Remember too, the purpose of calculating the Games carbon footprint is to facilitate ways of minimising GHG emissions within one's sphere of responsibility and control. It is not an academic exercise to measure every gram of carbon that might have some tangential relationship to the Games. Pragmatism and practicalities should outweigh purity of accounting, and a case-by-case approach should be followed. What is important, however, is to ensure that boundaries are very clearly stated and any potentially controversial exclusions are transparently justified and explained in documentation. In case of doubt and in order to ensure consistency, please consult the IOC to define the exact list of permanent infrastructure to include in the scope of the Games carbon footprint.

7.2.1   Category description

This category includes the materials and the energy needed for the construction of permanent infrastructure and the refurbishment of existing infrastructure to enable the Games. The infrastructure can be divided into 3 categories depending on their function:

1. Competition venues;
2. Non-competition venues (e.g. Olympic Village, IBC/MPC, training venues, warehouses, etc.); and
3. Venue-related urban and transport infrastructure.

Where possible, it would be good to provide a higher level of detail, for example by identifying the carbon footprint of each venue, in particular major venues such as the Olympic Village or the IBC/MPC.

7.2.2   Data to be collected

As a first approach, GHG emissions of each category must be calculated based on the total amount of materials and energy for the construction and refurbishment of all infrastructures.

If bio-based materials (e.g. wood) or biofuels are used, apply the methodology described in section 9.3.

The data recording format shown over the page should be used for each venue construction or refurbishment.

Material/ Source of energy	Unit	Amount	Source	Comment
Material				
Concrete	m³		OCOG functional area: Venue development, Venue urban infrastructure and Olympic and Paralympic Village, host city	
Steel	tonnes			
Stainless steel	tonnes			
Aluminium	tonnes			
Mortar	tonnes			
Asphalt	tonnes			
Wood (planted)	tonnes			
Wood (native)	tonnes			
Plaster	tonnes			
Paint	tonnes			
Plastics	tonnes			
Sealant membranes	tonnes			
Stone	tonnes			
Ceramics	tonnes			
Earth moved	m³			
...	...			
Energy consumption and/or machinery fuel consumption				
Diesel	litres		OCOG functional area: Venue Development, construction delivery partner(s)	The energy consumption of machinery can be calculated based on hours of use of machinery
Electricity from the grid	kWh			
...	...			

Table 7-42: Data recording template for permanent infrastructure construction or refurbishment

If these data are not available, estimate GHG emissions by dividing permanent infrastructure into six main types: outdoor stadia, indoor venues, outdoor venues, building construction, landscaping (around the infrastructure), and venue-related urban and transport infrastructure. For each of these infrastructure categories, calculate the GHG emissions based on an average emission factor as follows:

- **Outdoor stadiums**

This category refers to open stadiums (i.e. without enclosing roofs), such as for athletics, equestrian and hockey. The GHG emissions of an outdoor stadium can be calculated based on its seating capacity. An average factor for GHG emissions per spectator must be calculated for the construction of outdoor stadia, based on the amount of materials and energy of one or more similar venues in the country using data collection template from Table 7-37.

- **Indoor venues**

This category refers to indoor, arena-style venues, typically used for combat sports, track cycling and basketball. As with the outdoor stadia, the GHG emissions of each indoor venue can be calculated based on its capacity. An average factor for GHG emissions per spectator must be calculated for the construction of indoor venues, based on the amount of materials and energy of one or more similar venues in the country.

- **Outdoor venues**

This category refers to venues such as golf courses and rowing lakes, which have relatively little building construction and typically involve earthworks and various amounts of landscaping. The GHG emissions of each competition area can be calculated based on the total transformed surface area and an average emission factor per square metre.

- **Building construction**

This category refers to non-competition buildings such as IBC/MPC, Olympic Villages, club houses and depots. The GHG emissions of each building construction can be calculated based on the surface of constructed area and on an average emission factor, which can be calculated as the average of the emission factors of different types of buildings.

- **Landscaping**

The GHG emissions of landscaped areas can be calculated based on their total surface area and an average emission factor for landscaping per square metre.

- **Venue-related urban and transport infrastructure**

The GHG emissions must be calculated as follows:

- For the construction of urban roads, the GHG emissions are calculated based on the total surface area of roads and an average emission factor per square metre of road.
- For the construction and refurbishment of other types of infrastructure, GHG emissions can be calculated based on total surface area of the structure and an average emission factor per square metre.

If using this alternative methodology of calculation, use the following data collection template.

Type of venue	Category (competition venues, non-competition venues, etc.)	Venue name	Construction type (new, refurbished)	Constructed area	Spectator capacity	Competition area (fields of practice)	Landscaped areas	Venue-related and transport infra-structure	Source
	[-]	[-]	[-]	[m²]	[unit]	[m²]	[m²]	[m²]	
Outdoor stadium			New						OCOG functional area: Venue Development, construction delivery partner(s)
Outdoor stadium			Refurbished						
...									
Indoor venue			Refurbished						
...									
...									

Table 7-43: Data recording template for permanent infrastructure

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7.2.2.1 Post-Games transformation of permanent infrastructure

Under new policies, as exemplified by the IOC's "Olympic Agenda 2020 – The New Norm" publication, there should be far fewer cases than in previous Games, where expensive transformation works are undertaken to convert venues from Games configuration to legacy mode. The potential impact of these conversion works should have been factored out during the design phase.

There are two situations to consider in this context:

- **Dismantling activities:** these activities consist of the dismantling of some portions of the infrastructure that were specific for the Games. It could be, for example, additional seats in a sports venue that are not required in legacy use.
- **Transformation works:** these are undertaken to accommodate legacy purposes, different from their Games function. These works are usually carried out by (or on behalf of) future owners of the venues and are not part of the OCOG's remit. A typical example is the conversion of an Olympic Village into residential units and other amenities.

According to the definition above, the following rules apply:

- The GHG emissions related to dismantling activities should be included in the Games carbon footprint, in the appropriate category of the sphere of activities "Construction of permanent infrastructure". The GHG emission related to dismantling activities can be calculated based on financial flows using the emission factors provided below.
- The GHG emissions related to reconstruction/transformation of venues after the Games are not included in the Games carbon footprint.

7.2.3 Emission factors

For existing structures that do not need any refurbishment for the Games, use an emission factor of 0 kg CO_2-eq/m² or 0 kg CO_2-eq/spectator.

If the first approach is applied (using the amount and type of material and energy used for the constructions and refurbishments), apply country-specific emission factors and/or emission factors specific to the database selected for this category.

If the second approach is applied (using average emission factors for each type of permanent infrastructure), the average emission factor should be calculated using examples from venue(s) within the host country and based on country-specific emission factors and/or emission factors specific to the database selected.

If the GHG emissions are calculated based on financial flows, use the following emission factor.

Parameter	Emission factor	Unit	Source
Dismantling – Sector OECD "Manufacturing (including furniture)"	0.49	kg CO_2-eq/USD 2004*	Simmons, Gonzales and Lewis (2006) Methodology for determining global sectoral material consumption, carbon dioxide emissions and Ecological Footprints

Table 7-44: Emission factor for dismantling activities

*Please refer to section 9.4, which explains how to take account of inflation and currency conversion rates so that the emission factors are applied accurately in present day values.

7.3   Associated activities (not funded by OCOG and delivery partners)

This category includes activities that are clearly directly related to the Games being held but which are not under the control or responsibility of the OCOG or its key delivery partners, and consequently not funded by them. For example, this would include accommodation for spectators during the Games, but not their accommodation for other purposes, such as pre or post-Games tourism. There are many other activities that might also be included, but the practical difficulties in obtaining meaningful data will generally place them out of scope of the Games carbon footprint.

7.3.1   Uniforms (other)

7.3.1.1   Category description

This category includes all uniforms not included in the category "Operations and preparations – uniforms" (see section 7.1.8). In other words, all uniforms which are associated to the Games but are not funded by the OCOG and the delivery partners.

This includes in particular the uniforms of the NOCs, officials and security workforce.

7.3.1.2   Data to be collected

GHG emissions are calculated based on the total number of uniforms and the type of textiles used. If natural fibres are used (e.g. bamboo or cotton fibres), apply the methodology described in section 9.3.

Parameter	Amount	Weight per item	Total weight	Source
	[nb]	[kg/item]	[kg]	
Pieces of uniform made with natural textile (eg. Cotton, …)				OCOG functional area: Uniforms, People Management, NOC Services, etc.
Pieces of uniform made with synthetic textile (eg. polyester, …)				
Pieces of uniform made with unknown type of fiber				
…				

Table 7-45: Data recording template for uniforms

To facilitate data collection, particularly from NOCs, an estimation provided by 2 or 3 large representative NOCs can be extrapolated to other NOCs.

7.3.1.3   Emission factors

Use emission factors specific to the database selected for this category.

7.3.2 Travel to the host country and to the venues – NOCs, spectators, other

7.3.2.1 Category description

This category includes all transport not financed or organised by the OCOG. In other words, all travel not covered so far by the categories "Preparations and operations – travel", "Preparations and operations – transport services to venues" and "Preparations and operations – public transport to venues". The travel covered includes the transport to and from the host city (international or national) as well as the transport to venues, mostly competition venues.

Several groups of stakeholders can be partially or fully concerned, for international, national or local travel. In particular, NOCs, spectators and media are included. Some travel occurring during the preparation of the Games could also be included, for the example for the Chefs de Mission seminars and for Continental meetings up to three years before the Games.

Travel to and from the torch relay route is not included here but is included in the categories "Preparations and operations – torch relays" and "Associated activities – transport to torch relay".

7.3.2.2 Data to be collected

For international and national travel to and from the host city, the GHG emissions are calculated based on number of persons per point of origin and per mode of transport multiplied by the distance they travelled, hence person * km, denoted pkm or personkm.

The three parameters that need to be taken into account are:

1. Number of people per point of origin coming to the Games;
2. Mode of transport (including occupancy rate for car travel and class of travel for flights); and
3. Distance travelled from home to venue.

Example for spectators travel

For example, an international spectator coming to the Games will attend on average 2.5 events*. It means that for 1,000,000 tickets sold for the Games to international spectators, 1,000,000/2.5 = 400,000 international spectators will travel from their home to the Games to attend on average 2.5 events.

Travel planning documents and surveys can provide the needed information about the origin of ticketed spectators and the selected mode of transport.

Preliminary carbon footprint report of the Olympic Games Rio 2016 (published approximately 3 years prior to Games).

Future Games should make their own estimations, which will typically be based on their transport master plan, and provide explanations on their new assumptions.

For travel to and from the venues, the GHG emissions of transport must be calculated based on transport simulations. For example, for spectators, transport needs can be estimated by using the number of tickets sold and attendance for non-ticketed events, available modes of transport and average distance for each competition venue (see Table 7-46 on next page).

Origin	Proportion of spectators by origin	Number of tickets sold	Number of events per spectator	Number of spectators coming from their home to the Games	Source
[-]	[%]	[tickets]	[events/ pers]	[pers]	
Host city residents	e.g. 50%				OCOG functional area: Ticketing
Host country residents	e.g. 20%				
International (neighbouring countries)	e.g. 15%				
International (long distance overseas)	e.g. 15%				
Total Olympic Games	100%				
Host city residents	e.g. 50%				OCOG functional area: Ticketing
…					
Total Paralympics	100%				
Host city residents					OCOG functional area: Event Services, host city authorities
…					
Total non-ticketed events					

Table 7-46: Data recording template for transport to and from the Games – Number of spectators and their point of origin

If neither primary nor secondary data are available for the number of events per spectator, use the following default data.

Parameter	Value
Average number of events per spectator	2.5

Table 7-47: Average number of events per spectator

Mode of transport	Cabin class	Repartition rate between mode of transport	Distance travelled (one way)	Source	Comment
[-]	[-]	[%]	[km]		
Local spectators (host city)					
Metro	NA			OCOG functional area: Transport, National statistics on transport for leisure activities in host city, surveys	
Bus	NA				
…	NA				
Passenger car (occupancy rate: x pers/car)	NA				Complete the occupancy rate of passenger cars
Bicycle	NA				
On foot	NA				
…					
Total local		100%			
Regional spectators (< 1500 km from host city)					
Train	NA			OCOG functional area: Transport, National statistics on transport for leisure activities in host city, surveys	
Coach	NA				
Plane (short-haul)	Economy				
Plane (short-haul)	Business				
…					
Total regional		100%			
Global spectators (> 1500 km from host city)					
Train	NA			OCOG functional area: Transport, National statistics on transport for leisure activities in host city, surveys	
Coach	NA				
Plane (long-haul)	Economy				
Plane (long-haul)	Business				
…					
Total global		100%			

Table 7-48: Data recording template for transport to and from the Games – Mode and distance of transport per point of origin

7.3.2.3 Emission factors

For transport by plane, use the emission factors presented in section 8.2. For other types of transport, use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.3.3 Travel to torch relays (spectators, other)

7.3.3.1 Category description

This category includes the transport to and from the torch relay route that is not funded by the OCOG and concerns primarily spectators, but possibly other stakeholders such as media. The transport of staff and torchbearers is not included in this category, but in the category "Preparation and operations – torch relays".

7.3.3.2 Data to be collected

The GHG emissions are calculated based on number of persons per origin and per mode of transport multiplied by the distance they travelled, hence person * km, denoted pkm or personkm. The three parameters that need to be taken into account are thus:

1. Number of people per origin (mainly local spectators);
2. Mode of transport (including occupancy rate for car travel); and
3. Distance travelled from home to torch relay.

These elements are usually very difficult to measure or to estimate, as torch relays are non-ticketed events. However, estimation can be made based on surveys or on attendance estimation by local authorities.

Origin	Proportional split between origins	Number of spectators	Number of spectators coming from their home to the Games	Source
[-]	[%]	[spectators]	[pers]	
Local	e.g. 50%			OCOG functional area: Torch relay
Neighbouring towns	e.g. 20%			
…				
Total	100%			

Table 7-49: Data collection template for transport to and from the torch relay – Number of spectators and their point of origin

Mode of transport	Modal split	Distance travelled (one way)	Source	Comment
[-]	[%]	[km]		
Metro			OCOG functional area: Transport, Ticketing, National statistics on transport for leisure activities, surveys	
Bus				
...				
Passenger car (occupancy rate: x pers/car)				Complete the occupancy rate of passenger cars
Bicycle				
On foot				
...				
Total locals	100%			
Train			OCOG functional area: Transport, National statistics on transport for leisure activities in host city, surveys	
Coach				
...				
Total neighbouring towns	100%			

Table 7-50: Data recording template for transport to and from the Games – Mode and distance of transport per point of origin

7.3.3.3   Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

7.3.4 Accommodation (spectators, other)

7.3.4.1 Category description

This category includes:

- The total amount of nights spent in hotels or other types of accommodation that are not hosted in an official hotel or Village, or whose accommodation is not funded by the OCOG. This concerns primarily spectators, but also other stakeholders such as non-accredited media or non-accredited support staff.
- The amount of food and beverage purchased outside of the Games perimeters for stakeholders spending nights in hotels or other types of accommodation.

As a reminder, accommodation and related food and beverage for other purposes (for example pre and/or post-Games tourism) are not included in these calculations and are considered out of the scope of the Games carbon footprint.

7.3.4.2 Data to be collected

The GHG emissions related to accommodation and related food and beverages are calculated based on the number of nights per type of accommodation.

- Accommodation (split by hotel categories)

Type of accommodation	Number of overnights	Source
[-]	[unit]	
Hotel – medium hotel		OCOG functional area: Accommodation
Hotel – luxury hotel		
Bed and breakfast, private (e.g. family & friends)		
…		

Table 7-51: Data recording template for accommodation not funded by the OCOG

The data to be collected to estimate the GHG emissions of one overnight stay per type of accommodation are the following:

Parameter	Unit	Amount	Source
Electricity	kWh/night		Primary data from hotels, or statistical data from the country of the Games.
Fuel for hot water	MJ/night		
Water	litres/night		
Waste (municipal waste)	kg/night		
Food for breakfast	kg/night		

Table 7-52: Data recording template for overnight stays

If neither primary nor secondary data are available on energy and goods consumption per overnight stay, use the default data provided in section 8.3.

- Related food and beverage

For food and beverage, use the default data presented below:

Parameter	Value
Amount of food per person per day	1 breakfast 1 average meal[9]
Amount of beverage per person per day	0.7 litre of non-alcoholic beverage 0.3 litre of alcoholic beverage

Table 7-53: Default data for food and beverage related to accommodation not funded by the OCOG

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[9]Usually, the second meal is taken inside a venue perimeter, and included in the category "Preparations and operations – Catering" (see section 7.1.10).

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7.3.4.3   Emission factors

Use the emission factors presented in section 8.3.

7.3.5   NOCs/NPCs houses, IFs and commercial partners pavilions

7.3.5.1   Category description

This category includes all activities related to houses and pavilions active during the Games, such as:

- Construction, fit-out and decoration, including the transport of material;
- Energy consumption;
- Food, beverage and give-aways; and
- Waste production, including for dismantled material of temporary structures.

7.3.5.2   Data to be collected

The GHG emissions are calculated based on:

- The amount per type of material (wood, plastic, metal etc.). (See category "Preparations and operations – overlay and temporary structures", section 7.1.3.)
- Freighting of materials and goods, based on the distance travelled and the transport mode (see category "Preparations and operations – logistics", section 7.1.2).
- The type and amount of energy used on site (see category "Preparations and operations – energy use", section 7.1.5).
- The type and amount of food served (see category "Preparations and operations – catering", section 7.1.10).
- The type and amount of give-aways given during Games time (see category "Preparations and operations – merchandise", section 7.1.9).

If bio-based materials (e.g. wood) or biofuels are used, apply the methodology described in section 9.3.

If data are not available for physical flows, it may be possible to estimate GHG emissions based on financial flows. In this case, the list of data to be collected is much shorter, but the accuracy of the carbon footprint calculated based on financial flows is generally lower compared to the footprint calculated with physical flows. The main challenge will be to obtain budget and actual cost information from the various organisations commissioning these structures. The OCOG will not normally have access to these data.

Parameter	Unit	Amount	Origin (production place) and transport mode	Source
Budget for hospitality houses and showcases	Million $ (for example)		From the country, by truck	Commissioning organisation for the facility
...				

Table 7-54: Data collection template for overlay – Financial flows

7.3.5.3   Emission factors

If the GHG emissions are calculated based on financial flows, use the following emission factor.

Parameter	Emission factor	Unit	Source
NOCs/NPCs houses and pavilions – Sector OECD "Manufacturing (including furniture)"	0.49	kg CO_2-eq/ USD 2004*	Simmons, Gonzales and Lewis (2006) Methodology for determining global sectoral material consumption, carbon dioxide emissions and Ecological Footprints.

Table 7-55: Emission factor for the construction of NOC/ NPC houses and pavilions

*Please refer to section 9.4, which explains how to take account of inflation and currency conversion rates so that the emission factors are applied accurately in present day values.

7.3.6　City operations

7.3.6.1　Category description

This category includes the materials and energy consumption related to events organised by the host cities.

Events organised by the OCOG are not included here, but in the category "Preparations and operations – live sites".

7.3.6.2　Data to be collected

The GHG emissions are calculated based on:

- The amount per type of material (giant screen, wood, plastic, metal etc.). The GHG emissions of freighting the materials are calculated based on the distance travelled and the transport mode, and should be reported in this category.
- The type and amount of energy used on site.

If bio-based materials (e.g. bamboo, cotton fibres) or biofuels are used, apply the methodology described in section 9.3.

Type of item	Unit	Amount	Material	Origin (production place) and transport mode	Source	Comment
Carpets	kg		Virgin PP	From the country, by truck	Host city	Weight of carpet can be estimated based on surface of carpet, and average density of carpet (e.g. 380 g/m²)
Wood	kg		Type of Wood			
...						
Temporary tent structure	kg		Steel			Weight of steel for tent structures can be estimated based on weight of steel per m² of temporary tent
...						

Table 7-56: Data recording template for side events – Materials

Type of energy	Unit	Amount	Source
Electricity from the grid	kWh		Host city
Generator – Conventional diesel	litres		
Generator – Bio-diesel from cooking oil	litres		
Generator – Average bio-diesel	litres		
Natural gas (heating)	MJ or Nm_3		
Other energy source	MJ		
...			

Table 7-57: Data recording template for side events – Energy use

7.3.6.3   Emission factors

Use country-specific emission factors and/or emission factors specific to the database selected for this category.

8 Appendix 3: Default data and emission factors

This section presents some default emission factors to be used for the following specific activities, and are presented together with the default data to be used:

- Materials and waste;
- Transport by plane;
- Accommodation; and
- Food and beverage.

8.1 Materials and waste

For materials, use the emission factors listed below. If there is recycled content in the materials (i.e. using secondary materials as inputs, such as for stadium seats produced from recycled plastic), use the emission factors listed below by considering a weighted average of the percentage of virgin and recycled material[10].

Material	Virgin material – Emission factor	100% recycled material – Emission factor	Unit
Aluminium	18.91	15.28	kg CO_2-eq/kg
Cardboard	0.98	0.96	kg CO_2-eq/kg
Paper*	1.62	1.62	kg CO_2-eq/kg
Glass	1.31	1.19	kg CO_2-eq/kg
Plastic (other than PET bottles)	2.16	1.12	kg CO_2-eq/kg
PET bottles	3.24	1.93	kg CO_2-eq/kg
Steel	2.652	2.21	kg CO_2-eq/kg
Wood	0.41	0.34	kg CO_2-eq/kg
Concrete	0.06	0.06	kg CO_2-eq/kg

Table 8-1: Emission factors of materials

*Note: though virgin and recycled paper tend to have the same carbon footprint, the main reason to encourage the use of recycled paper is not to reduce carbon footprint but to reduce pressure on forest (and associated negative impact on biodiversity).

[10]The emission factors are calculated based on the allocation rules described in the PEF Guidance Version 6.3 (Source: European Commission (2017) – Product Environmental Footprint Category Rules Guidance Version 6.3).

For the waste treatment, use the emission factors listed below by considering a weighted average of the different types of end-of-life treatment (recycling, incineration, landfilling)[11].

Material	100% recycled – Emission factor	100% landfilled – Emission factor	100% incinerated – Emission factor	Unit
Aluminium	-12.27	0.05	-0.15	kg CO_2-eq/kg
Cardboard	-0.09	1.52	-0.54	kg CO_2-eq/kg
Paper	-0.44	1.19	-0.47	kg CO_2-eq/kg
Glass	-0.45	0.01	0.02	kg CO_2-eq/kg
Plastic (other than PET bottles)	-0.64	0.13	1.44	kg CO_2-eq/kg
PET bottles	-0.63	0.10	1.23	kg CO_2-eq/kg
Steel	-1.60	0.01	0.02	kg CO_2-eq/kg
Wood	-0.01	0.08	-0.49	kg CO_2-eq/kg
Concrete	0	0.004	n/a	kg CO_2-eq/kg

Table 8-2: Emission factors for waste treatment

[11]*The emission factors are calculated based on the allocation rules described in the PEF Guidance Version 6.3 (Source: European Commission (2017) – Product Environmental Footprint Category Rules Guidance Version 6.3).*

8.2 Transport by plane

For transport of passengers by plane, use the following emission factors.

Type of travel by plane	Cabin class	Emission factor (kg CO_2-eq/pers.km)
Short-haul (< 5 hrs)	Economy	0.16
	Business	0.24
	First	0.24
Long-haul (> 5 hrs)	Economy	0.15
	Business	0.44
	First	0.61

Table 8-3: Emission factors for passenger air travel. Source: Defra 2017

For freight flights, use the following emission factors.

Type of travel by plane	Emission factor (kg CO_2-eq/tonne.km)
Short-haul (< 4,000 km)	2.00
Long-haul (> 4,000 km)	1.46

Table 8-4: Emission factor for freight flights. Source: Defra 2017

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8.3 Accommodation

For accommodation, if neither primary nor secondary data are available, use the following default data and emission factors.

8.3.1 Default data

- Energy and water consumption and waste production for one night in a luxury hotel (4-5 stars)

Parameter	Value (per overnight per person)
Electricity	30 kWh
Fuel for hot water	10 MJ
Water	450 L
Waste (municipal waste)	1.5 kg
Breakfast	1 gourmet breakfast

Table 8-5: Default data for luxury hotel night

- Energy and water consumption and waste production for one night in a medium hotel (2-3 stars)

Parameter	Value (per overnight per person)
Electricity	20 kWh
Fuel for hot water	7 MJ
Water	300 L
Waste (municipal waste)	1 kg
Breakfast	1 standard breakfast

Table 8-6: Default data for medium hotel night

- Energy and water consumption and waste production for one night in a bed and breakfast (B&B)

Parameter	Value (per overnight per person)
Electricity	10 kWh
Fuel for hot water	3.5 MJ
Water	150 L
Waste (municipal waste)	0.5 kg
Breakfast	1 standard breakfast

Table 8-7: Default data for B&B night

8.3.2 Emission factors

For overnight at friends or family house, use the following emission factor(s).

Parameter	Emission factor	Unit
Overnight at friends or family house	0	kg CO_2-eq/overnight

Table 8-8: Emission factor for overnights at friends

For calculating the impacts related to breakfast, use the following emission factors depending on the type of breakfast (default data provided below) or model your country specific breakfast:

Parameter	Emission factor	Unit	Source
1 standard breakfast	0.84	kg CO_2-eq/breakfast	Based on WFLDB (2015)
1 gourmet breakfast	2.33	kg CO_2-eq/breakfast	Based on WFLDB (2015)

Table 8-9: Emission factor for breakfast

Item	Standard breakfast	Gourmet breakfast	Unit
Bakery	150	150	g
Coffee	1	1	unit
Milk	200	200	g
Butter	20	20	g
Jam	30	30	g
Sugar	6	6	g
Eggs	0	120	g
Bacon & Sausages	0	100	g
Orange juice	0	400	g

Table 8-10: Data and assumptions for breakfast

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8.4 Food and beverage

If using default data, apply the following corresponding emission factors. Please note that the methodology described in section 7.1.10 was applied to calculate the emission factors.

Parameter	Emission factor	Unit	Source
1 cold or hot snack	2.02	kg CO_2-eq/hot snack	Based on WFLDB (2015) Calculated as 50% cold sandwich, 50% hot snack (burger and fries)
1 average meal	4.70	kg CO_2-eq/meal	Based on WFLDB (2015) Calculated as 20% vegetarian meal, 40% meal with chicken, 40% meal with beef (see details in tables below)
Non-alcoholic beverage	0.20	kg CO_2-eq/litre	Based on WFLDB (2015) Bottled water, including packaging
Alcoholic beverage	1.87	kg CO_2-eq/litre	Based on Bengoa, X (2010)* Wine (Including packaging)

Table 8-11: Emission factors for catering

*Bengoa, X (2010) ISO-compliant comparative life cycle assessment (LCA) of wine packaging from multiple origins (North America, South America, Europe, Australia, South Africa). Société des Alcools du Québec. CIRAIG, Montreal, Canada

Parameter	Emission factor	Unit	Source
1 hot snack (burger + frites)	2.77	kg CO_2-eq/hot snack	Based on WFLDB (2015)
1 sandwich	1.27	kg CO_2-eq/sandwich	Based on WFLDB (2015)

Table 8-12: Emission factors for snacks

Parameter	Emission factor	Unit	Source
Bread	200	g	Based on WFLDB (2015)
Chicken	50	g	Based on WFLDB (2015)
Beef	50	g	Based on WFLDB (2015)
Ham or bacon	20	g	Based on WFLDB (2015)
Potatoes (fries)	100	g	Based on WFLDB (2015)
Cheese (hard)	30	g	Based on WFLDB (2015)
Tomato	20	g	Based on WFLDB (2015)
Butter	10	g	Based on WFLDB (2015)
Oil	10	g	Based on WFLDB (2015)
Frying	2	unit	Based on WFLDB (2015)
Storage (chilled)	2	litre.day	Based on WFLDB (2015)
Ingredients supply	700	kgkm	Based on WFLDB (2015)

Table 8-13: Data and assumptions for snacks

Parameter	Emission factor	Unit	Source
Meal, vegetarian	2.85	kg CO_2-eq/meal	Based on WFLDB (2015)
Meal, with chicken	3.39	kg CO_2-eq/meal	Based on WFLDB (2015)
Meal, with beef	6.93	kg CO_2-eq/meal	Based on WFLDB (2015)

Table 8-14: Emission factors for meals

Item	Meal, vegetarian	Meal, with chicken	Meal, with beef	Unit
Chicken	0	200	0	g
Beef	0	0	200	unit
Soybean	200	0	0	g
Potatoes	150	150	150	g
Rice	50	50	50	g
Tomatoes	50	50	50	g
Carrots	50	50	50	g
Yogurt or cheese	125	125	125	g
Cheese (soft)	0	0	0	g
Cheese (hard)	0	0	0	g
Bread	20	20	20	g
Pasta	50	50	50	g
Oil	20	20	20	g
Espresso	1	1	1	unit
Cream	20	20	20	g
Chocolate	25	25	25	g
Eggs	0	0	0	g
Boiling	2	2	2	unit
Frying	1	1	1	unit
Storage (chilled)	10	10	10	litre.day
Ingredients supply	700	700	700	kgkm

Table 8-15: Data and assumptions for meals

9 Appendix 4: Additional modelling rules for specific topics

In the cases listed below it is necessary to define specific modelling rules for certain topics that **need to be applied for the entire study:**

- electricity, in particular defining rules for the electricity mix to consider, and defining rules for calculating the emission factor for a renewable electricity mix;
- bio-based materials (wood, bio-fuels, cotton, etc.), in particular defining rules on how to consider the biogenic carbon, which is the carbon that is incorporated into the biomass during growth (carbon uptake, the result of the photosynthesis effect) and which can be released during decomposition or combustion at the end-of-life;
- rented material, in particular defining rules for modelling its GHG emissions compared to purchased material; and
- financial flows, in particular defining rules to use emission factors from financial databases with current monetary value in the specific host country of the Games.

The rules to be applied for each of these topics are defined in the section below.

9.1 Electricity

9.1.1 Electricity mix from the grid

The electricity mix should account for physical power trade between regions[12].

- In Europe, use the ENTSO-E (European Network of Transmission System Operators for Electricity) electricity mix.
- In the United States, use the production mixes of the three continental interconnections (East, West, Texas) as a proxy for consumption mix, as well as those of Hawaii and Alaska. Those production mixes must be remodelled based on eGRID data https://www.epa.gov/energy/egrid. Always document the sources for electricity and calculation procedures.
- For other countries (outside Europe and United States), use the national consumption mix.

9.1.2 Production or purchase of renewable electricity

On-site renewable electricity sources should be included in the calculations, when directly used by a facility/venue to offset grid electricity purchases. For example, include any investment made by the OCOG to build renewable electricity installations.

According to the "market-based approach" of the GHG Protocol, if qualifying contractual agreements for low-carbon electricity are purchased by the OCOG, the low-carbon emission factor must be used instead of the "average" emission factor for the region under two conditions:

- Hydropower may not be accounted for as "certified renewable electricity", because in most cases, it represents large scale, existing dams and produces electricity which is already included in the regional/national mixes.
- Certificates provided must be official certificates validated by official authorities (e.g., Guarantee of Origin in Europe, REC in North America, or i-REC standard, for other countries).

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[12]Renewable electricity sources that are part of a country or region-specific grid mix have to be included in calculations.

9.2 Rented equipment

The GHG emissions related to rented equipment production must also be included in the Games carbon footprint. However, unlike purchased equipment, for which 100 per cent of the GHG emissions related to the production have to be allocated to the Games, rented equipment may have already been used at other events and will be used for several other occasions after the Games. The GHG emissions of rented equipment production should therefore be allocated to the Games as a portion of the equipment's life-cycle.

For calculating the GHG emission related to rented equipment, apply the following rules in hierarchical order:

- As a first choice, calculate the GHG emissions based on financial flows and emission factors from input/output databases. In fact, by modelling based on financial flows, the lower GHG emissions of rented equipment compared to GHG emissions of purchased equipment are implicitly accounted for, since renting the equipment can be cheaper than purchasing.
- If not using the financial flows and if the GHG emissions of rented equipment production are calculated based on physical flows (amount of material and energy), it is necessary to multiply the GHG emissions of rented equipment by a factor allowing to take into account the lower GHG emissions of rented equipment compared to purchased equipment. This factor, called "Impact ratio of renting equipment compared to purchased equipment" should be calculated as follows: $F_{re} = P_r / P_p$
  With: F_{re}: Impact ratio of renting equipment compared to purchased equipment
  P_r : Price of renting the equipment
  P_p : Price of purchasing the equipment

9.3 Bio-based materials and fuels

A bio-based material is defined as a material made from substances derived from living (or once-living) organisms. It includes raw bio-based materials such as wood, vegetables, fruits (also called biotic materials), but also refers to modern materials that have undergone more extensive processing, such as cotton fibres, plastic made out of cellulose fibres and fuels made out of soya (e.g. biodiesel).

All these bio-based materials are composed of biogenic carbon, which is defined as the carbon that is taken up and incorporated in the biomass during growth (as the result of photosynthesis) and which can be released during decomposition or combustion at the end of life.

Use the following approach for modelling the biogenic carbon content of bio-based material:

- The global warming potential for biogenic carbon is 0 kg CO_2-eq/kg of biogenic carbon dioxide, for both uptake and release.
- No discounting for temporary carbon storage is taken into account, due to the relatively short period of storage, when emissions occur.
- Include emissions related to land use and land use change (e.g. deforestation). These are treated similar to fossil carbon emissions with a global warming potential 1 kg CO_2-eq per kg CO_2 emitted. These emissions can be calculated using the Dryad tool, which is available at https://quantis-intl.com/lucguidance/.

9.4 Financial flows: using emission factors to account for inflation rate and conversion rate

If the GHG emissions are calculated based on financial flows, using a dedicated Economic Input/Output database[13], it could be relevant to take into account the inflation rate and currency conversion rates when the modelling year and currency are different from those given by the background database. The approach for adjusting the difference is as follows:

- The average local inflation rate must be considered in order to know the value of the service across time periods. Inflation rates in various countries can be found here: http://www.inflation.eu/inflation-rates/cpi-inflation.aspx
- The exchange rate (http://fxtop.com/fr/historates.php) should be applied consistently with the chosen time period.

Additionally, an efficiency correction factor could be applied according to economic sectors across different locations.

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[13]E.g.: World input-output database. www.wiod.org/home