



Ricardo
Energy & Environment

Glasgow Airport Carbon Footprint 2017

In accordance with the UK Government's Conversion Factors for Company Reporting.

Report for Glasgow Airport Limited



Customer:**Glasgow International Airport Limited****Customer reference:**

Carbon Footprint 2017

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Executive summary

This report provides the results of the 2017 carbon footprint assessment for Glasgow Airport Limited (GLA). GLA is wholly owned by AGS Airports Limited, a partnership between Ferrovial and Macquarie Infrastructure and Real Assets (MIRA). The carbon footprint has been undertaken in accordance with best practice guidance for greenhouse gas emissions reporting by Ricardo Energy & Environment.

Since 2009, Ricardo Energy & Environment has been commissioned to provide an assessment of Glasgow Airport carbon footprints.

To make sure that a rigorous methodology has been applied that will stand-up to external scrutiny, the carbon footprint modelling tools used (first developed in 2008) have undergone iterations that reflect improvements in best practice (such as updates to the *GHG Protocol*) and access to data.

The results presented in this report have been calculated using UK Government 2017 conversion factors for company reporting¹ as the latest version available at the time of reporting. The carbon footprint is divided into scopes, which cover:

- **Scope 1** – Scope 1 emissions are defined as direct GHG emissions arising from sources that are owned or controlled by the company. The emissions result from activities that Glasgow Airport can have direct influence on through its actions.
- **Scope 2** – Scope 2 emissions are associated with the use of electricity imported from the grid or from a third-party supplier of energy in the form of heat or electricity. These indirect GHG emissions are due to upstream emissions from the production and delivery of fuel to power stations. Glasgow Airport can influence the amount of electricity it uses; however, it has little control over the generation of the electricity.
- **Scope 3** – Scope 3 emissions are defined as those arising as an indirect consequence of the use of goods or services provided by the company. Glasgow Airport do have some influence over Scope 3 emissions but the activities are not under its control.

An overview of the 2017 carbon footprint by emission scope is shown below. Some of the key comments to note are:

- The key performance indicators adopted by Glasgow Airport are absolute emissions (Scope 1, 2, and 3), per passenger (PAX), and per air traffic movement (ATM) (Scope 1 and 2) – Table 3. Both the latter two have decreased from 2017, this partly to do with the increase in customer numbers and flights.
- **Scope 1 and 2 emissions have decreased by 12% from 2016.** This is linked to a reduction in the Scope 2 electricity emission conversion factor, as in fact Glasgow Airport's electricity consumption has increased by 0.2%. Scope 1 emissions have increased overall.
- Glasgow Airport's **Scope 3 emissions have increased by 14% this year from 2016**, mainly due to the increase in passenger numbers and aircraft movements.
- Passenger surface access to the airport and aircraft movements are the largest emissions sources for Glasgow Airport, at 45.5% and 44.3% respectively (see Table 3).
- Generally, the data quality for the majority of emissions sources are good.
 - Scope 1 and 2 emissions data sources are of good quality and mainly provide confidence in their emissions.
 - Scope 3 emissions, which are harder to influence and quantify tend to be the largest emissions. In the case of Glasgow Airport this holds true as Scope 3 emissions are the largest source and indeed the data quality is poorest.

¹ www.ukconversionfactorscarbonsmart.co.uk/

Table 1: Intensity metric for Scope 1 and Scope 2 emissions for Glasgow Airport

Intensity Metric		2011	2012	2013	2014	2015	2016	2017
Glasgow	Scope 1 and Scope 2 carbon footprint / air traffic movement (kgCO ₂ e/ATM)	207	210	206	200	183	158	133
	Scope 1 and Scope 2 carbon footprint / passenger (kgCO ₂ e/PAX)	2.4	2.4	2.2	2.2	1.9	1.7	1.4

Table 2 shows the emissions scope split for Glasgow Airport and for AGS Airports as a whole for comparison. The 'Outside of Scopes' refers to emissions associated with the biofuel component of diesel consumed by each airport (i.e. Scope 1). Scope 3 emissions account for 92.5% of Glasgow Airport's total emissions, largely arising from passenger surface access and aircraft movements (see Table 3). For further information on what is included in passenger surface access and aircraft movements, please refer to the methodology in Appendix 1.

Table 2: Glasgow Airport's and AGS Airports' 2017 carbon emissions by scope expressed as tonnes carbon dioxide equivalent (tCO₂e)

Emissions by scope (tCO ₂ e)	Glasgow	% split of Glasgow	AGS total 2017 emissions	% total split
Scope 1	3,070	1.7%	5,002	1.8%
Scope 2	10,518	5.8%	17,252	6.3%
Scope 3	168,735	92.5%	253,724	91.9%
Outside of Scopes	5	0.0%	22	0.01%
Total	182,328	100%	276,001	100%

Table 3 shows the breakdown of the emissions by source and activity for Glasgow Airport and AGS Airports as a whole. The largest emissions sources are passenger aircraft movements (44.3%) and passenger surface access (45.5%).

Table 3: Glasgow Airport's and AGS Airports' 2017 carbon emissions by source/activity expressed as tonnes carbon dioxide equivalent (tCO₂e)

Emissions by source and activity (tCO ₂ e)	Scope	Glasgow	% split of Glasgow	AGS total 2017 emissions	% total split
Aircraft movements	Scope 3	80,826	44.3%	125,024	45.30%
Aircraft engine testing	Scope 3	360	0.2%	544	0.20%
Business travel	Scope 3	21	0.01%	35	0.01%
Fire Training	Scope 1	40	0.02%	178	0.06%
Staff commute	Scope 3	359	0.2%	1,284	0.47%
Operational vehicles	Scope 1 / Scope 3	587	0.3%	2,160	0.78%
Passenger surface access	Scope 3	82,886	45.5%	118,825	43.05%
Utilities	Scope 1 / Scope 2 / Scope 3	14,394	7.9%	23,284	8.44%
Waste (disposal and production of virgin material)	Scope 3	2,856	1.6%	4,667	1.69%
Total		182,328	100%	276,001	100%

Glossary

Term	Definition
Arisings	Materials forming the secondary or waste products of industrial operations.
ATM	Air traffic movements – an aircraft take-off or landing at an airport. For airport traffic purposes one arrival and one departure is counted as two movements.
Carbon dioxide equivalent (CO ₂ e)	The carbon dioxide equivalent (CO ₂ e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO ₂ . CO ₂ e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100 year global warming potential (GWP).
Carbon footprint	A carbon footprint measures the total greenhouse gas emissions caused directly and indirectly by a person, organisation, event or product. A carbon footprint is measured in tonnes of carbon dioxide equivalent (tCO ₂ e).
Degree days	A unit used to determine the heating requirements of buildings, representing a fall of one degree below a specified average outdoor temperature (usually 18°C) for one day.
Emission factor	An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.
GHG	Greenhouse gas – a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.
Outside of Scopes	<p>All fuels with biogenic content (e.g. 'Diesel and petrol (average biofuel blend)') should have the 'Outside of Scope' emissions reported to ensure a complete picture of an organisations' emissions is created.</p> <p>The emissions are labelled 'Outside of Scopes' because the Scope 1 impact of these fuels has been determined to be a net '0' (since the fuel source itself absorbs an equivalent amount of CO₂ during the growth phase as the that CO₂ is released through combustion).</p>
PAX	Number of passengers.

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1 Introduction

1.1 Background

AGS Airports Limited, a partnership between Ferrovial and Macquarie Infrastructure and Real Assets (MIRA), owns Aberdeen International Airport Limited (ABZ). The airport operates 365 days a year serving 9.9 million passengers a year and handling around 98,000 aircraft movements per year. AGS Airports employ 846 full time employees (FTE), of which 445 are based in Glasgow Airport, many of whom commute to the airport by car or public transport. To continue operating in an environmentally responsible manner, it is important for the airport to monitor and manage all its emissions from all operations.

The calculation of the annual carbon footprint will help AGS Airports Limited and the individual airports understand the different areas which contribute to their overall carbon footprint and monitor changes on a yearly basis. This process will help identify improvement opportunities, which will ultimately reduce AGS Airports' carbon footprint and associated costs. In addition, the success of any management strategies previously implemented can be evaluated.

1.2 Legislation and drivers

The legislative landscape around the mandatory reporting of consumption and emissions data, as well as best practice/standards around the voluntary reporting of such data is ever changing. It is important to consider what AGS Airports may need to, or may wish to, report going forward.

The following, recent or upcoming changes to legislation or best practice / standards are likely to impact on what AGS Airports needs to disclose publicly.

1.2.1 Non-financial reporting

The EU Non-Financial Reporting Directive (2014/95/EU) came into force on 6th December 2014 to improve the quality and consistency of companies' non-financial reporting (NFR) across the EU. Intended to provide investors and other stakeholders with a comprehensive picture of their performance, companies will require accurate NFR reporting to safeguard reputations and business continuity. This is therefore likely to require AGS Airports to report on a wide variety of subjects including the environment, such as the Modern Slavery Act, employee and community activity and other aspects of the overall business model.

The 2017/18 financial year is the first year of reporting under the EU Non-Financial Reporting (NFR) Directive, which was implemented into UK law as the 'The Companies, Partnerships and Groups (Accounts and Non-Financial Reporting) Regulations 2016', effective January 1st 2017. This brings the NFR Directive into national law and require companies falling into scope to comply or risk penalties.

1.2.2 Scope 2 changes

The Greenhouse Gas (GHG) Protocol, produced by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), is the most widely used accounting tool for GHG emissions. Its 'A Corporate Accounting and Reporting Standard' is used by businesses and governments around the world. There have been recent changes to the standard regarding the accounting of GHG emissions from Scope 2 electricity.

Companies should now report two Scope 2 electricity emission figures, one on a **location-based method** and another on a **market-based method**.

The location-based method reflects the average emissions intensity of macro-scale (regional/national) electricity grids where energy consumption occurs. Companies should use the regional/national grid-average emission factor. In the UK, this would be sourced from the Defra/DECC UK Government conversion factors for Company Reporting.

The market-based method reflects the emissions from the electricity that a company is purchasing. Energy suppliers in the EU are already required, by law, to disclose to consumers the fuel mix and GHG emissions associated with their portfolio or tariffs. As such, companies intending to report a market-based Scope 2 electricity emissions figure should:

- Request the emission factor for their tariff(s) from their energy supplier(s).
- Request the source of this data (e.g. generator declarations in the UK).
- Request the energy generation technologies and mix specific to the supplier / tariff(s).

A comparison between the location-based and market-based reporting method is carried out for each of the AGS Airports below and summarised in the table below. In this instance it is possible to see that applying the location based factor reduces the emissions proportion of Scope 2 to around 6.4% instead of the 6.8% attributed to it under the location based method. Scope 3 still remains, by far, the largest emissions source (noting that Scope 3 WTT or T&D losses haven't been amended to take into account Scope 2 market based emissions factors).

Though the market-based reporting method can give a lower carbon emission factor than that of the location-based, location based must be used as it is the actual energy mix that has been used by the site. Apart from within this section where Scope 2 is referred to it should be assumed that the location based method has been used.

Table 4: UK Mandatory Reporting requirements

Emissions by scope (tCO ₂ e)	Glasgow	% total split (location based)	% total split (market based)
Scope 1	3,070	2%	2%
Scope 2 (Location based)	10,518	8%	
Scope 2 (Market based)	2,205		1%
Scope 3	168,735	90%	97%
Outside of Scopes	5	0%	0%
Total (Location based)	182,328	100%	100%
Total (Market based)	174,015		

1.2.2.1 Glasgow Airport market-based method comparison

Glasgow Airport's electricity consumption during 2017 was 29,918,625kWh. This is a 0.22% increase in electricity consumption compared to 2016.

Location-based method: As all of the 29,918,625kWh of electricity consumption by Glasgow Airport occurred in the UK, it is multiplied by the UK Government conversion factors for Company Reporting UK electricity emission factor of 0.35156kgCO₂e/kWh to calculate the emissions as 10,518tCO₂e.

Market-based method: In 2016 Glasgow Airport switched supplier to Axpo UK for all of their 29,918,625kWh of electricity consumption. Glasgow Airport contacted the supplier and asked for the details of the fuel mix. The following breakdown was provided for the period ending March 2017 (Source of Electricity, Percentage):

- Coal, 3.3%
- Natural Gas, 10.2%
- Nuclear, 2.8%
- Renewable, 82.6%
- Other fuels, 1.1%

The weighted emission factor was provided as 73.7gCO₂/kWh (or 0.074kgCO₂/kWh).

Multiplying the electricity consumption of 29,918,625kWh by the emission factor of 0.074kgCO₂/kWh calculates the emissions as 2,205tCO₂e

Comparing the two factors:

Location-based method: 10,518tCO₂e

Market-based method: 2,205tCO₂e

The fact that the emissions calculated through the market-based method are lower than those calculated through the location-based method means that Glasgow Airport's choice of supplier and the fuel mix it uses to generate the power that Glasgow Airport receives is less carbon-intensive than the UK-average.

1.2.3 Upcoming consultation on a 'single reporting framework'

In the 2016 budget, the Chancellor announced a number of business energy efficiency tax changes. These included the eventual abolishment of the CRC Energy Efficiency Scheme (CRC) at the end of its second phase in 2019 and changes to the Climate Change Levy (CCL). The main changes included an increase to the CCL to maintain the revenue generated by the CRC after 2019, as well as a rebalancing of the CCL rates on electricity and gas.

As a case study, utilising Glasgow Airports energy and regulatory costs, the impact of the changes in regulation outlined above was assessed. This analysis determined that by 2022 regulatory costs will decrease by 33%, energy costs will increase by 34% leading to a total increase in cost of 24%.

These changes were first considered in HM Treasury's consultation on *Reforming the business energy efficiency tax landscape*. One of the other proposals put forward by the government in that consultation, which is still pending, was a proposal to move away from the current system of overlapping policies towards a system where a business faces just one tax and one reporting scheme.

The taxation element of the proposal was concluded as part of the 2016 budget. In the budget, the government outlined that it will consult on the simplified energy and carbon reporting framework later in 2016, for introduction by April 2019.

The government's proposal(s) around a simplified reporting framework will not be known until this new consultation is released. However, it is likely that the Energy Saving Opportunity Scheme (ESOS) and Climate Change Agreements (CCAs) will be in the scope of the consultation. The indicated timing of the introduction of the simplified reporting framework, in April 2019, will follow the abolishment of the CRC and so is not expected to be in scope. AGS Airports will need to be prepared to report data in line with the new requirements, which may be different in scope/granularity compared to existing reporting.

1.3 Carbon footprinting

Carbon footprinting is a tool that has been widely adopted to measure the quantity of carbon dioxide (CO₂) and other greenhouse gas emissions (GHGs) that are produced both directly and indirectly, from organisations activities.

The operations and activities at the AGS Airports cover a wide range of emission sources. These include emissions from; travel and transport fuel, aircraft related emissions, emissions from disposal and treatment of waste, emissions from using and disposing of water, and emissions from the use of refrigerant gases.

The range of emission sources have a number of greenhouse gas emissions associated with them, and each have different levels of impact on global warming (referred to as Global Warming Potential, GWP). As such, to get a meaningful comparison between the GHG emissions, conversion factors are used to convert the quantities consumed into tonnes of carbon dioxide equivalent (CO₂e). CO₂e is a measure for describing the impact of each different GHG in terms of the amount of carbon dioxide that would create the same amount of global warming.

In line with the methodology used to calculate the previous carbon footprints, Ricardo Energy & Environment has calculated the 2017 carbon footprint using a tool based on the Greenhouse Gas Protocol² and UK Government conversion factors for company reporting³. The Greenhouse Gas Protocol is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.

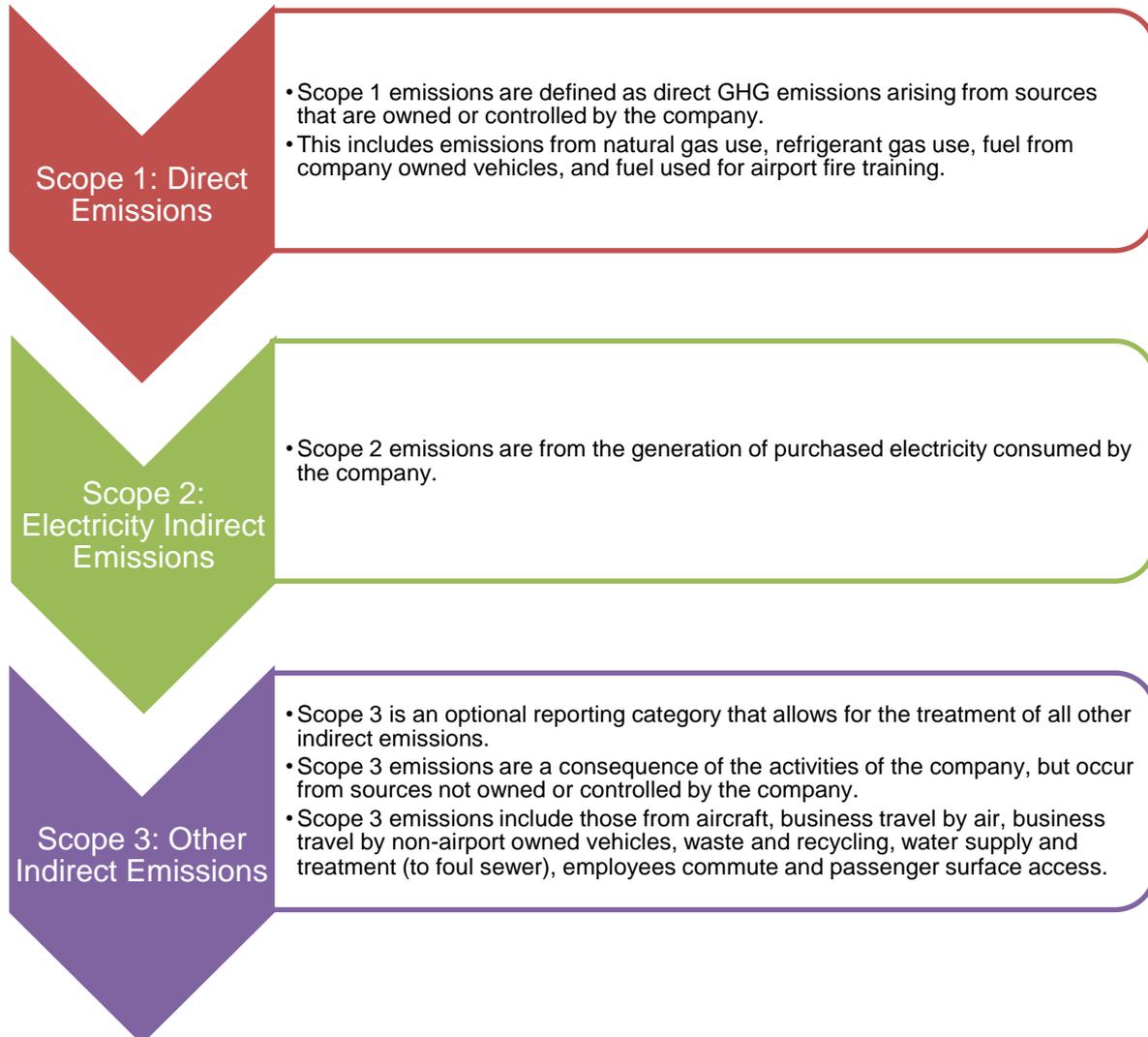
² Greenhouse Gas (GHG) Protocol Corporate Accounting and Reporting Standard methodology developed by World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI)

³ DCFCarbonFactors_9_3_2016 accessed www.ukconversionfactorscarbonsmart.co.uk/

1.3.1 Emissions scopes

The GHG protocol⁴ divides emissions sources into three different emission scopes. These relate to how much control and influence a company has over them. A further description of the emission scopes, including details of the emissions included, are shown in Figure 1. In addition to these three scopes, organisations should report both the direct emissions from combustion of the fuel and the biogenic portion of this fuel. These emissions are reported as outside of scopes emissions but are still included as part of the airport's overall carbon footprint.

Figure 1: Emission scope boundaries of AGS Airports' 2017 carbon footprint



1.3.2 Specific exclusions from the carbon footprint

The carbon footprint for the AGS Airports has consciously sought not to calculate emissions from aircraft in the cruise phase of flight for arriving aircraft, and beyond the cruise phase of flight for departing aircraft. This is because the ability of the AGS Airports to influence changes to the emissions here is minimal. That responsibility is with airline operators and air-traffic control service providers (e.g. NATS and Eurocontrol).

However, emissions within the aircraft landing and take-off (LTO) cycle (from ground to 1,000 metres above aerodrome level) have been calculated. This is because the AGS Airports do have some influence over these emissions. This approach is consistent with the industry benchmark scheme for carbon footprint calculation, the Airports Council International Airport Carbon Accreditation Scheme (ACI ACA)⁵.

⁴ <http://www.ghgprotocol.org/>

⁵ <http://www.airportcarbonaccreditation.org/>

Other emissions excluded from the scope of this assessment are those from surface access cargo movements (e.g. freight and delivery trucks accessing the airport) and emissions arising through AGS Airports' procurement and supply chain activities.

1.4 Reporting format

Reporting of electricity consumption

A change to the UK Government guidance in 2013 meant that the 5-year grid rolling average conversion factor applied to electricity before this date was replaced with a single average factor for a particular year. This change was to allow organisations to report using a factor representing the most current emissions estimation from the grid. This has a number of benefits, including an immediate ability for organisations to report efficiencies achieved in national infrastructure, rather than this being dampened within a five-year average. The one-year average factor is however more sensitive to energy mix changes on a year-on-year basis.

In addition, to account for electricity emissions fully, Government guidance suggests that organisations should report the transmission and distribution (T&D) loss associated with purchased electricity. If an organisation generated their own renewable electricity on site, they would not need to account for this loss. Therefore, reporting T&D helps demonstrate the full impact of an organisation's activities and operations. This procedure should have no impact on the total reported electricity emissions. However, it will split these emissions across Scopes 2 and 3.

Calculation of Electricity Emissions

Due to the previously discussed changes to the way in which electricity consumption is reported, introduced in 2013, a re-baselining of 2011 and 2012 emissions has been carried out in 2013 and 2014 reports for Glasgow Airport.

2 Key performance indicators (KPI)

This section provides a breakdown on a series of KPIs. These KPIs have been monitored for a number of years and allow us to see how the group and each airport is performing. There are two types of KPIs that have been monitored.

- Intensity metrics; and,
- Absolute emissions

2.1 Intensity metrics for Glasgow Airport

Intensity metrics allow comparison over time against other factors that fluctuate and have an impact on the environmental performance of the airports. The two chosen key performance indicators are aircraft movements and passenger numbers.

Another reason that intensity metrics are included is that Under the Companies Act 2006 (Strategic and Directors' Reports) Regulations 2013, all companies listed on the main market of the London Stock Exchange have to report their annual greenhouse gas (GHG) emissions in their directors' report.

Whilst AGS Airports is a limited company and isn't required to comply, it is helpful to have these metrics in place should the requirements for reporting publicly ever change. Under company reporting at the moment there are a number of sources which need to be included in the metrics. These are shown in Table 5.

Table 5: UK Mandatory Reporting requirements

Emissions source requirement	Corresponding AGS Airports emissions sources
The combustion of fuel	Diesel use
	Petrol use
	Fuel oil use
	Kerosene use
	LPG use
	Natural gas use
Fugitive emissions	Emissions from air conditioning and refrigeration systems
Purchase of electricity, heat, steam or cooling	Electricity use

The metrics shown in Table 6 are based on Scope 1 and Scope 2 emissions only to allow Glasgow Airport to track progress against emissions over which it has direct control. The results show that there has been an improvement in both the carbon footprint per passenger (PAX) metric and the carbon footprint per air traffic movement (ATM) metric.

An air traffic movement represents an aircraft that takes off, or lands at the airport.

Table 6: Intensity metric for Scope 1 and Scope 2 emissions for Glasgow Airport

Intensity Metric		2012	2013	2014	2015	2016	2017
Glasgow	Scope 1 and Scope 2 carbon footprint / air traffic movement (kgCO ₂ e/ATM)	210	206	200	183	158	133
	Scope 1 and Scope 2 carbon footprint / passenger (kgCO ₂ e/PAX)	2.4	2.2	2.2	1.9	1.7	1.4

Table 6 provides a comparison of emissions since 2011. It is interesting to note that Glasgow Airport has seen a steady downward trend in these metrics which implies that environmental performance has improved over time; noting that during this time the PAX and ATM numbers for Glasgow Airport have continued to increase substantially.

These KPIs show if an airport is 'growing', the same service can be delivered in a more carbon efficient manner as more passengers share the baseload carbon emissions. If it is 'contracting', then comparing year on year KPIs show how well the airport is reacting to the contraction in managing emissions and the baseload – the function/activities that have to be undertaken despite PAX numbers. Or, the airport may have exhausted all applicable baseload reduction options.

It should be noted that in 2008 and 2009 the carbon footprint was expressed as carbon dioxide (CO₂). For subsequent years carbon dioxide equivalent (CO₂e) has been used. Using CO₂e will cause a slight uplift in overall emissions as it takes into account the relative contribution of other greenhouse gases in addition to those from carbon dioxide.

2.2 Glasgow Airport

Table 7 provides a breakdown of the emissions by scope for Glasgow Airport since 2011.

Table 7: Glasgow Airport's total emissions (tCO₂e) by scope

Scope	2011 emissions (tCO ₂ e)	2012 emissions (tCO ₂ e)	2013 emissions (tCO ₂ e)	2014 emissions (tCO ₂ e)	2015 emissions (tCO ₂ e)	2016 emissions (tCO ₂ e)	2017 emissions (tCO ₂ e)
Scope 1	2,622	2,973	3,029	2,650	2,990	3,202	3,070
Scope 2	13,579	13,958	13,364	14,159	13,584	12,301	10,518
Scope 1 and Scope 2 total	16,201	16,931	16,394	16,809	16,574	15,502	13,589
Scope 3	120,317	113,651	102,182	167,456	174,048	196,753	168,735
Outside of Scope	N/A	N/A	3	4	6	5	5
Total across all scopes	136,518	130,582	118,579	184,269	190,627	212,260	182,328

In general, since 2011, Scope 1 and Scope 2 combined emissions have decreased, however an increase in these emissions was seen in 2012 and in 2013 (Scope 1 only). However, as discussed earlier, the reduction is both a consequence of UK Government guidance splitting electricity emission over Scope 2 and Scope 3 and changing best practice recommendations to use an annual conversion factor, and reduction in consumption.

- In general, Scope 1 and Scope 2 have plateaued since 2011 and then reduced by 6% from 2015 to 2016, due to a decrease in the conversion factor by 10%.
- In 2017, Scope 1 emissions decreased by a further 4%.
- Scope 2 electricity emissions have seen a reduction of 14% since 2016.
- Scope 3 emissions are the largest emissions scope and are dominated by aircraft movements (44.3% of total footprint) and passenger surface access (45.5% of total footprint). Changes here are due to increases in passenger numbers and aircraft movements. However, there has been a reduction of 14% in Scope 3 emissions since 2016. PAX/ATM is still on an upward trend which aids both KPIs (carbon emissions per ATM and carbon emissions per PAX) which have both reduced since 2016.

3 2017 Carbon Footprint by Scope

This section provides a breakdown of the carbon footprint by the emission scope for Glasgow Airport.

3.1 Scope 1 emissions

Scope 1 emissions account for **3,070tCO₂e**, which is 1.7% of Glasgow Airport's total carbon footprint.

Figure 2 shows the composition of Glasgow Airport's Scope 1 emissions by activity and Table 8 shows the contribution of the emissions activity and source to the scope.

Scope 1 emissions include:

- Fuel used in company owned operational vehicles
- Natural gas usage for heating and hot water
- Fuel oil for back-up generators
- Release of refrigerant gases used for cooling systems through maintenance and/or leakages (R410A)
- Burning of fuels for airport fire training (Propane and kerosene)

There has been an increase in fuel oil consumption of 16% compared with 2016. However, overall there has been a decrease in Scope 1 emissions of 4% from 2016.

Figure 2: Glasgow Airport's Scope 1 emissions (tCO₂e) by activity

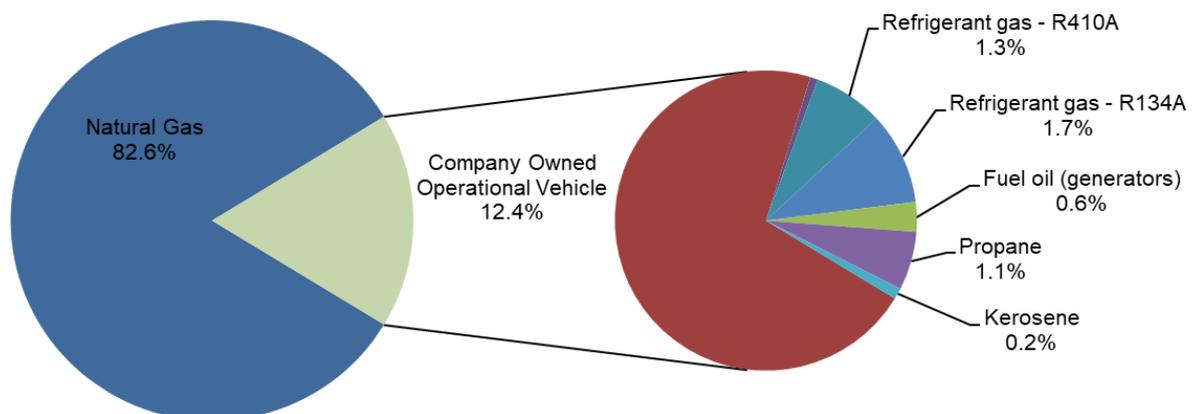


Table 8: Glasgow Airport's Scope 1 emissions (tCO₂e) by emission source

Emission activity	Emissions source	2017 Emissions (tCO ₂ e)
Utilities	Natural Gas	2,536.46
Utilities	Refrigerant gas - R410A	40.09
Utilities	Refrigerant gas - R134A	52.91
Utilities	Fuel Oil (generators)	17.18
Operational vehicles	Company Owned Operational Vehicle	379.45
Business Travel	Fuel purchase (hire car)	0.02
Business Travel	Business travel (personal car)	4.30
Fire Training	Propane	33.59
Fire Training	Kerosene	6.33
Total		3,068.11

3.1.1 Scope 2 emissions

Scope 2 emissions consist of electricity bought from the grid and consumed at Glasgow Airport. Scope 2 emissions total **10,518tCO₂e**, which is 5.8% of Glasgow Airport's total carbon footprint across all scopes.

For 2017, the electricity consumption by 3rd parties (tenants) within the airport has been recorded. If this 3rd party consumption were to be deducted from the AGS Airports reporting, the difference would be a reduction of 12,262,776kWh of electricity consumption and 4,311tCO₂e overall.

In 2017, the Scope 2 and Scope 3 (transmission and distribution losses) conversion factor for electricity reduced by 14.7% and 11.8% respectively compared to the 2016 conversion factors due to the composition change. Table 9 illustrates the changes to electricity conversion factors and electricity consumption since 2013.

Table 9: Glasgow Airport's comparison of electricity consumption and conversion factors since 2013

	2013	2014	2015	2016	2017
Annual Scope 2 conversion factor (kgCO ₂ e/kWh)	0.45	0.49	0.46	0.41	0.35
Annual Scope 3 conversion factor (kgCO ₂ e/kWh)	0.04	0.04	0.04	0.04	0.03
Electricity usage (kWh)	29,999,565	28,646,547	29,390,537	29,851,963	29,918,625
Scope 2 emissions from electricity production (tCO₂e) - using actual year conversion factor	13,364	14,159	13,584	12,301	10,518
Scope 3 emissions for electricity transmission and distribution loss (tCO ₂ e) - using actual year conversion factor	1,143	1,238	1,122	1,113	983
Total electricity emissions (tCO₂e) – using actual year conversion factors	14,507	15,397	14,706	13,413	11,502
Originally reported emissions as Scope 2 (tCO ₂ e) – using 5-year grid rolling average conversion factor	N/A	N/A	N/A	N/A	N/A

3.1.2 Scope 3 emissions

Unlike Scope 1 and Scope 2 emissions, emissions categorised as Scope 3 are not under the direct control of the airport. All of the Scope 3 activities that have been reported were agreed between Ricardo Energy & Environment and Glasgow Airport and are consistent with best practice guidelines. Scope 3 emissions are shown in Figure 3 and Table 10.

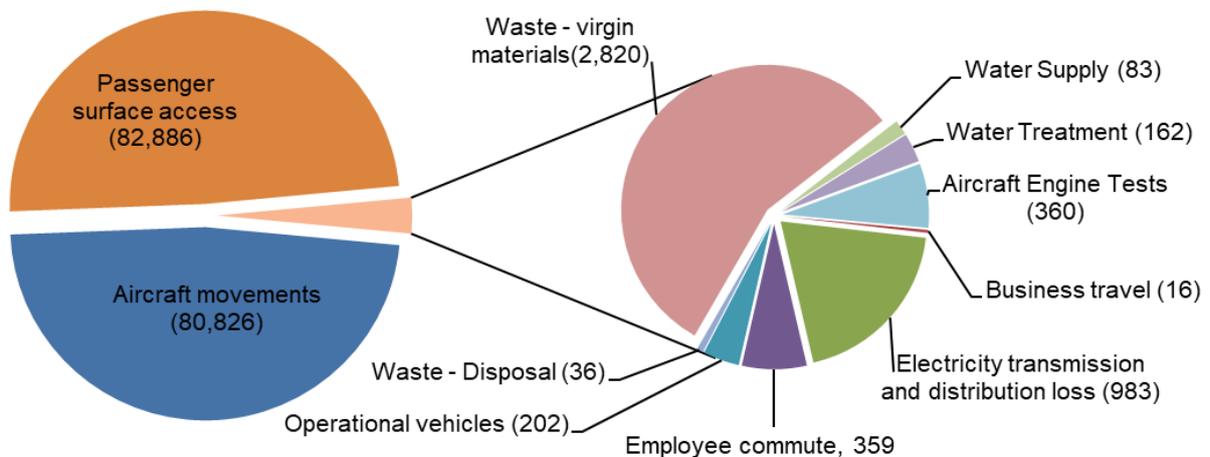
In summary:

- Scope 3 emissions total **168,735tCO₂e**, which is 92.5% of Glasgow Airport's total emissions
- Aircraft movements and passenger surface access continue to be the dominant Scope 3 activities.

Table 10: Glasgow Airport’s Scope 3 emissions (tCO₂e) by emission activity

By source and scope	Emissions (tCO ₂ e)	Percentage of scope	Percentage of total emissions
Aircraft movements	80,826	47.9%	44.3%
Business travel	16	0.0%	0.0%
Electricity transmission and distribution loss	983	0.6%	0.5%
Employee commute	359	0.2%	0.2%
Operational vehicles	202	0.1%	0.1%
Passenger surface access	82,886	49.1%	45.5%
Waste - Disposal	36	0.0%	0.0%
Waste - virgin materials	2,820	1.7%	1.5%
Water Supply	83	0.0%	0.0%
Water Treatment	162	0.1%	0.1%
Aircraft Engine Testing	360	0.2%	0.2%
Total	168,735	100.0%	92.5%

Figure 3: Glasgow Airport’s Scope 3 emissions (tCO₂e) by emission activity



3.1.3 Outside of Scope emissions

For biofuels, UK government conversion factors assume that the Scope 1 emissions are ‘net 0’. This is because the fuel source (e.g. plants, trees) has absorbed an equivalent amount of carbon dioxide during its growth as has been released through its combustion. This means that the conversion factors for biofuels calculate ‘0’ carbon dioxide (CO₂).

Due to this the UK Government guidance now recommends that although the Scope 1 conversion factors for biofuels contain a ‘0’ value for CO₂ emissions, organisations should still account for the impact of the CO₂ released through combustion of the biofuel. Therefore, the biofuel emissions are captured and reported as ‘Outside of Scope’ emissions but still count towards the overall organisational carbon footprint.

Outside of Scopes emissions should therefore be reported for any fuel with a biogenic content. For Glasgow Airport, Outside of Scope emissions are reported for the biofuel content of fuel (petrol and diesel) used in vehicles. This is because it is assumed that this fuel is obtained from forecourt fuel sources (i.e. fuel service stations) and because this fuel typically contains a small blend of biofuel. UK Government guidance recommends that the ‘average biofuel blend’ conversion factors be used.

For Glasgow Airport, Outside of Scope emissions include:

- Diesel purchased for use in company owned operation vehicles – **5tCO₂e**.

3.1.4 All scopes summary

The total carbon footprint for Glasgow Airport including all scopes and Outside of Scope is **182,328tCO₂e** and is shown in Table 11.

Table 11: Glasgow Airport’s summary of all scope emissions for 2017

Emissions by scope	Total 2017 emissions (tCO ₂ e)	Percentage of total emissions
Scope 1	3,070	1.7%
Scope 2	10,518	5.8%
Scope 3	168,735	92.5%
Outside of Scope	5	0.0%
Total	182,328	100%

Figure 4 show emissions since 2010 and Table 12 shows the emissions since 2012. It can be seen that:

- Across all scopes, there has been a decrease (14%) in CO₂e emissions between 2016 and 2017.
- Whilst passenger numbers in 2017 have continued to rise, there has been a decrease in Scope 3 emissions since 2016. This is mainly due to reductions in emissions factors for passenger surface access and aircraft movement emissions.
- Scope 1 and Scope 2 have plateaued between 2011 and 2016, this is because electricity emissions (Scope 2) have remained relatively consistent, and these are the dominant emission source within Scope 1 and Scope 2. However, there has been a 14% reduction in Scope 2 since 2016.

Figure 4: Glasgow Airport’s annual carbon footprints by emissions scope (tCO₂e)

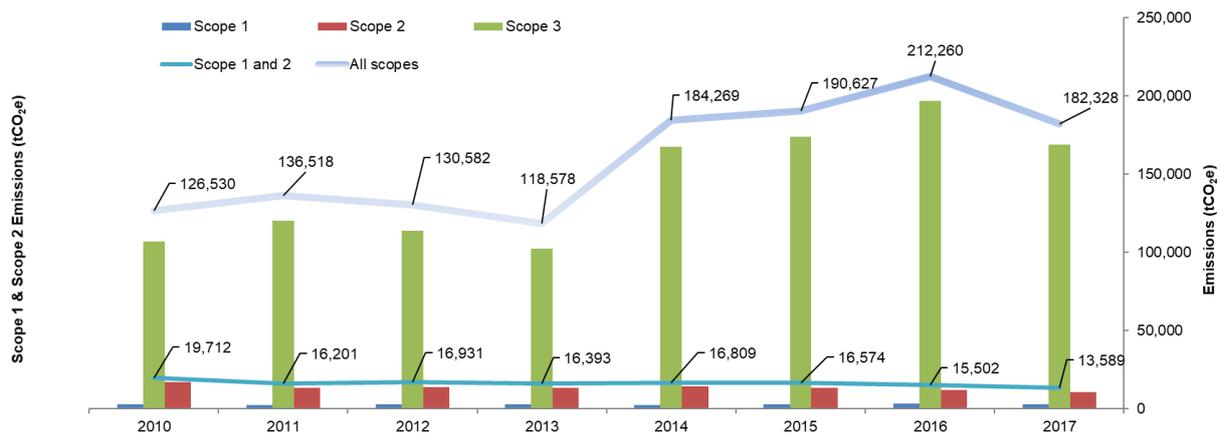


Table 12: Glasgow Airport's annual emissions comparison by scope

Emissions by Scope	2012 emissions (tCO ₂ e)	2013 emissions (tCO ₂ e)	2014 emissions (tCO ₂ e)	2015 emissions (tCO ₂ e)	2016 emissions (tCO ₂ e)	2017 emissions (tCO ₂ e)
Scope 1	2,973	3,029	2,650	2,990	3,202	3,070
Scope 2	13,958	13,364	14,159	13,584	12,301	10,518
Total Scope 1 and Scope 2 emissions	16,931	16,394	16,809	16,574	15,502	13,589
Scope 3	113,651	102,182	167,456	174,048	196,753	168,735
Outside of Scope	N/A	3	4	6	5	5
Total emissions	130,582	118,579	184,269	190,627	212,260	182,328

Emissions by Scope	Difference between 2017 and 2012	Difference between 2017 and 2013	Difference between 2017 and 2014	Difference between 2017 and 2015	Difference between 2017 and 2016
Scope 1	3%	1%	16%	3%	-4%
Scope 2	-25%	-21%	-26%	-23%	-14%
Total Scope 1 and Scope 2	-20%	-17%	-19%	-18%	-12%
Scope 3	48%	65%	1%	-3%	-14%
Outside of Scope	N/A	71%	29%	-7%	5%
All scopes	40%	54%	-1%	-4%	-14%

4 2017 Carbon Footprint by Activity

This section provides further breakdown of the carbon footprint by activity for Glasgow Airport.

The carbon footprint has been calculated using tools originally developed in 2009 by Glasgow Airport that separate emissions by activity. The composition of Glasgow Airport's 2017 emissions by activity is presented in Table 13, and will be discussed in more detail in the subsequent sections.

Table 13: Glasgow Airport's 2017 emissions by source (tCO₂e)

By Activity	Emissions (tCO ₂ e)	Percentage of total emissions
Aircraft movements	80,826	44.3%
Aircraft engine testing	360	0.2%
Business travel	18	0.01%
Fire Training	40	0.02%
Staff commute	359	0.2%
Operational vehicles	587	0.3%
Passenger surface access	82,886	45.5%
Utilities	14,394	7.9%
Waste	2,856	1.6%
Total	182,328	100%

4.1.1 Utilities emissions

In total, Utilities emissions are **14,394tCO₂e**, which is 7.9% of Glasgow Airport's total footprint. The breakdown of the emission sources for the utilities footprint is presented in Table 14 and Figure 5.

. For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

Utilities emissions include:

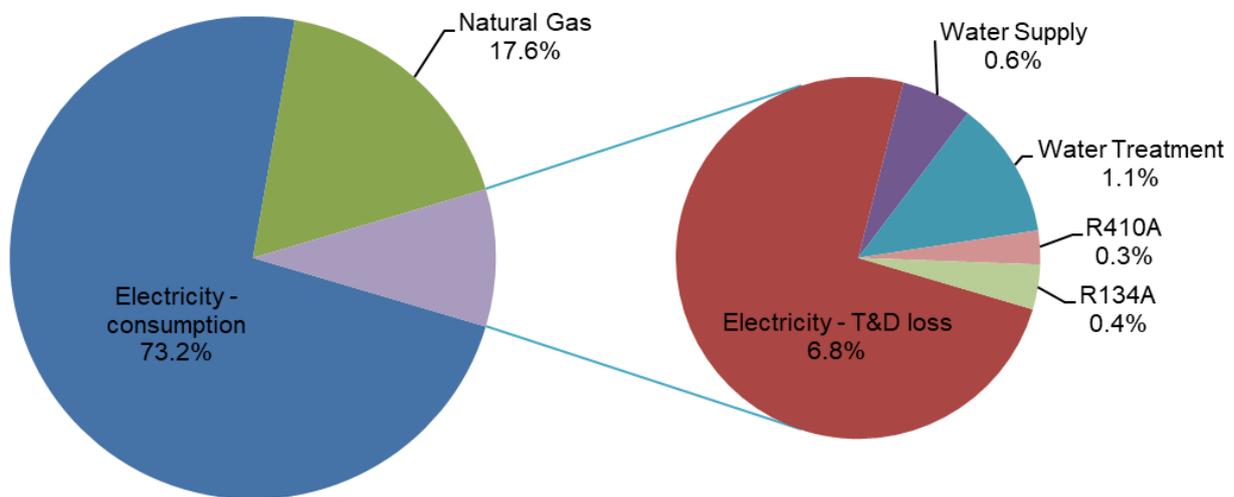
- Electricity use (Scope 2 from consumption and Scope 3 from transmission and distribution loss)
- Natural gas (Scope 1)
- Refrigerant gases (Scope 1)
- Water supply and treatment to foul sewer (Scope 3)
- Fuel oil (Scope 1)

Table 14: Glasgow Airport's utility emissions by source

Utility	Scope	Consumption	Unit	Gross CV Basis Conversion factor (kgCO ₂ e per unit)	Emissions (tCO ₂ e)
Electricity – consumption	Scope 2	29,918,625	kWh	0.35	10,518
Electricity – T&D loss	Scope 3	29,918,625	kWh	0.03	983
Natural gas	Scope 1	13,772,825	kWh	0.18	2,536
Water supply	Scope 3	241,300	m ³	0.34	83
Water treatment	Scope 3	229,235	m ³	0.71	162
Refrigerant gas – R410A	Scope 1	19	kg	2,088	40
Refrigerant gas – R134A	Scope 1	37	kg	1,430	53
Fuel Oil	Scope 1	5,818	litres	3	17
Total					14,394

Figure 5: Glasgow Airport's 2017 utility emissions (tCO₂e) by source

Glasgow Airport 2017 utilities emissions (tCO₂e)



As indicated in Chapter 3, 3rd party utilities consumption has been recorded for 2017. Table 15 shows the impact that 3rd party consumption has on Glasgow Airport's overall carbon footprint. Note that only in 2017 has 3rd party electricity consumption has been recorded for Glasgow Airport, therefore no comparison is possible at this time. In future years it will be possible to carry out a year-on-year comparison of this 3rd party consumption.

Table 15: Glasgow Airport's 2017 3rd party utility emissions by source

Utility	Scope	3 rd party consumption	Unit	Gross CV Basis Conversion factor (kgCO ₂ e per unit)	3 rd party emissions (tCO ₂ e)
Electricity – consumption	Scope 2	12,262,776	kWh	0.35	4,311
Electricity – T&D loss	Scope 3	12,262,776	kWh	0.03	403
Total					4,714

Table 16 provides a summary of the year-on-year utilities emissions and shows that the emissions from utilities have been on a downward trend since 2011. As with previous years, electricity consumption (Scope 2 and Scope 3 emissions) accounts for the largest component of the utilities footprint (6,787tCO₂e, 70%).

Table 16: Glasgow Airport's year on year utilities emissions comparison

Fuel	2011 (tCO ₂ e)	2012 (tCO ₂ e)	2013 (tCO ₂ e)	2014 (tCO ₂ e)	2015 (tCO ₂ e)	2016 (tCO ₂ e)	2017 (tCO ₂ e)
Natural gas	2,237	2,439	2,454	2,208	2,617	2,577	2,536
Refrigerant gas	22	0	252	40	8	160	93
Electricity	14,740	15,061	14,507	15,397	14,706	13,413	6,787
Water supply and treatment	181	27	151	150	314	145	245
Burning oil	13	9	N/A	0	0	0	0
LPG	N/A	23	N/A	0	0	0	0
Fuel oil	N/A	N/A	N/A	27	5	15	17
Total	17,191	17,558	17,364	17,821	17,649	16,510	9,679

Fuel	Change Since 2011	Change Since 2012	Change Since 2013	Change Since 2014	Change Since 2015	Change Since 2016
Natural gas	13.4%	4.0%	3.4%	14.9%	-3.1%	-1.6%
Refrigerant gas	327.1%	N/A	-63.1%	134.4%	1013.8%	-41.9%
Electricity	-54.0%	-54.9%	-53.2%	-55.9%	-53.8%	-49.4%
Water supply and treatment	35.8%	801.5%	62.5%	63.6%	-21.8%	69.1%
Burning oil	N/A	N/A	N/A	N/A	N/A	N/A
LPG	N/A	N/A	N/A	N/A	N/A	N/A
Fuel Oil	N/A	N/A	N/A	N/A	237.9%	16.0%
Total	-43.7%	-44.9%	-44.3%	-45.7%	-45.2%	-40.7%

4.1.2 Operational vehicles

Operational vehicles account for 0.3% of Glasgow Airport's total carbon emissions, at **587tCO₂e**, of which 379tCO₂e (65%) is Scope 1 (from Glasgow Airport owned airside operational vehicles), 202tCO₂e (34%) is Scope 3 (from non- Glasgow Airport owned airside operational vehicles) and 5tCO₂e (1%) is Outside of Scope emissions arising from biofuel used in airport owned vehicles.

For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

The emissions by fuel type and fuel owner are presented in Table 17.

Table 17: Glasgow Airport's breakdown of 2017 operational vehicles fuel use and emissions by scope

Category	Scope	Fuel Type	Fuel Consumption	Unit	Conversion factor (kg/CO ₂ e per unit)	Emissions (tCO ₂ e)
Company Owned Operational Vehicle	Scope 1	Diesel	76,160.67	litres	2.60	198.03
Company Owned Operational Vehicle	Scope 1	Gas Oil	61,423.99	litres	2.95	181.42
Third Party Operational Vehicle	Scope 3	Gas Oil	68,416.82	litres	2.95	202.07
Outside of Scope	Outside of Scope	Diesel	76,160.67	litres	0.07	5.14
Total						586.7

Table 18 provides a year on year comparison of vehicle emissions by operator and shows that there was an almost no change in emissions from Glasgow Airport's company owned operational vehicles, and a downward trend from third party operational vehicles since 2012. However, there has been an increase for 2017. The increases and decreases in company owned and third party operational vehicles since 2013 is most likely to have been brought about due to variations in the operational requirements.

Table 18: Glasgow Airport's year on year comparison of operational vehicles emissions by user

Mode of travel	Scope	2012 (tCO ₂ e)	2013 (tCO ₂ e)	2014 (tCO ₂ e)	2015 (tCO ₂ e)	2016 (tCO ₂ e)	2017 (tCO ₂ e)
Company owned operational Vehicles	Scope 1	503	314	353	334	416	379
Third Party operational vehicles	Scope 3	210	216	158	174	185	202
Outside of Scope	Outside of Scope	N/A	3	4	6	5	5
Total		713	533	515	513	606	587

Mode of travel	Scope	Change since 2012	Change since 2013	Change since 2014	Change since 2015	Change since 2016
Company owned operational Vehicles	Scope 1	-25%	21%	7%	14%	-9%
Third Party operational vehicles	Scope 3	-4%	-6%	28%	16%	9%
Outside of Scope	Outside of Scope	N/A	N/A	N/A	-7%	5%
Total		-18%	10%	14%	14%	-3%

4.1.3 Business travel

Business travel accounts for just 0.01% of Glasgow Airport's carbon footprint, at **20.6tCO₂e**; of this, 13.05tCO₂e is due to business travel by air. It is important to note that the AGS business travel has also been included in this section due to the main headquarters being based at Glasgow Airport. The composition of the business travel footprint is presented in Table 19. For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

Table 19: Glasgow Airport's breakdown of business travel emissions by mode of transport

Category	Scope	Source	Distance	Unit	Conversion factor (kgCO ₂ e per unit)	Emissions (tCO ₂ e)
Flights	Scope 3	Domestic flights	77,206	km	0.14	10.92
Flights	Scope 3	European flights	5,582	km	0.09	0.48
Flights	Scope 3	International flights	17,342	km	0.10	1.65
Petrol purchase	Scope 1	Petrol purchase	96	km	0.18	0.02
Public transport	Scope 3	Taxis	2,021	km	0.16	0.32
Public transport	Scope 3	UK Bus and Coach	946	km	0.10	0.10
Public transport	Scope 3	UK Rail	58,808	km	0.05	2.75
International transport	Scope 3	Overseas Bus and Coach	89	km	0.10	0.01
International transport	Scope 3	Overseas Rail	5,513	km	0.01	0.07
Business travel sub-total						16.3
Fuel (Unknown)	Scope 1	Business travel by private and/or leased vehicles	23,594	km	0.18	4.30
Fuel (Diesel)	Scope 1	Business travel by private and/or leased vehicles	0	km	0.18	0.00
Fuel (Petrol)	Scope 1	Business travel by private and/or leased vehicles	0	km	0.19	0.00
Business travel by car subtotal						4.3
Total business travel						20.6

Table 20 provides a summary of the year on year comparison of emissions from business travel. Overall emissions associated with business travel have decreased since 2012, though there was a sharp increase in 2014 and a subsequent sharp decrease in 2015 and 2016. A further increase is witnessed for 2017 (68% based on 2016) due to the inclusion of AGS business travel. It should be noted that business travel emissions are very low at only 0.01% of the overall footprint, and therefore a small change in absolute emissions corresponds to a large percentage change, but does not affect significantly on total emissions for the airport.

Table 20: Glasgow Airport's year on year comparison of business travel emissions

Mode of travel	2012 (tCO ₂ e)	2013 (tCO ₂ e)	2014 (tCO ₂ e)	2015 (tCO ₂ e)	2016 (tCO ₂ e)	2017 (tCO ₂ e)	Change since 2012	Change since 2013	Change since 2014	Change since 2015	Change since 2016
Company cars	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A	N/A	N/A	N/A
Domestic flights	46.9	75.4	135.3	23.8	5.1	10.9	-77%	-86%	-92%	-54%	115%
European flights	7.0	13.0	22.5	4.8	1.6	0.5	-93%	-96%	-98%	-90%	-70%
International flights	4.2	2.1	3.9	6.3	0.0	1.7	-60%	-21%	-58%	-74%	100%
Petrol purchase	0.3	0.2	3.7	0.0	0.3	0.0	-93%	-91%	-100%	-63%	-94%
Taxis	0.4	0.3	0.3	0.3	0.3	0.3	-20%	5%	-9%	10%	18%
UK Bus and Coach	0.1	0.1	0.1	0.1	0.1	0.1	18%	-3%	83%	0%	36%
UK Rail	2.7	2.0	2.8	2.7	2.1	2.8	3%	38%	0%	1%	29%
Personal Car	2.0	3.7	1.3	3.2	2.8	4.3	115%	16%	226%	34%	54%
Total	63.4	96.7	169.9	41.2	12.3	20.5	-68%	-79%	-88%	-50%	68%

4.1.4 Aircraft movements and engine testing

Aircraft emissions are the second largest contributor to Glasgow Airport's carbon footprint, totalling **81,186tCO₂e** (44.3% of total footprint). These emissions are from aircraft main engines and auxiliary power units for all aircraft movements within the aircraft LTO cycle (operations on the ground up to a height of 1,000 metres) and engine testing. For detailed methodology of how these are calculated, please refer to Appendix 1. Table 21 shows the relative contribution of each part of the aircraft LTO cycle to the emissions associated with aircraft.

Table 21: Glasgow Airport's emissions by aircraft LTO phase

Source	Emissions (tCO ₂ e)	% of aircraft footprint
Auxiliary power unit (APU)	9,344	12%
Taxi Out	6,071	7%
Hold	13,243	16%
Take-Off	6,941	9%
Initial Climb (to 450m)	7,460	9%
Climb Out (450-1000m)	10,968	14%
Approach	18,333	23%
Reverse Thrust	1,044	1%
Landing Roll	1,350	2%
Taxi In	6,071	7%
Engine tests	360	0.4%
Total	81,186	100%

Table 22 provides a comparison of the year on year emissions from aircraft and shows that there is an 18% reduction in emissions since 2016 but a 31% increase from 2013.

Table 22: Glasgow Airport's year on year comparison of aircraft emissions

Aircraft mode of operation	2012 (tCO ₂ e)	2013 (tCO ₂ e)	2014 (tCO ₂ e)	2015 (tCO ₂ e)	2016 (tCO ₂ e)	2017 (tCO ₂ e)	Change since 2012	Change since 2013	Change since 2014	Change since 2015	Change since 2016
APU (Auxiliary Power Unit)	8,566	7,301	9,036	9,291	7,168	9,344	9%	28%	3%	1%	30%
Taxi Out	6,089	3,895	6,499	6,478	7,510	6,071	0%	56%	-7%	-6%	-19%
Hold	13,374	10,761	13,714	14,206	15,696	13,243	-1%	23%	-3%	-7%	-16%
Take-Off	6,284	6,239	7,282	6,931	7,927	6,941	10%	11%	-5%	0%	-12%
Initial Climb (to 450m)	6,639	6,212	7,553	7,315	11,272	7,460	12%	20%	-1%	2%	-34%
Climb Out (450-1,000m)	6,089	7,573	10,541	11,048	16,149	10,968	80%	45%	4%	-1%	-32%
Approach	17,966	15,474	19,261	19,308	23,122	18,333	2%	18%	-5%	-5%	-21%
Reverse Thrust	912	949	1,016	1,030	767	1,044	14%	10%	3%	1%	36%
Landing Roll	1,353	1,119	1,399	1,446	1,584	1,350	0%	21%	-3%	-7%	-15%
Taxi In	6,089	3,895	6,499	6,478	7,510	6,071	0%	56%	-7%	-6%	-19%
Engine Testing*	-	-	-	363	311	360	N/A	N/A	N/A	-1%	16%
Total	73,362	63,419	82,801	83,895	99,016	81,186	35%	56%	-30%	70%	-18%

* Note that 2015 is the first year in which aircraft engine testing data was collected for Glasgow Airport

4.1.5 Employee commute

Employee commute represents just 0.2% (359tCO₂e) of Glasgow Airport's total carbon footprint. It is evident that the majority of employees commute by private car and emissions from this accounts for 94% of the employee commute footprint. The relative contribution of each part of the employee commute footprint is presented in Figure 6 and Table 23.

For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

Figure 6: Glasgow Airport's 2017 employee commute emission (tCO₂e) by mode of transport

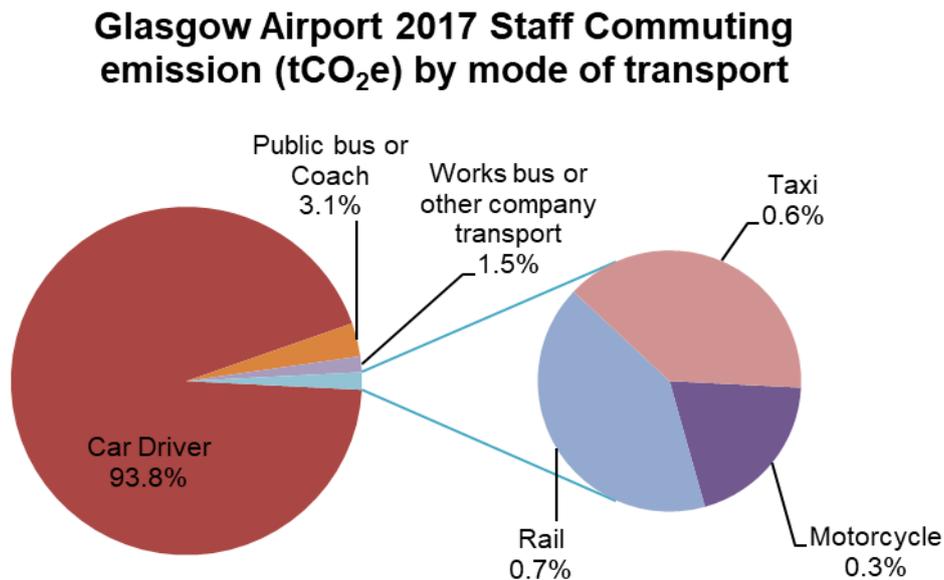


Table 23: Glasgow Airport's 2017 employees commute emissions

Mode of transport	Scope	Emissions (tCO ₂ e)
Car Driver	Scope 3	337
Motorcycle	Scope 3	1
Public bus or Coach	Scope 3	11
Rail	Scope 3	2
Taxi	Scope 3	2
Works bus or other company transport	Scope 3	5
Total		359

Table 24 provides a break-down of the 2017 emissions and comparison with the break-downs since 2012. It should be noted that the data used for this part of the footprint reflects an employee travel survey undertaken in 2009. The location of employees and mode of transport may have changed since this survey was carried out. Due to this, any changes in emissions are only reflective of a shift in airport employee numbers and not a result of employee behavioural change, car sharing or other carbon saving measures.

Table 24: Glasgow Airport's annual comparisons of employee commute emissions

Mode of transport	2012 (tCO ₂ e)	2013 (tCO ₂ e)	2014 (tCO ₂ e)	2015 (tCO ₂ e)	2016 (tCO ₂ e)	2017 (tCO ₂ e)
Car Driver	4,628	4,309	5,377	324	308	337
Motorcycle	36	36	45	1	1	1
Public bus or Coach	274	184	198	11	12	11
Rail	18	15	21	2	2	2
Taxi	240	224	375	3	3	2
Works bus other company transport	34	23	25	5	5	5
Total	5,230	4,792	6,041	347	331	359

Mode of transport	Change since 2012	Change since 2013	Change since 2014	Change since 2015	Change since 2016
Car Driver	-93%	-92%	-94%	4%	9%
Motorcycle	-97%	-97%	-97%	4%	9%
Public bus or Coach	-96%	-94%	-94%	0%	-4%
Rail	N/A	N/A	N/A	N/A	N/A
Taxi	-99%	-99%	-99%	-24%	-20%
Works bus other company transport	-85%	-77%	-79%	0%	-4%
Total	-93%	-92%	-94%	4%	8%

As shown in Table 24, employee commute emissions have decreased by 94% since 2014. Emissions associated with employee commuting from 2015 are significantly lower than previous years due to the identification of an error where full time employee numbers have been incorrectly reported and thus the large change in emissions for employee commute can be attributed to this correction. These emissions were calculated using survey data from 2009; and, change in emissions is an indication of changes in airport employee numbers and conversion factors rather than a change in mode of transport.

Table 25 shows the results of the travel survey and the assumed modal split of employees.

Table 25: Glasgow Airport's mode of travel by employees commuting to the airport

Method of Transport	Total (%) of employees by mode	Total distance travelled per day (km)
Bicycle	2%	73
Car Driver	81%	7,790
Car Passenger	5%	463
Motorcycle	0.4%	42
Public bus or Coach	8%	457
Rail	0.9%	217
Taxi	1.1%	61
Walk	0.9%	11
Works bus or other company transport	0.9%	217
Total	100%	9,330

4.1.6 Passenger surface access

Passenger surface access is the largest component of Glasgow Airport's carbon footprint after aircraft movements, totalling 45.5% of all emissions, or **82,886tCO₂e**.

It should be noted that the data used in this report is based on an updated travel survey carried out in 2013. This survey was conducted in the departure lounge of the airport, and captured whether the passenger was outward or homeward bound, their mode of transport, and the postcode from which they set off. This allowed the distance from the passenger's street to the airport to be calculated, based on road distances. The previous survey, conducted in 2009, only collected data on the passenger's local authority area or city of origin, and used as the crow flies distances to calculate the distance travelled. As such, due to an improvement in the accuracy and granularity in the data, and an increase in passenger numbers at the airport, there is a 176% increase in emissions compared with 2013.

For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

A composition of the passenger surface access emissions by mode is presented in Figure 7. Table 26 shows the total emissions by mode of transport. As only the final mode of transport taken by the customer to the airport has been considered, there are no rail emissions (as there is no train station at the airport).

Figure 7: Glasgow Airport 2017 passenger surface access emissions (tCO₂e) by mode of transport

Glasgow Airport 2017 Passenger Surface Access emissions (tCO₂e) by mode of transport

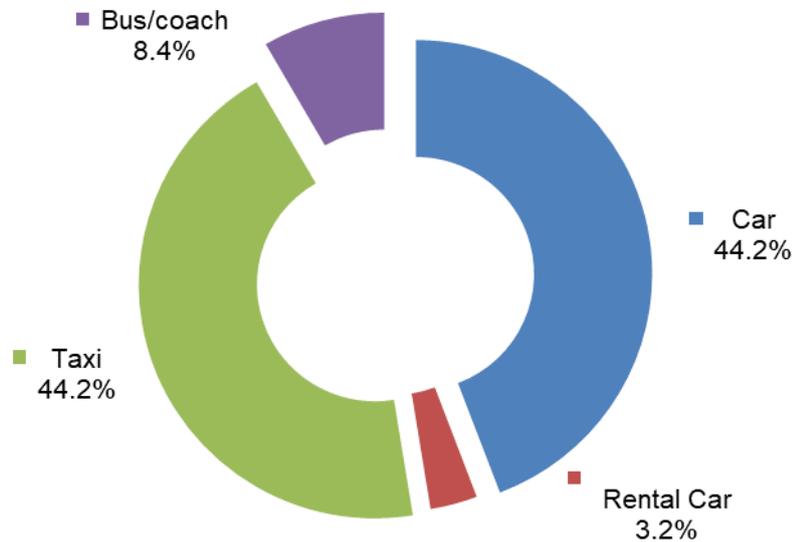


Table 26: Glasgow Airport's 2017 passenger surface access emission by mode

Mode of transport	Scope	Passenger kilometres (km)	Assumed load factor for mode	Travel km per year	CO ₂ e conversion (kgCO ₂ e per km)	Emissions per year (tCO ₂ e)
Car	Scope 3	381,707,156	1.9	200,898,503	0.1824	36,648
Rental Car	Scope 3	27,816,716	1.9	14,640,377	0.1824	2,671
Taxi	Scope 3	234,592,226	2.13	110,137,195	0.1562	36,636
Bus/coach	Scope 3	67,564,148	9	7,507,128	0.1026	6,931
Total						82,886

4.1.7 Waste

Emissions associated with waste at Glasgow Airport represent 1.6% of the total carbon footprint, at **2,856tCO₂e**. For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

- 36.13tCO₂e is from waste disposal
- 2,819.86tCO₂e is from the production of virgin materials that have been disposed

In total, the airport produced 2,856 tonnes of waste in 2017, of which approximately 609 tonnes were recycled.

A summary of waste disposal emissions is presented in Table 27 and Table 28 shows the emissions associated with the production of the virgin materials.

Figure 8 shows the total emissions from waste for both disposal and production of virgin materials.

Table 27: Glasgow Airport's 2017 waste disposal emissions (tCO₂e) by category

Waste fraction	Category	Total net CO ₂ e emissions (tonnes)
Paper	Waste - RDF/Combustion	3.47
Card	Waste - RDF/Combustion	4.86
Plastic	Waste - RDF/Combustion	3.44
Textiles	Waste - RDF/Combustion	0.26
Wood	Waste - RDF/Combustion	1.05
Glass	Waste - RDF/Combustion	0.88
Kitchen Waste	Waste - RDF/Combustion	4.61
Non-Aluminium Metal	Waste - RDF/Combustion	0.84
Aluminium	Waste - RDF/Combustion	0.07
Paper	Waste - recycle	4.18
Card	Waste - recycle	5.86
Plastic	Waste - recycle	4.15
Textiles	Waste - recycle	0.31
Glass	Waste - recycle	1.06
Non-Aluminium Metal	Waste - recycle	1.01
Aluminium	Waste - recycle	0.08
Total	Waste disposal	36.13

Table 28: Glasgow Airport's 2017 emissions from production virgin materials for waste (tCO₂e) by category

Waste fraction	Category	Total net CO ₂ e emissions (tonnes)
Paper	Waste - RDF/Combustion	148.01
Card	Waste - RDF/Combustion	187.46
Plastic	Waste - RDF/Combustion	526.95
Textiles	Waste - RDF/Combustion	262.52
Wood	Waste - RDF/Combustion	19.68
Glass	Waste - RDF/Combustion	36.38
Kitchen Waste	Waste - RDF/Combustion	859.96
Non-Aluminium Metal	Waste - RDF/Combustion	144.71
Aluminium	Waste - RDF/Combustion	41.31
Paper	Waste - recycle	152.65
Card	Waste - recycle	214.12
Plastic	Waste - recycle	129.19
Textiles	Waste - recycle	2.16
Glass	Waste - recycle	25.89
Non-Aluminium Metal	Waste - recycle	57.23
Aluminium	Waste - recycle	11.64
Total	Production of virgin material	2,819.86

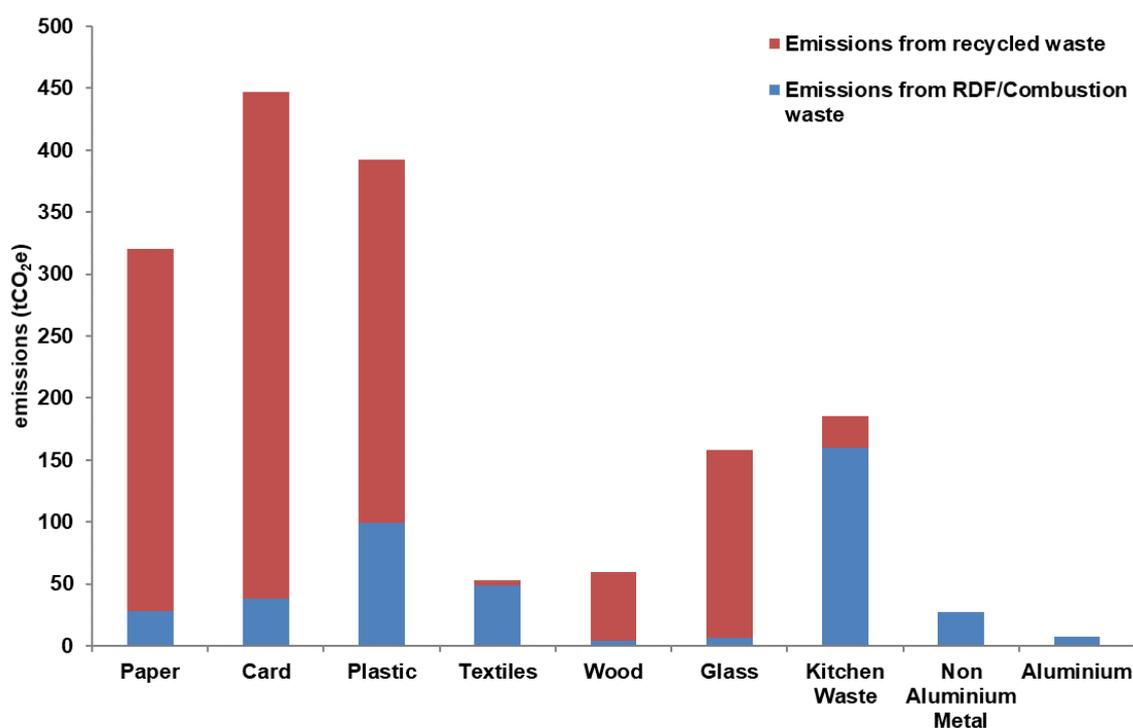
Figure 8: Glasgow Airport's contribution of different material types to waste associated emissions for 2017 from both waste disposal and from the production of virgin materials

Table 29 shows the combined emissions of the disposal route and the production of the virgin materials. This shows that overall emissions have increased slightly, by 4% compared with Glasgow Airport's 2016 carbon footprint. However, there has been a 25% increase since 2013. Since 2013 there has been a 313% increase in emissions as a result of diverting waste away from landfill and towards RDF. In addition, there has been a 65% decrease in the emissions associated with waste being recycled, also since 2013. Compared to 2016, overall emissions and landfill emissions have increased and by 4% and 8% respectively, whilst recycling emissions have decreased by 8%.

Table 29: Glasgow Airport's year on year comparison of total waste emissions (including waste disposal and production of virgin materials) by landfilled and recycled waste

Material	Disposal Method	2014 net emissions (tCO ₂ e)	2015 net emissions (tCO ₂ e)	2016 net emissions (tCO ₂ e)	2017 net emissions (tCO ₂ e)	Change since 2014	Change since 2015	Change since 2016
Paper	Waste – landfill / RDF	29.9	28.4	140.1	151.5	407%	434%	8%
Card	Waste – landfill / RDF	40.3	38.3	189.4	192.3	377%	402%	2%
Plastic	Waste – landfill / RDF	97.3	99.0	487.6	530.4	445%	436%	9%
Textiles	Waste – landfill / RDF	50.5	48.7	240.7	262.8	421%	440%	9%
Wood	Waste – landfill / RDF	6.3	4.1	20.1	20.7	226%	409%	3%
Glass	Waste – landfill / RDF	7.1	6.9	34.1	37.3	421%	440%	9%
Kitchen Waste	Waste – landfill / RDF	146.9	160.2	791.7	864.6	489%	440%	9%
Non-Aluminium Metal	Waste – landfill / RDF	23.3	27.1	134.0	145.5	524%	437%	9%
Aluminium	Waste – landfill / RDF	8.0	7.7	38.0	41.4	419%	438%	9%
Total	Landfill	409.7	420.4	2,075.8	2,246.5	448%	434%	8%
Paper	Waste - recyclate	273.6	291.6	157.5	156.8	-43%	-46%	0%
Card	Waste - recyclate	383.8	409.0	220.9	220.0	-43%	-46%	0%
Plastic	Waste - recyclate	276.8	293.8	155.6	133.3	-52%	-55%	-14%
Textiles	Waste - recyclate	4.4	4.6	2.5	2.5	-44%	-47%	-2%
Glass	Waste - recyclate	52.7	55.9	30.2	27.0	-49%	-52%	-11%
Non-Aluminium Metal	Waste - recyclate	92.8	151.5	81.8	58.2	-37%	-62%	-29%
Aluminium	Waste - recyclate	9.8	25.3	13.7	11.7	20%	-54%	-14%
Total	Recyclate	1,093.8	1,231.8	662.2	609.5	-44%	-51%	-8%
Total		1,503	1,652	2,738	2,856	90%	73%	4%

4.1.8 Fire training

Fire training emissions were introduced into Glasgow Airport's carbon footprint in 2013. Previously airport fire training emissions have been combined with emissions from utilities. Fire training emissions come from the combustion of propane (LPG) and kerosene.

For detailed information on the methodology used for calculating the carbon footprint, please refer to Appendix 1.

- Fire training accounts for 0.02% of the airports emissions, or **40tCO₂e**
- All emissions are listed as Scope 1.

Emissions from fire training are:

- LPG/Propane (34tCO₂e).
- Kerosene (6tCO₂e)

4.1.9 Total emissions by activity and source

Table 30 shows the total emissions by activity and by scope. It can be seen that passengers travelling to the airport by car and taxi contribute 40% of total emissions, with aircraft movements (approach) 10% of total emissions. Emissions from passenger surface access (all modes) and aircraft (all movements including engine testing) total 164,072tCO₂e, which is 90% of total emissions.

Table 30: Glasgow Airport's emissions by activity and source – Top 96%

Activity	Scope 1 emissions (tCO ₂ e)	Scope 2 emissions (tCO ₂ e)	Scope 3 emissions (tCO ₂ e)	Outside of Scope emissions (tCO ₂ e)	Total emissions (tCO ₂ e)	Percentage of total emissions
Passenger surface access - Car	0.00	0.00	36,647.90	0.00	36,648	20.10%
Passenger surface access - Taxi	0.00	0.00	36,636.27	0.00	36,636	20.09%
Aircraft movements - Approach	0.00	0.00	18,332.99	0.00	18,333	10.05%
Aircraft movements - Hold	0.00	0.00	13,243.27	0.00	13,243	7.26%
Aircraft movements - Climb Out (450-1000m)	0.00	0.00	10,967.88	0.00	10,968	6.02%
Utilities - Electricity - consumption	0.00	10,518.19	0.00	0.00	10,518	5.77%
Aircraft movements - APU	0.00	0.00	9,344.47	0.00	9,344	5.13%
Aircraft movements - Initial Climb (to 450m)	0.00	0.00	7,459.81	0.00	7,460	4.09%
Aircraft movements - Take-Off	0.00	0.00	6,940.71	0.00	6,941	3.81%
Passenger surface access - Bus/coach	0.00	0.00	6,931.41	0.00	6,931	3.80%
Aircraft movements - Taxi In	0.00	0.00	6,071.02	0.00	6,071	3.33%
Aircraft movements - Taxi Out	0.00	0.00	6,071.02	0.00	6,071	3.33%
Passenger surface access - Rental Car	0.00	0.00	2,670.70	0.00	2,671	1.46%
Utilities - Natural Gas	2,536.46	0.00	0.00	0.00	2,536	1.39%
Total	2,536	10,518	161,317	-	174,372	96%

Table 31: Glasgow Airport's emissions by activity and source – Bottom 5%

Activity	Scope 1 emissions (tCO ₂ e)	Scope 2 emissions (tCO ₂ e)	Scope 3 emissions (tCO ₂ e)	Outside of Scope emissions (tCO ₂ e)	Total emissions (tCO ₂ e)	Percentage of total emissions
Aircraft movements - Landing Roll	0.00	0.00	1,350.46	0.00	1,350	0.74%
Aircraft movements - Reverse Thrust	0.00	0.00	1,044.43	0.00	1,044	0.57%
Utilities - Electricity - T&D loss	0.00	0.00	983.43	0.00	983	0.54%
Waste (disposal and virgin material emissions) - Kitchen Waste	0.00	0.00	864.56	0.00	865	0.47%
Waste (disposal and virgin material emissions) - Plastic	0.00	0.00	663.73	0.00	664	0.36%
Waste (disposal and virgin material emissions) - Card	0.00	0.00	412.31	0.00	412	0.21%
Operational vehicles - Company Owned Operational Vehicle	379.45	0.00	0.00	0.00	379	0.20%
Aircraft Engine Tests - Aviation Fuel	0.00	0.00	359.96	0.00	360	0.18%
Staff Commute - Car Driver	0.00	0.00	337.15	0.00	337	0.17%
Waste (disposal and virgin material emissions) - Paper	0.00	0.00	308.30	0.00	308	0.15%
Waste (disposal and virgin material emissions) - Textiles	0.00	0.00	265.24	0.00	265	0.11%
Waste (disposal and virgin material emissions) - Non-Aluminium Metal	0.00	0.00	203.79	0.00	204	0.11%
Operational vehicles - Third Party Operational Vehicle	0.00	0.00	202.07	0.00	202	0.09%
Utilities - Water Treatment	0.00	0.00	162.30	0.00	162	0.05%
Utilities - Water Supply	0.00	0.00	83.01	0.00	83	0.04%
Waste (disposal and virgin material emissions) - Glass	0.00	0.00	64.22	0.00	64	0.03%
Waste (disposal and virgin material emissions) - Aluminium	0.00	0.00	53.11	0.00	53	0.03%
Utilities - R134A	52.91	0.00	0.00	0.00	53	0.02%
Utilities - R410A	40.09	0.00	0.00	0.00	40	0.02%
Fire Training - Refuelling Propane Gas Tank - AFS Training Ground	33.59	0.00	0.00	0.00	34	0.01%
Waste (disposal and virgin material emissions) - Wood	0.00	0.00	20.73	0.00	21	0.01%
Utilities - Fuel Oil	17.18	0.00	0.00	0.00	17	0.01%
Staff Commute - Public bus or Coach	0.00	0.00	11.12	0.00	11	0.01%
Business travel - Domestic flights	0.00	0.00	10.92	0.00	11	0.00%

Activity	Scope 1 emissions (tCO ₂ e)	Scope 2 emissions (tCO ₂ e)	Scope 3 emissions (tCO ₂ e)	Outside of Scope emissions (tCO ₂ e)	Total emissions (tCO ₂ e)	Percentage of total emissions
Fire Training - Refuelling Kerosene Tank - AFS Training Ground	6.33	0.00	0.00	0.00	6	0.00%
Staff Commute - Works bus or other company transport	0.00	0.00	5.27	0.00	5	0.00%
Operational vehicles - Outside scopes	0.00	0.00	0.00	5.14	5	0.00%
Business travel - UK Rail	0.00	0.00	2.75	0.00	3	0.00%
Staff Commute - Rail	0.00	0.00	2.40	0.00	2	0.00%
Staff Commute - Taxi	0.00	0.00	2.26	0.00	2	0.00%
Business travel - Personal Car	2.09	0.00	0.00	0.00	2	0.00%
Business travel - International flights	0.00	0.00	1.65	0.00	2	0.00%
Staff Commute - Motorcycle	0.00	0.00	1.15	0.00	1	0.00%
Business travel - European flights	0.00	0.00	0.48	0.00	0	0.00%
Business travel - Taxis	0.00	0.00	0.32	0.00	0	0.00%
Business travel - UK Bus and Coach	0.00	0.00	0.10	0.00	0	0.00%
Business travel - Overseas Rail	0.00	0.00	0.07	0.00	0	0.00%
Business travel - Petrol purchase	0.02	0.00	0.00	0.00	0	0.00%
Business travel - Overseas Bus and Coach	0.00	0.00	0.01	0.00	0	0.74%
Total	534	0	7,417	5	7,551	4%

Appendices

Appendix 1: Methodology

Appendix 2: Carbon emission conversion factors

Appendix 1 - Methodology

The following sections provide a summary of the methodology adopted by Ricardo Energy & Environment to calculate the 2017 carbon footprint for the AGS Airports.

The standard approach to carbon footprinting is to use the Greenhouse Gas (GHG) Protocol Corporate Accounting and Reporting Standard developed by World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI); this sets out a corporate accounting and reporting methodology for GHGs.

Scope 1

Scope 1 emissions are defined as direct GHG emissions arising from sources that are owned or controlled by the company. The emissions result from activities that the company can have direct influence on through its actions. AGS Airports' emissions that are included are: natural gas use, company owned vehicles fuel use, fuel use for business travel, refrigerant gas use (from leaks during maintenance or malfunction), wood pallets and diesel use for fire training, propane combustion and kerosene combustion.

Scope 2

Scope 2 emissions are associated with the use of electricity imported from the grid or from a third-party supplier of energy in the form of heat or electricity. These indirect GHG emissions are due to upstream emissions from the production and delivery of fuel to power stations. AGS Airports can influence the amount of electricity it uses; however, it has little control over the generation of the electricity and these emissions are therefore classed as Scope 2.

Scope 3

Scope 3 emissions are defined as those arising as an indirect consequence of the use of goods or services provided by the company. AGS Airports do have some influence over Scope 3 emissions but the activities are not under its control. Sources included by AGS Airports include aircraft (all aircraft movements up to a height of 1,000m above aerodrome level), employees commuting to the airport, passenger surface access to the airport, airside vehicle activities by third party operators, waste disposal (including production of the virgin materials), water (supply and treatment) and airport business travel.

Emissions sources listed here are consistent with those recommended by the industry benchmark scheme for carbon footprinting the Airports Council International Airport Carbon Accreditation Scheme (ACI ACA)⁶. The scheme has four levels – Mapping, Reduction, Optimisation and Neutrality. It is probable that AGS Airports meet the requirements of at least the first two stages and for the more advanced stages it is necessary to begin third party engagement. These scope 3 emissions are all already included in the carbon footprint scope for the AGS Airports, and are as follows:

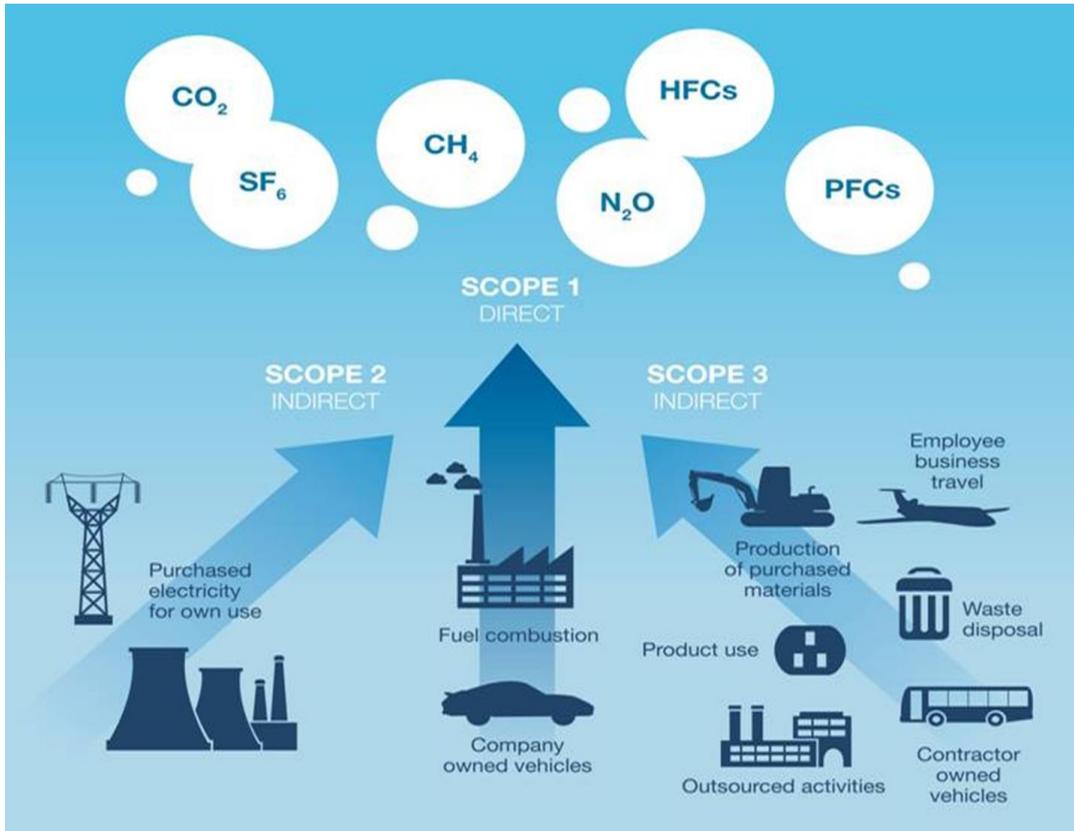
- Aircraft landing and take-off cycle emissions;
- Aircraft engine testing where applicable;
- Employee commuting to the airport;
- Employee business travel emissions;
- Surface access to the airport for passengers;
- Waste; and
- Water supply and treatment.

⁶ <http://www.airportcarbonaccreditation.org/>

Outside of Scope

A change to the UK Government conversion factors for 2013 means that in order to fully account for the biofuel content of fuel in a carbon footprint, organisations should report both the direct emissions from the combustion of the fuel and the biogenic portion of this fuel. These emissions are reported as Outside of Scope emissions and included as part of the carbon footprint.

Figure 9: Summary of emission sources by emission scope



Since 2008, carbon footprinting tools developed by Glasgow Airport, Aberdeen Airport and Ricardo Energy & Environment, in accordance with this best practice guidance, have been used in the calculation of its carbon footprint. The carbon footprinting tools used to calculate emissions for 2016 are expressed as carbon dioxide equivalent (CO₂e) emissions. This takes into account non-CO₂ greenhouse gases (e.g. methane and nitrous oxide) and the equivalent Global Warming Potential (GWP) of these compared with carbon dioxide.

For 2017, the carbon footprinting tools have been updated to reflect changes in accessibility to data and changes to the UK Government 2017 conversion factors for company reporting. Full details of the methodologies, raw data and emissions factors used are provided in the accompanying worksheets:

- Aircraft Movements 2017
- Aircraft Engine Testing 2017
- Business Travel 2017
- Employee Commute 2017
- Fire Training 2017
- Operational Vehicles 2017
- Passenger Surface Access 2017
- Utilities 2017
- Waste 2017

Collection of data

Table 32 is divided into the key activity areas that contribute to the carbon footprint for the AGS Airports and the data sources used for calculating emissions in that area. All data used in the carbon footprint was supplied in an electronic format from designated representatives at Aberdeen, Glasgow and Southampton Airports.

Table 32: Data sources used to calculate the AGS Airports' 2017 footprint

Footprint area	Components of footprint	Data source
Airport employee business travel	Airport employee expenses claims with cost and mode of travel	Airport employee expenses data and proportionally divided for airports based on their employee numbers
Aircraft engine testing	Duration and number of aircraft engine tests	Spreadsheet log of aircraft engine test by date, with aircraft type and start and finish of test
Aircraft movements	Total aircraft movements by aircraft type with engine and APU assigned	Number of aircraft movements by aircraft type and aircraft registration from the airport's BOSS database ICAO emissions databank for emissions from aircraft main engines
Business travel	Airport employee expenses claims with cost and mode of travel	Airport employee expenses data
Employee travel to the airport (employee commute)	<ul style="list-style-type: none"> Mode of transport used with place of origin Annual employee numbers (expressed as full-time equivalents, FTEs) 	Based on an employee travel survey which was carried out in 2009/2013 and pro-rated with 2017 airport site employees (excluding tenants and third parties)
Fire training	Fire training fuel use, including: <ul style="list-style-type: none"> Burning oil (kerosene) LPG (Propane) Wood pallets 	Fuel delivery reports to the airport
Operational vehicles	Airport owned and third party owned vehicle fuel use. Split by: <ul style="list-style-type: none"> Diesel (assumed to be standard forecourt biodiesel blend diesel) Gas oil (red diesel) 	Fuel use and type of fuel provided in monthly values including supplies to third parties.
Passenger surface access	<ul style="list-style-type: none"> Mode of transport used by airport passengers with place of origin Total airport annual passenger numbers 	Based on a passenger surface access survey conducted in 2009 and 2013 including individual post codes and mode of transport. Further updates have been made available on aspects of this for 2017.
Utilities	<ul style="list-style-type: none"> Electricity consumption Natural gas consumption Fugitive Refrigerant gas use Water supply 	Total site Utilities consumption data provided on a monthly usage basis.

Footprint area	Components of footprint	Data source
	<ul style="list-style-type: none"> Waste water disposal (to foul sewer) 	
Waste	<ul style="list-style-type: none"> Total volume of waste sent for refuse derived fuel (RDF) or landfill Total volume of waste sent for recycling Example waste compositional analysis 	Monthly waste totals supplied as tonnage of waste being sent for RDF/landfill, and for recycling.

Assumptions used to calculate emissions

As with all carbon footprints, the interpretation and analysis of the data requires a number of assumptions to be made. Details of the assumptions used to calculate the AGS Airports' carbon footprint are described below:

Aircraft engine tests

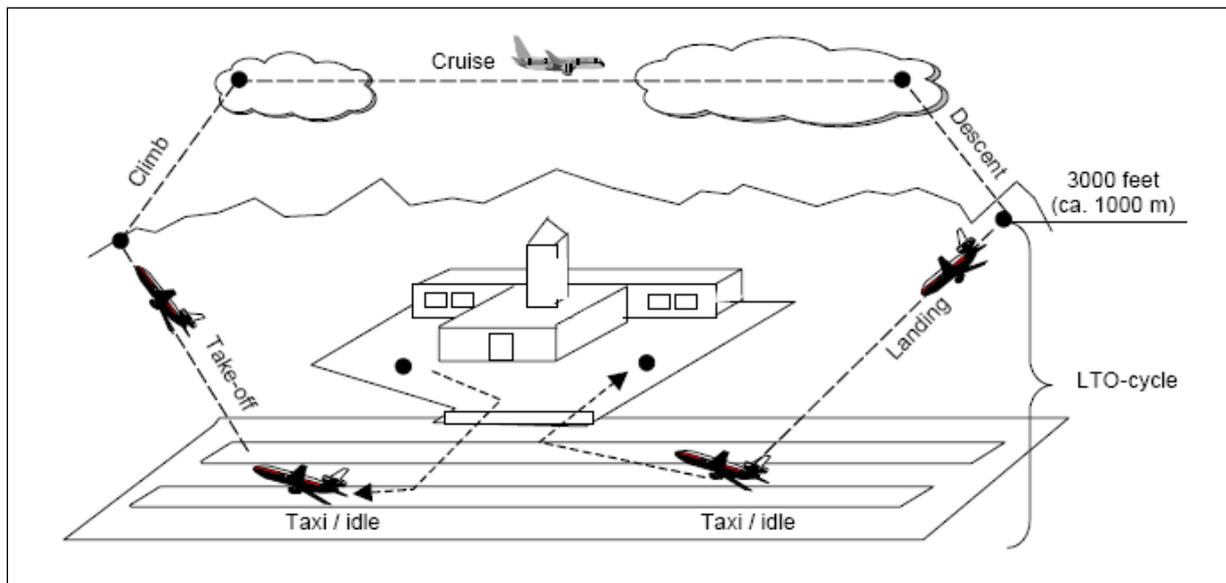
To calculate emissions from aircraft engine tests a number of assumptions were applied to the data:

- Where aircraft engines were not identified a surrogate engine has been assumed from a comparable aircraft type.
- It is assumed during the test the engine is run at idle for 90% and at full-thrust for the remaining 10%, unless otherwise stated in the data provided.

Aircraft movements

A typical approach to standardising this for airports is to consider the International Civil Aviation Authority (ICAO) Landing and Take-Off (LTO) cycle, defined as being all aircraft operations below 1,000 metres; this is illustrated in Figure 10.

Figure 10: Aircraft movement classifications according to ICAO's LTO cycle



This assessment has considered a number of modes of aircraft operations within the LTO cycle, and assumptions have been applied based on the aircraft type, the typical aircraft engine thrust setting and the actual engine fitted to the aircraft. This study has considered the following LTO phases:

- Ground movements; Taxiing (in and out), time in runway hold, and use of auxiliary power units (APUs).
- Departing flights; Take-off roll, initial climb (to 450m), and climb (to 1,000m).
- Arriving flights; Approach (from 1,000m); landing Roll, and use of reverse thrust.

Emissions from these phases are included in the AGS Airports' footprint as it is considered that the AGS Airports can influence its partners to improve efficiency and reduce emissions.

To calculate carbon emissions from aircraft the numbers of aircraft movements, including details of aircraft type, were supplied by the AGS Airports. Using this information, Ricardo Energy & Environment estimated aircraft emissions from the aircraft main engines and auxiliary power unit using the following assumptions:

- All aircraft are using auxiliary power units.
- There are no reduced thrust take-offs or intersection departures.
- There is no single/reduced engine taxiing (i.e. aircraft taxi using all engines).
- Where aircraft movement emissions have not been quantified, average fuel calculations have been applied using average emissions from the airport for the NATS Grouping.
- Where a NATS Category could not be established, a 'default' engine been assumed and average emissions across all NATS category.

Business travel

To calculate emissions from business travel a number of assumptions have been applied to the data:

- The conversion factors are taken from UK Government 2017 conversion factors for company reporting 'Business travel - land' and 'Business travel – air' conversion factors.
- Air travel conversion factors are calculated on the area of the aircraft each passenger takes up. If an aircraft is comprised totally of business class seats, as opposed to more closely packed economy class seats, fewer passengers can fly and therefore each passenger takes a larger share of the emissions.
- The conversion factor used for air applies an 8% increase to compensate for aircraft not flying using the most direct route (i.e. flying around international airspace and waiting in holds)
- The conversion factor for business travel flights is the 'Average passenger' conversion factor, which assumes a national average between economy, business and first-class seats, and is in accordance with UK government best practice advice.
- Flight distances have been calculated based on the departure and arrival information supplied in the expense. Where no information has been made available, an average distance based on domestic, EU and international flights has been applied.
- All petrol purchased for use during business travel is used in non-airport owned vehicles (i.e. employee owned or rental) and is classified as a Scope 1 emission.

Fire training

Emissions from the airport's fire training activities have been included in this footprint. Airport fire-training emissions are those associated with airport firefighting personnel simulating an aircraft fire. To calculate the emissions a number of assumptions have been made:

- All fuel purchased by the airport within the reporting year has been consumed.
- Wood pallets are assumed to be made up of wood chip (for the purposes of emission conversion) and it is further assumed that six pallets weigh 1 tonne.
- Gas from Calor gas bottles is propane gas.

Operational vehicles

The AGS Airports have a fleet of operational vehicles. To calculate emissions from these vehicles a number of assumptions have been made to the data:

- All diesel and gas oil purchased has been consumed within the year.
- Diesel and petrol consumed is standard forecourt fuel and uses the 'average biofuel blend' conversion factor, and as such Outside of Scope emissions have also been calculated.

Passenger surface access

An updated travel survey was carried out in 2013 (superseded the 2009 survey used previously) and was used to obtain distance travelled and modes of transport used by passengers for Aberdeen and Glasgow Airport. Some updates have been made available for 2017, such as mode of transport for Southampton Airport.

The following assumptions were made to the survey data to calculate emissions, unless specifically stated in the respective airport sections:

- To calculate passenger vehicle emissions, UK Government 'Passenger vehicles' company reporting conversion factors have been used. All others are taken from the 'Business travel – land' conversion factors.
- Passengers traveling by coach and bus have not been distinguished. Therefore, an average conversion factor has been applied. The factor applied is taken from the UK Government 'Business travel – land' and is the 'average local bus' conversion factor.
- Only the final mode of transport to the airport has been used to calculate passenger surface access emissions. Therefore, passengers traveling by multiple modes may be represented inaccurately. For example, a passenger travelling by rail and then by travelling by bus will be assumed to have travelled the whole journey by bus. Additionally, the accuracy is based on the answer provided by respondents in the survey and no data quality assessment has been carried out on this.
- The category assigned 'car passenger' was assumed to be zero emissions as the emissions have already been captured by the 'car driver' category.
- Road distances have been used to calculate the distance from the passenger's place of origin to the airport. This is mainly from the major urban centres in the area.
- Where full postcodes have not been provided by a passenger during the survey, distances to part postcodes have been calculated and used.

Employee commute

Emissions associated with employees commuting to and from the airport is based on a survey conducted in 2009, and the update to this survey in 2013, which was used to obtain distance travelled and the modes of transport used by employees.

The following assumption was used to calculate emissions:

- For employees commute the data assumes that employees are only present on site for 65% of the time in a given year this assumes two days off per week and an annual leave entitlement of 20 to 25 days.

Utilities

To calculate emissions from utilities it has been necessary to make a number of assumptions to the data:

- Usage for utilities is taken from the supplier invoice data.
- Due to difficulties in apportioning usage to airport tenants, except in the case of Glasgow Airport, all usage is reported. This is a conservative approach. If analysis was undertaken to identify the end user it is likely that this would result in a large reduction in reported emissions.
- For Glasgow Airport, due to the charging of tenants for energy, the energy data associated with tenant usage is not reported.

Waste and recycling

As in previous years, to calculate emissions from waste a standard compositional analysis⁷ has been applied. This provides an assessment of the types and quantities of materials being sent for recycling and those sent for refuse derived fuel (RDF) or landfill. Emissions were also calculated for the

⁷ The basic waste composition data is taken from an SLR Report for Environment Agency Wales entitled: Determination of the Biodegradability of Mixed Industrial and Commercial Waste Landfilled in Wales.

production of the virgin material and for the method of disposal and treatment of the material. To calculate emission from waste the following has been assumed:

- Waste disposal (RDF/Combustion):
 - Where no waste is sent to an RDF, it has been assumed that it still goes to landfill.
 - Plastic is assumed to be of 'average plastic' composition.
 - All recyclate are assumed recycled in an open-loop recycling process. Open-loop UK Government conversion factors for company reporting have been applied (where available). This is representative of a worst-case scenario.
- Production of virgin material:
 - Calculations assume 100% virgin material.
 - The waste production figure for textiles does not currently account for the split of material types on the UK market.

Appendix 2 – Carbon emissions conversion factors

The emission factors for the 2017 carbon footprint model are provided by BEIS in the 2017 GHG Reporting publication⁸. Unless otherwise stated, the emission factors used in this report all draw on UK Government Conversion Factors for Company Reporting and are provided in Table 33 below. In addition, the 2016 conversion factors have been provided to aid year on year comparison.

It should be noted that minor variations in emission factors occur year on year due to the re-baselining of data and increased granularity of data available that enable the calculations. However, the emission factor for electricity generation is an exception to this rule (highlighted in Table 33). The UK electricity grid is undergoing a major de-carbonisation which has seen the contribution from renewable generation increase exponentially. The effect that this has on the emission factor is a commensurate reduction in the carbon emission factor due to the offset of electricity generation from carbon intensive power plant (coal and natural gas). This also affects the emission factor for the transmission and distribution losses (Scope 3) portion of electricity. The result is that for 2017, there has been a 14.7% reduction in the Scope 2 emission factor and an 11.8% reduction in the Scope 3 emission factor from 2016. This will have a positive impact on AGS Airports reported Scope 2 emissions which does not reflect any energy savings measures or policies implemented during the period.

The EC Ozone Regulation (No. 1005/2009) as introduced to phase out HCFCs, including R22 gas, used in air conditioning and refrigeration systems. Since this introduction, all industries have been replacing their R22 gas with alternatives.

Table 33: UK Government Conversion Factors for Company Reporting 2016-2017

Activity	Raw data units	2016 emission factor (kgCO ₂ e per unit)	2017 emission factor (kgCO ₂ e per unit)	Notes
FUELS				
Diesel use (vehicle fuel/power generation)	litres	2.612	2.600	average biodiesel blend (from forecourt)
Outside of Scope (diesel)	litres	0.061	0.068	to account for the direct CO ₂ impact of burning biodiesel
Fuel Oil	tonnes	3,225	3,227	
Burning Oil/Kerosene	litres	2.532	2.532	
Gas Oil	litres	2.966	2.954	
LPG/Propane	litres	1.505	1.505	
Wood	tonnes	1,484	1,336	wood pallets – wood chips
Aviation turbine fuel	tonnes	3,181	3,181	
UTILITIES				
Natural Gas	kWh	0.184	0.184	
Electricity generation	kWh	0.412	0.352	
Electricity transmission and distribution loss	kWh	0.037	0.033	
Water supply	m ³	0.344	0.344	
Water treatment	m ³	0.708	0.708	
REFRIGERANTS				

⁸ 2017 Greenhouse Gas Conversion Factors for Company Reporting - <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017>

Activity	Raw data units	2016 emission factor (kgCO ₂ e per unit)	2017 emission factor (kgCO ₂ e per unit)	Notes
Refrigerant gas – R407C	kg	1,774	1,774	
Refrigerant gas – R410A	kg	2,088	2,088	
Refrigerant gas – R134A	kg	1,430	1,430	
Refrigerant gas – R22	kg	1,810	1,810	
WASTE DISPOSAL – from landfill and recycling				
Paper (combustion/RDF)	tonnes	21	22	
Card (combustion/RDF)	tonnes	21	22	
Plastic (combustion/RDF)	tonnes	21	22	
Textiles (combustion/RDF)	tonnes	21	22	
Wood (combustion/RDF)	tonnes	21	22	
Glass (combustion/RDF)	tonnes	21	22	
Kitchen Waste (combustion/RDF)	tonnes	21	22	
Non-aluminium Metal (combustion/RDF)	tonnes	29	22	
Aluminium (combustion/RDF)	tonnes	21	22	
Paper (recyclate)	tonnes	21	22	
Card (recyclate)	tonnes	21	22	
Plastic (recyclate)	tonnes	21	22	
Textiles (recyclate)	tonnes	21	22	
Glass (recyclate)	tonnes	21	22	
Non-aluminium Metal (recyclate)	tonnes	21	22	
Aluminium (recyclate)	tonnes	21	22	
MATERIAL USE – from primary material production				
Paper (combustion/RDF)	tonnes	939	939	
Card (combustion/RDF)	tonnes	904	838	
Plastic (combustion/RDF)	tonnes	3,342	3,328	
Textiles (combustion/RDF)	tonnes	22,310	22,310	
Wood (combustion/RDF)	tonnes	435	409	
Glass (combustion/RDF)	tonnes	895	895	
Kitchen Waste (combustion/RDF)	tonnes	4,060	4,060	
Non-aluminium Metal (combustion/RDF)	tonnes	3,771	3,758	
Aluminium (combustion/RDF)	tonnes	12,912	12,874	
Paper (recyclate)	tonnes	683	795	
Card (recyclate)	tonnes	683	795	
Plastic (recyclate)	tonnes	679	678	
Textiles (recyclate)	tonnes	131	152	
Glass (recyclate)	tonnes	508	529	
Non-aluminium Metal (recyclate)	tonnes	1,493	1,234	
Aluminium (recyclate)	tonnes	3,014	3,014	
TRANSPORT				
Domestic flights	passenger. km	0.147	0.141	average passenger and without RF

Activity	Raw data units	2016 emission factor (kgCO ₂ e per unit)	2017 emission factor (kgCO ₂ e per unit)	Notes
European flights	passenger.km	0.089	0.085	average passenger and without RF
International flights	passenger.km	0.095	0.095	average passenger and without RF
Taxi	passenger.km	0.219	0.156	assumed black cab
UK Bus and Coach	passenger.km	0.102	0.103	assumed average local bus
UK Rail	passenger.km	0.049	0.047	assumed national rail
Overseas Bus and Coach	passenger.km	0.102	0.103	assumed average local bus
Overseas Rail	passenger.km	0.012	0.012	assumed international rail (Eurostar)
Personal Car	km	0.187	0.182	unknown fuel and average size
Motorbike	km	0.120	0.117	average size



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