Ricardo Energy & Environment

Glasgow Airport Carbon Footprint 2021

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

Report for Glasgow Airport Limited

Introduction

All Scope Emissions = 52,938 tCO_2e

All emissions are reported in Market Based methodology, unless stated otherwise.
All figures are rounded to the nearest whole number.

Overall 22% increase from 2020

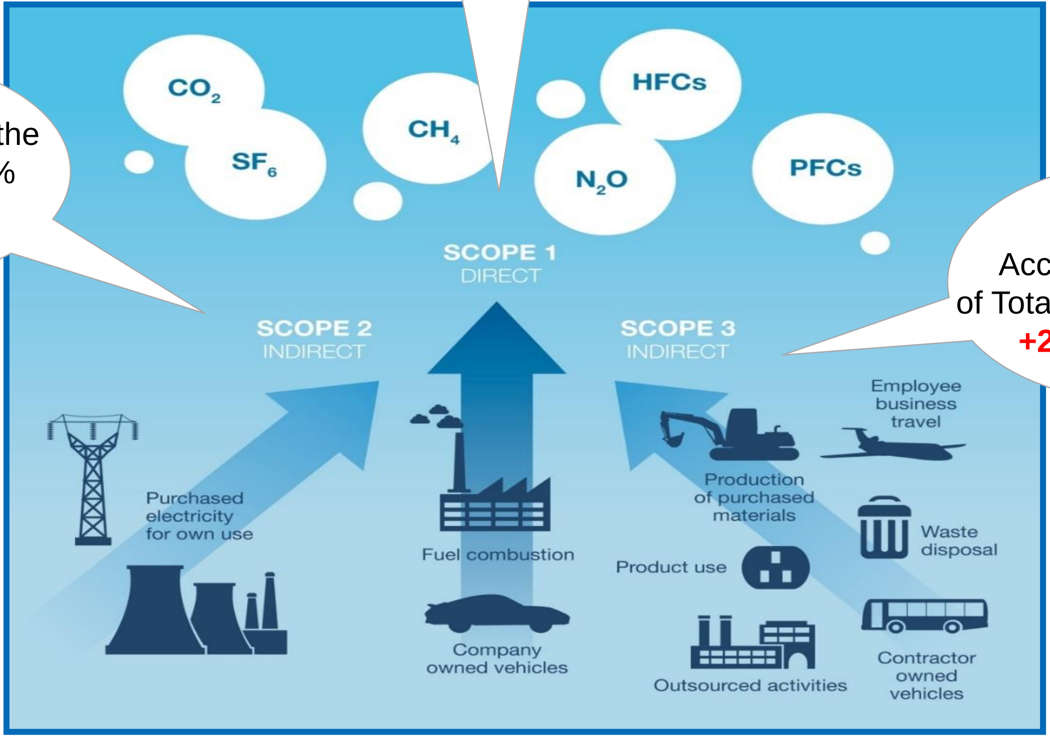
Overall increase is primarily due to the removal of Covid-19 travel restrictions in 202, leading to increased travel compared to 2020.

Number of aircraft movements have increased by 14.8% since 2020

Passenger numbers have increased by 6.7% since 2020

+3% since 2020

0% change since 2020 due to the purchase of 100% renewable electricity



Accounts for 94.3% of Total Emissions in 2021
+23% since 2020

Scope 1 and Scope 2 emissions have seen an overall increase of +3% since 2020. This is likely due to increases in activity returning to pre-pandemic levels.

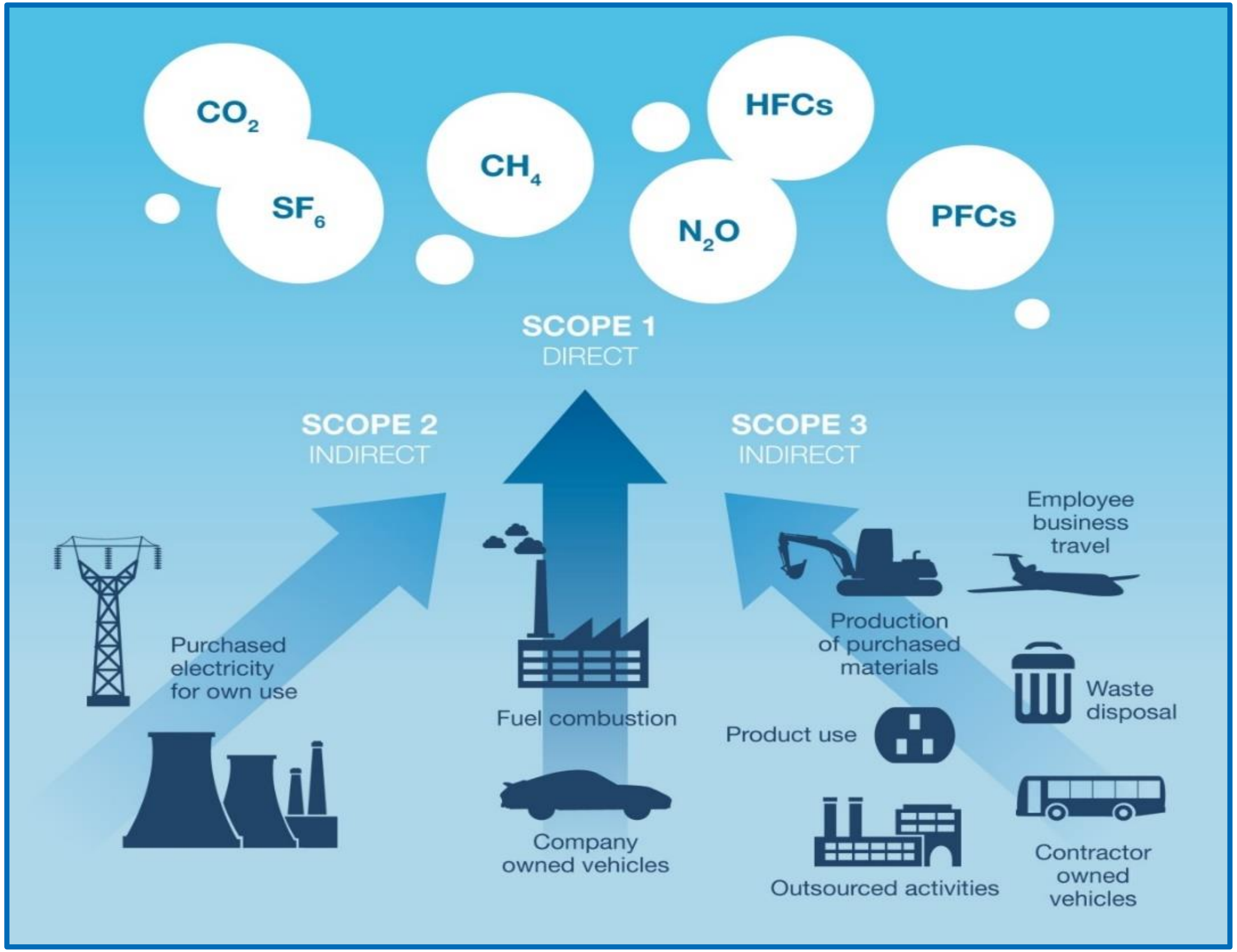
Included Emission Sources

The following emissions sources are included in the 2021 carbon footprint for Glasgow Airport:

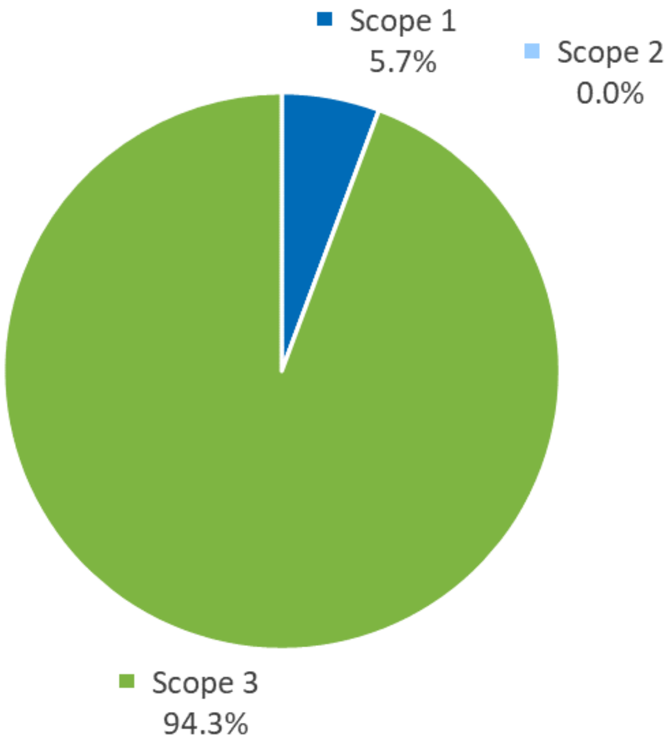
Scope 1: Direct Emissions:
- Fuels burnt on site (boilers, generators, airport owned operational vehicles, fire training)
- Refrigerant gas losses
- Airport glycol based de- icer

Scope 2: Indirect Emissions:
- Purchased electricity

Scope 3: Indirect Emissions:
- 3rd party operational vehicle fuels
- 3rd party glycol based de-icer
- Tenant energy use (sub metered electricity and natural gas recharged to tenants)
- Aircraft LTO cycle, APU usage and engine testing
- Business travel
- Water supply and wastewater treatment
- Staff commute
- Passenger surface access
- Waste disposal and material use



Key Stats- Carbon Emissions by Scope 2021



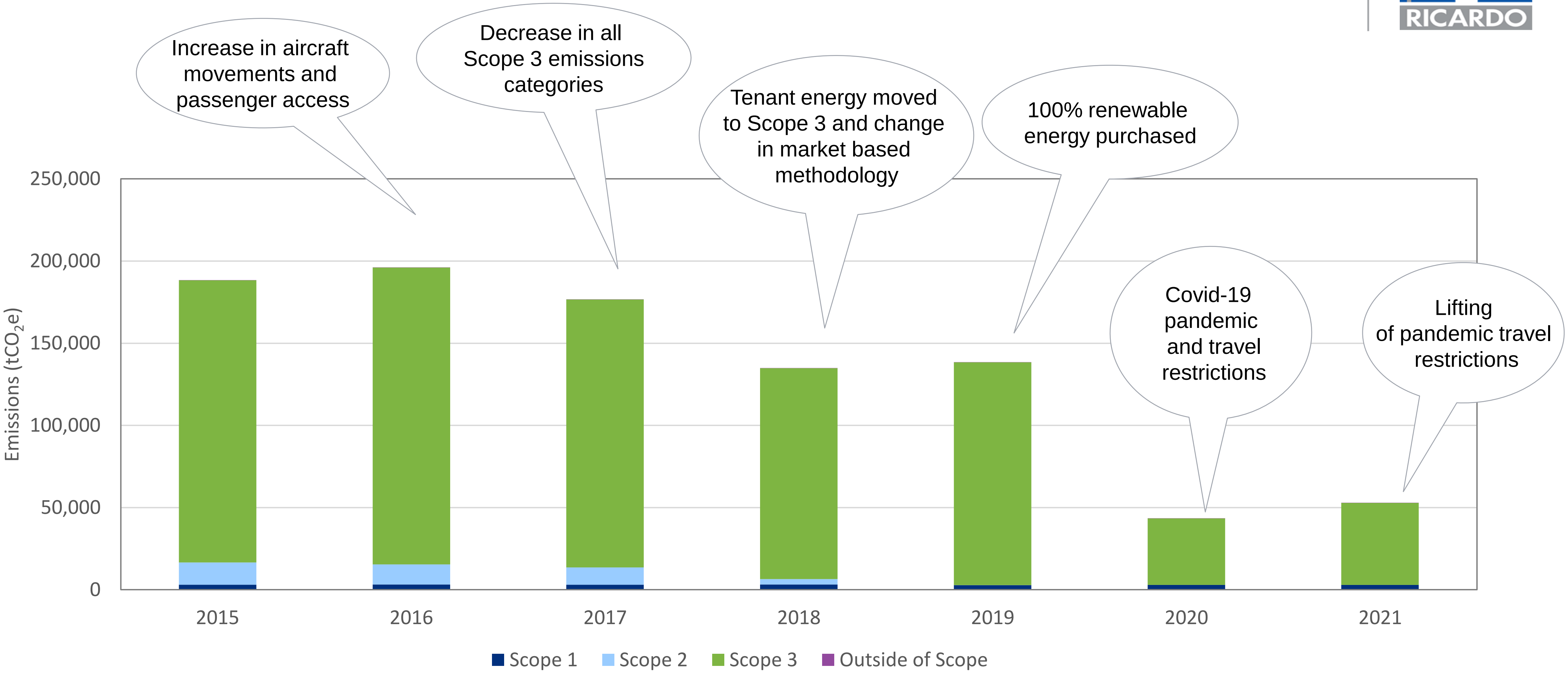
	Total 2021 emissions (tCO2e)	% of total emissions
Scope 1	3,007	5.7%
Scope 2	0	0.0%
Scope 3	49,925	94.3%
Outside of Scope	6	0.0%
Total	**52,938**	**100%**

Scope 1:
Emissions on-site, or an associated process, from the combustion of fossil fuels, e.g. natural gas, oil, LPG and company-owned vehicles.

Scope 2:
Emissions 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.

Scope 3:
Scope 3 is a category that includes the emissions from all other indirect sources. Scope 3 emissions are the consequence of the activities of GLA but arise from sources not owned or controlled by GLA. These include; aircraft movements, passenger and staff travel to the airport, airside activities, waste disposal, water, and business travel.

Key Stats- All Scopes Summary

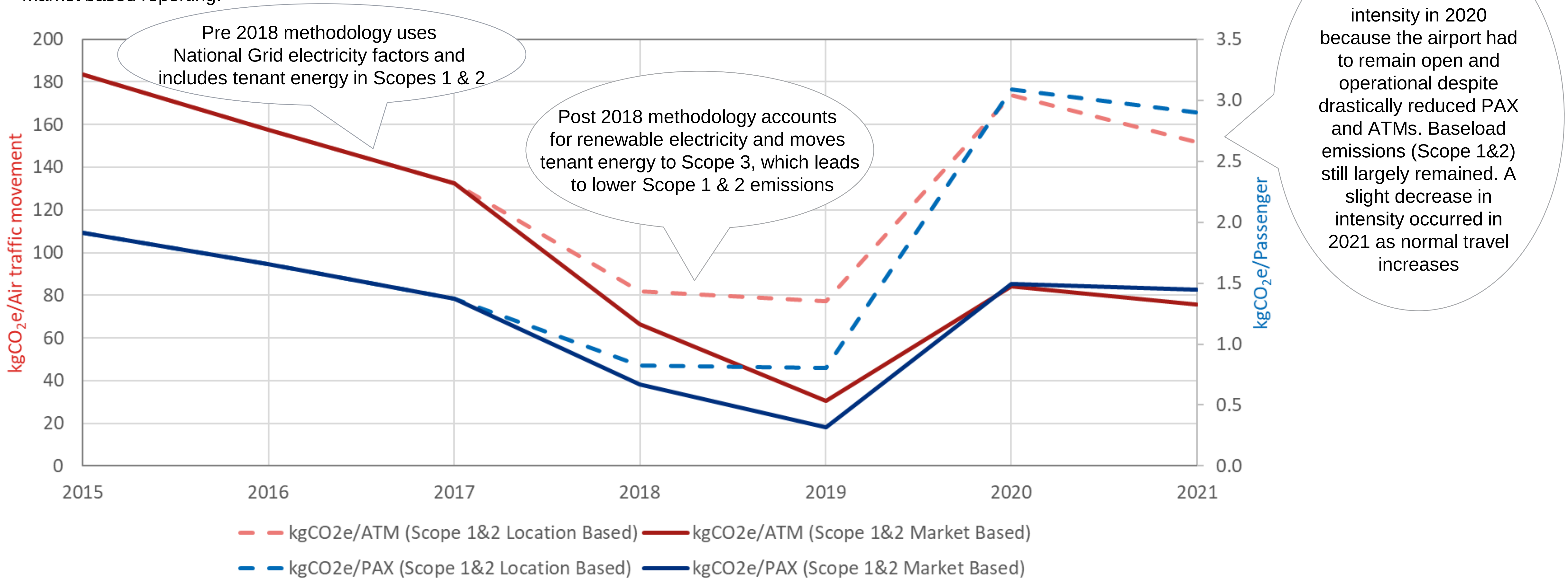


Scope 3 emissions have always been the largest contributor to Glasgow Airport’s carbon footprint. The majority of which are from aircraft activities and passenger access to the airport.

Key Stats - Intensity Metrics comparison over time - 1

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.

The chart below shows the scope 1&2 emissions per Aircraft Movement (ATM) and Passenger (PAX) under both location and market based reporting.



There was a slight decrease in Market and Location-based intensity metrics in 2021. This is likely due to the lifting of travel restrictions enforced in 2020 and an increase in ATM and PX numbers relative to emissions.

Key Stats - Intensity Metrics comparison over time - 2

The table below shows the figures from the chart on the previous slide for:

- Location based 2 and Tenant Energy in Scope 3 from 2018
- Market based Scope 2 and Tenant Energy in Scope 3 from 2018

	2015	2016	2017	2018	2019	2020	2021
ATM	90,782	98,264	102,490	97,415	91,848	34,589	39,720
PAX	8,718,269	9,370,402	9,902,239	9,659,818	8,850,565	1,947,877	2,078,962
% Change in ATM (year-on-year)	N/A	8.2%	4.3%	-5.0%	-5.7%	-62.3%	14.8%
% Change in PAX (year-on-year)	N/A	7.5%	5.7%	-2.4%	-8.4%	-78.0%	6.7%
Scope 1 & 2 (tCO_2e) Location Based Tenant energy in Scope 3	16,645	15,500	13,584	7,987	7,109	6,017	6,022
$kgCO_2e$/ATM	183.4	157.7	132.5	82.0	77.4	173.9	151.6
$kgCO_2e$/PAX	1.9	1.7	1.4	0.8	0.8	3.1	2.9
Scopes 1 & 2 (tCO_2e) Market Based Tenant energy in Scope 3	N/A	N/A	N/A	6,461	2,806	2,915	3,007
$kgCO_2e$/ATM	N/A	N/A	N/A	66.3	30.6	84.3	75.7
$kgCO_2e$/PAX	N/A	N/A	N/A	0.7	0.3	1.5	1.4

*Note that for the years 2015-2017, no figures for this methodology are available.

Table of Contents

Background

AGS Airports Limited, a partnership between Ferrovial and Macquarie Infrastructure and Real Assets (MIRA), owns Glasgow International Airport Limited (GLA). The airport operates 365 days per year serving around 9 million passengers and handling around 92,000 aircraft movements. AGS Airports employ around 350 full time employees (FTE), of which 184 are based in Glasgow Airport. Many of these commute to the airport by car or public transport, though cycling has become more popular in recent years.

To continue operating in an environmentally responsible manner, it is important for the airport to monitor and manage all its emissions from all operations – both those the airport is directly responsible for, and those it can influence under it’s scope 3 emissions.

During the reporting year of 2021, national travel restrictions remained in place until spring in response to the Covid-19 pandemic. With the lifting of these restrictions, passenger numbers saw an increase, and as a result so did aircraft movements and the related emissions.
The reporting year 2021 saw an increase in aircraft movements, passenger numbers and employee commuting, however these are not yet at pre-pandemic levels.

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.

Changes to Footprint Methodology

It is important to understand any changes in emissions that are a direct result of changes in carbon footprint calculation methodology, and not a change in operations. Therefore, for the 2021 carbon footprint there are outlined below:

- WTT Emissions added to Electricity (Scope 3) in carbon footprint calculations in order to better encapsulate the emissions related to using the UK energy grid
- Staff commute emissions were calculated using a pre-covid survey and an average 2021 furlough figure to account for employees on furlough between January-September 2021.
- Business Travel methodology has been updated and improved in both 2020 and 2021 calculations. Estimates were slightly inflated in previous years but have now been corrected.
- Improved calculation methods for passenger surface access emissions was applied to 2019, 2020, 2021 calculations to more accurately show annual emission change
- CCD emissions estimated and reported separately from carbon footprint calculations in order to better encapsulate the emissions from aircraft movements beyond the immediate vicinity of the airport.

Carbon Emissions by Source and Activity 2021 – 1

Glasgow Airport's emissions can be broken down by activity as seen in this table.

The main activities that contribute to the footprint are aircraft movements, passenger surface access, and utilities.

Utilities include natural gas and refrigerant usage in the terminal, as well as electricity consumption and glycol based de-icer

While not as large as utilities, staff commuting represents nearly 10% of overall emissions.

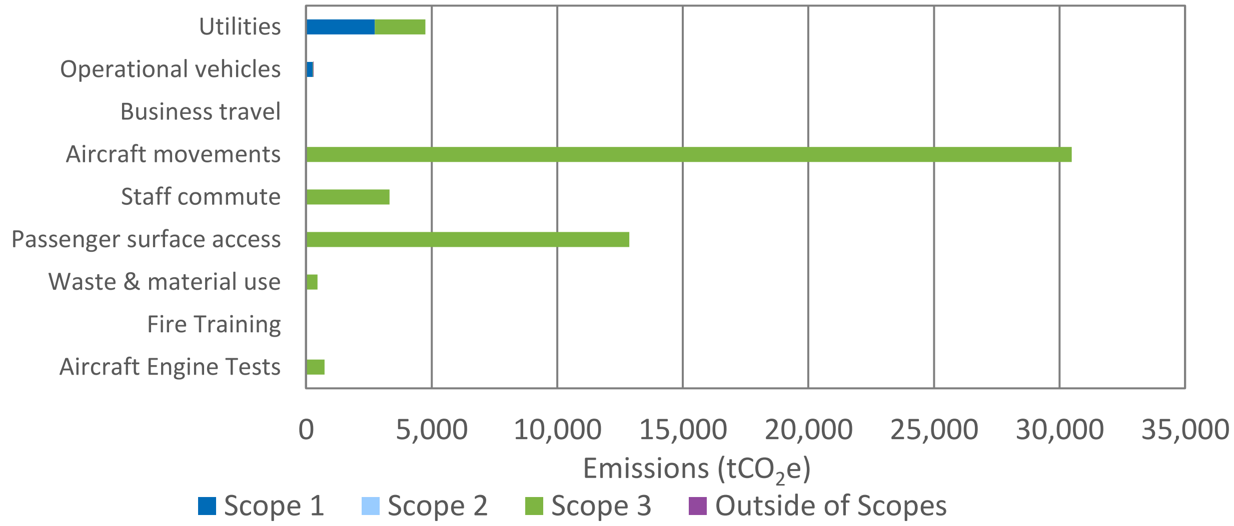
Waste, fire training and business travel contribute to <1% of the carbon footprint

Emission Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Outside of Scopes (tCO_2e)	Total (tCO_2e)	% of total emissions
Aircraft movements	0	0	30,484	0	30,484	57.6%
Passenger surface access	0	0	12,869	0	12,869	24.3%
Utilities	2,731	0	2,021	0	4,751	9.0%
Staff commute	0	0	3,325	0	3,325	6.3%
Operational vehicles	255	0	38	6	300	0.6%
Waste & material use	0	0	453	0	453	0.9%
Aircraft Engine Tests	0	0	730	0	730	1.4%
Fire Training	21	0	0	0	21	0.0%
Business travel	0	0	5	0	5	0.0%
	3,007	**0**	**49,925**	**6**	**52,938**	**100.0%**

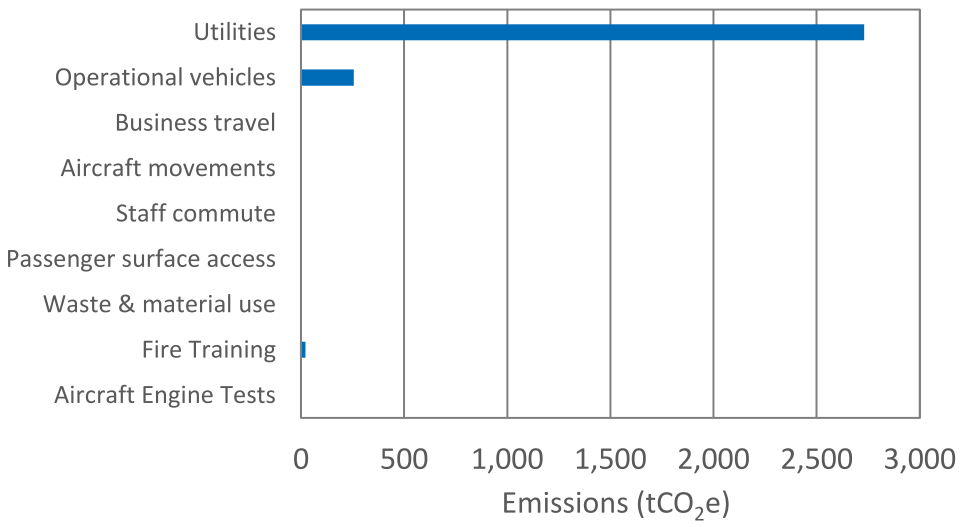
Accounts for the direct carbon dioxide (CO_2) impact of using biofuels in airport vehicles.

Carbon Emissions by Source and Activity 2020 – 2

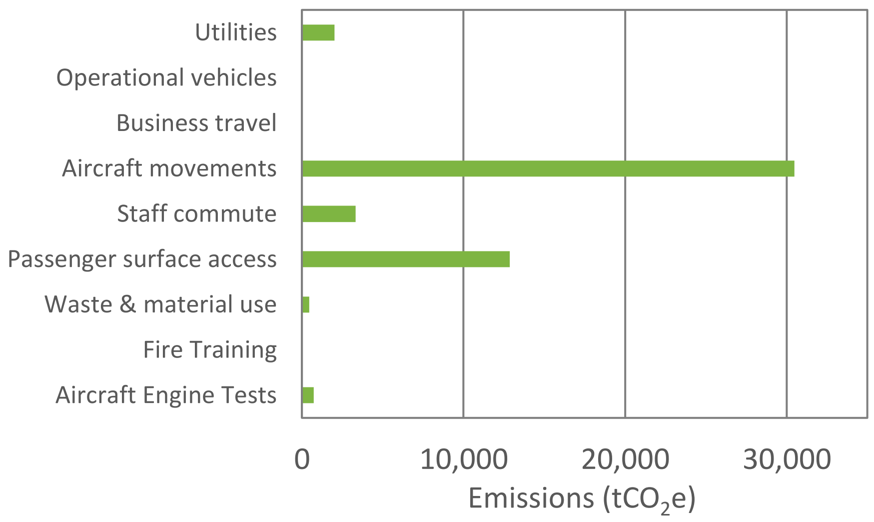
All Scopes carbon emissions split by source/activity



Scopes 1&2 carbon emissions split by source/activity



Scope 3 carbon emissions split by source/activity

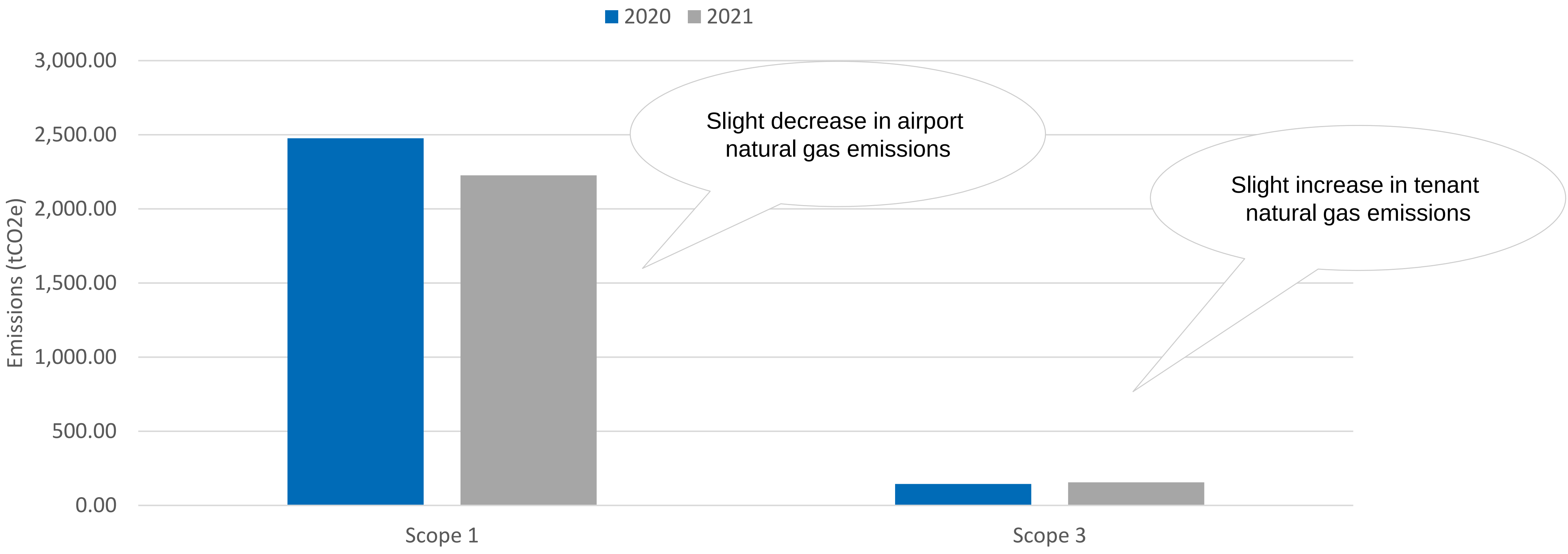


Tenant Energy

- As tenant energy is outside the control of the airport, this was moved to Scope 3 emissions in 2019, in order to more clearly identify the airport’s controllable emissions.

- All tenant energy that is contained in Scope 3 is sub metered energy that was recharged to tenants.

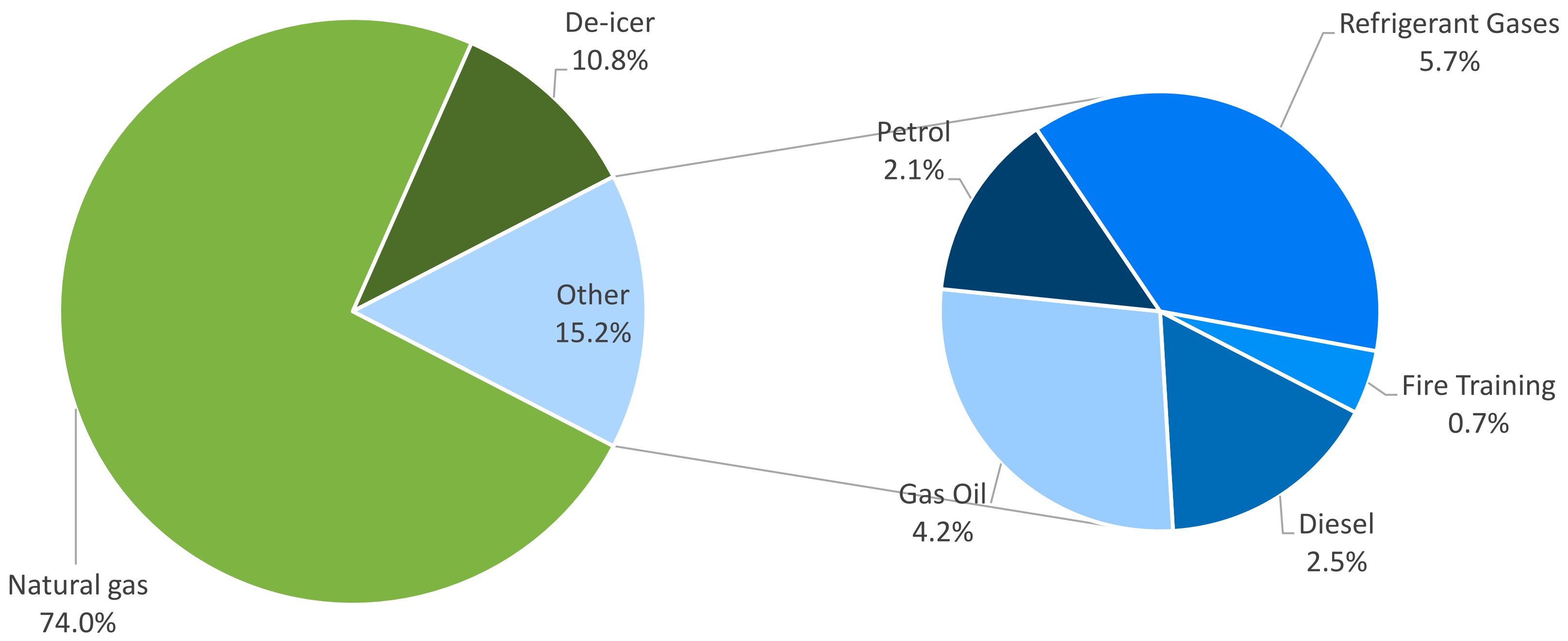
- A comparison of emissions from natural gas split by scope 1 and 3 (airport and tenant) can be seen below. Electricity is not included in this chart because renewable electricity is purchased and has no associated emissions.



Scope 1 Emissions Sources

Scope 1 = 3,007 tCO_2e (5.7% of Total)

Scope 1 emissions are those under the direct control of the airport



Scope 2: Location and Market Based Emissions

Scope 2 = 0 tCO_2e (0% of total)

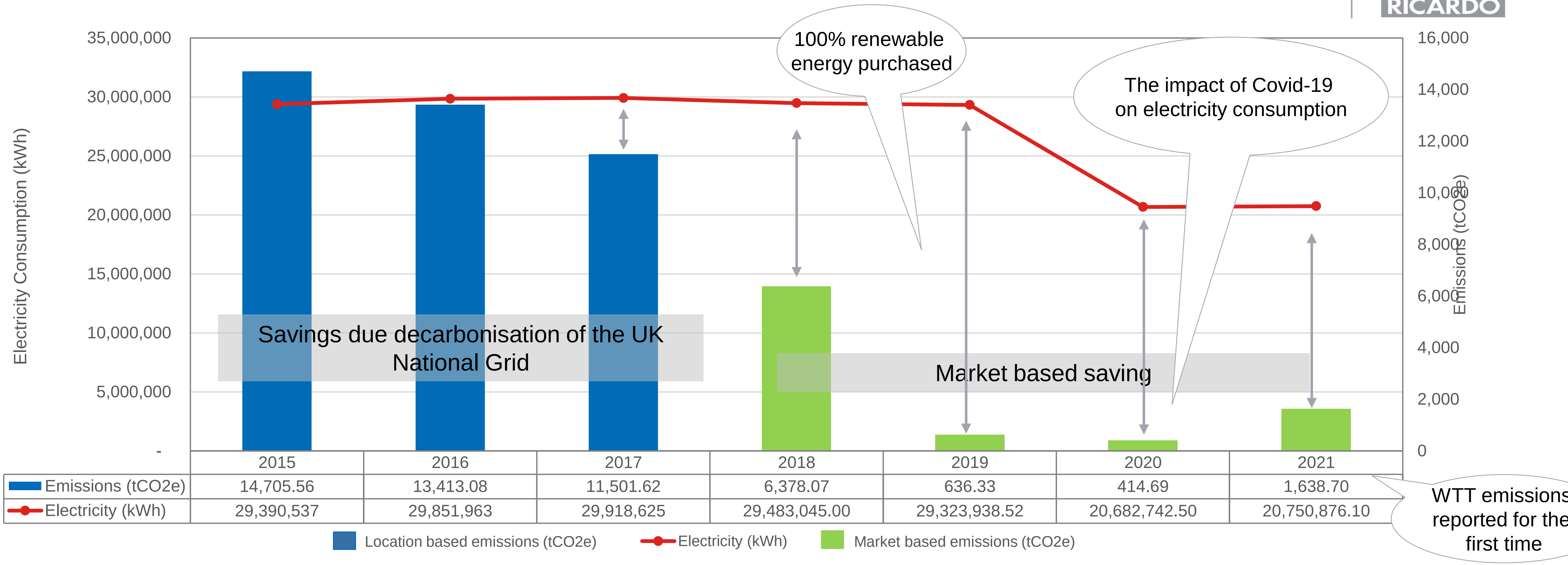
Scope 2 emissions relate to the electricity consumption at the airport. These can be calculated as:

- Location-Based method: This reflects the average emission intensity of the electricity grid where consumption occurs. Companies reporting using this method should use the Regional/National Grid average emission factor. In this UK, this would be sourced from the BEIS UK Government conversion factors for Company Reporting.
- Market-Based method: This reflects the emissions from the electricity that a company is purchasing. Energy suppliers are required under UK law to disclose to consumers the fuel mix and GHG emissions associated with their portfolio or tariffs. This airport chooses to purchase energy that is greener than the National Grid average emissions factor. The advantage of procuring electricity that is higher in renewable energy content than that of the National Grid is outlined in the table below:

	Location-Based (tCO2e)	Market-Based (tCO2e)
Airport Electricity Emissions (Scope 2)	3,015	0

- Here, Market-Based emissions are zero because the airport purchased 100% green electricity from its energy suppliers. A supplier statement has been provided which indicates that the supply is 100% renewable and REGOs will be available in mid-2022.
- The following slide provides an annual comparison of the electricity consumption and relevant emissions at Glasgow Airport.

Comparison of Electricity Consumption and Carbon Emissions



	2015	2016	2017	2018	2019	2020	2021
Emissions (tCO2e)	14,705.56	13,413.08	11,501.62	6,378.07	636.33	414.69	1,638.70
Electricity (kWh)	29,390,537	29,851,963	29,918,625	29,483,045.00	29,323,938.52	20,682,742.50	20,750,876.10

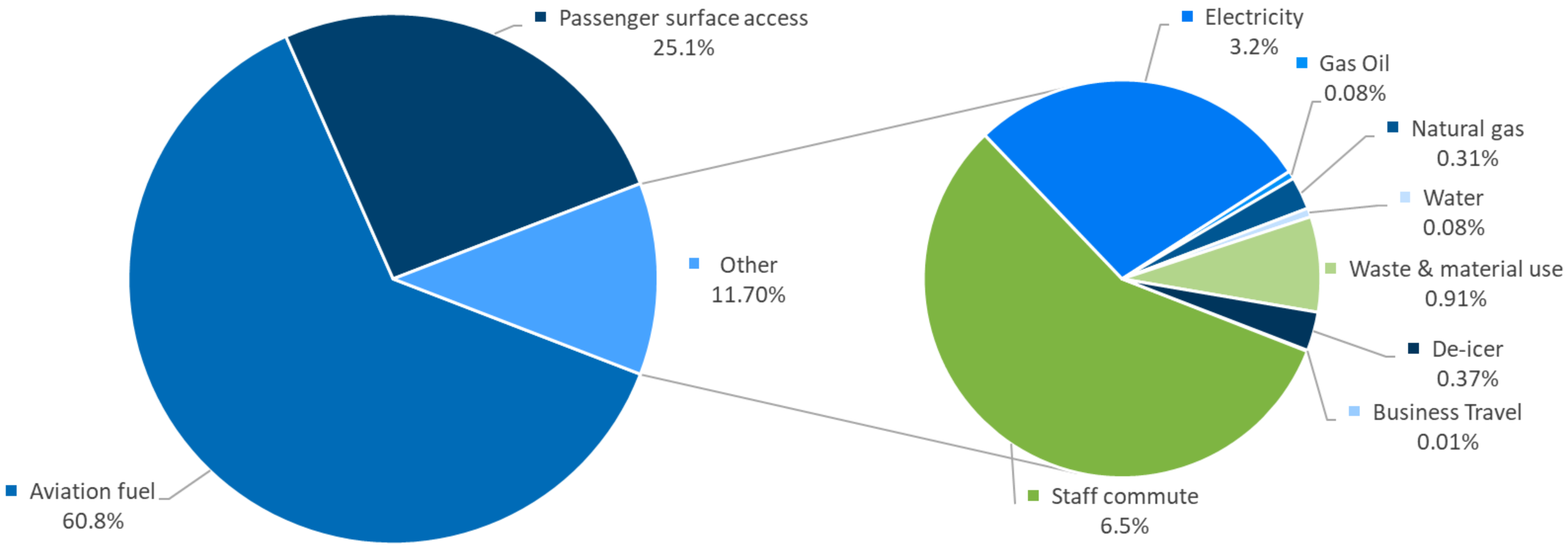
There was only a small deviation in total electricity consumption from 2015-2019. The majority of savings in emissions during this period is due to the increase of renewables on the national electrical grid and the purchasing of 100% renewable electricity from 2018. From 2019-2020, electricity consumption and the resulting emissions reduced, likely due to the Covid-19 pandemic. From 2021, electricity consumption increased 6.1% due to the removal of travel restrictions in the latter half of the year. Emissions from electricity have increased largely because of the inclusion of Well-To-Tank (WTT) emissions for the first time in 2021.

Note: to allow for better comparison to previous years, the figures for electricity emissions above include tenant electricity use, as well as Transmission and Distribution (T&D) and WTT emissions.

Scope 3 Emissions Sources

Scope 3 = 49,925 tCO_2e (94.3% of Total)

Unlike Scope 1 and 2 emissions, those categorised as Scope 3 are not under the direct control of the airport



The Scope 3 figure above for electricity is inclusive of the emissions associated with Transmission and Distribution (T&D) and Well-To-Tank (WTT) only. GLA procures 100% renewable electricity, however, it still receives energy from the UK electricity grid and therefore it is best practice to report these Scope 3 emissions.

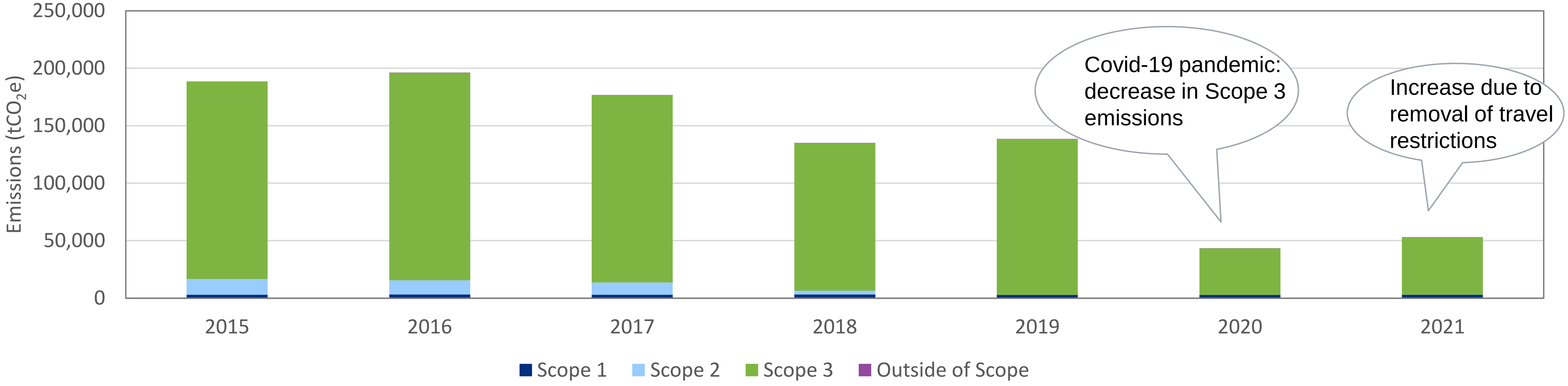
Landing Take-Off Cycle

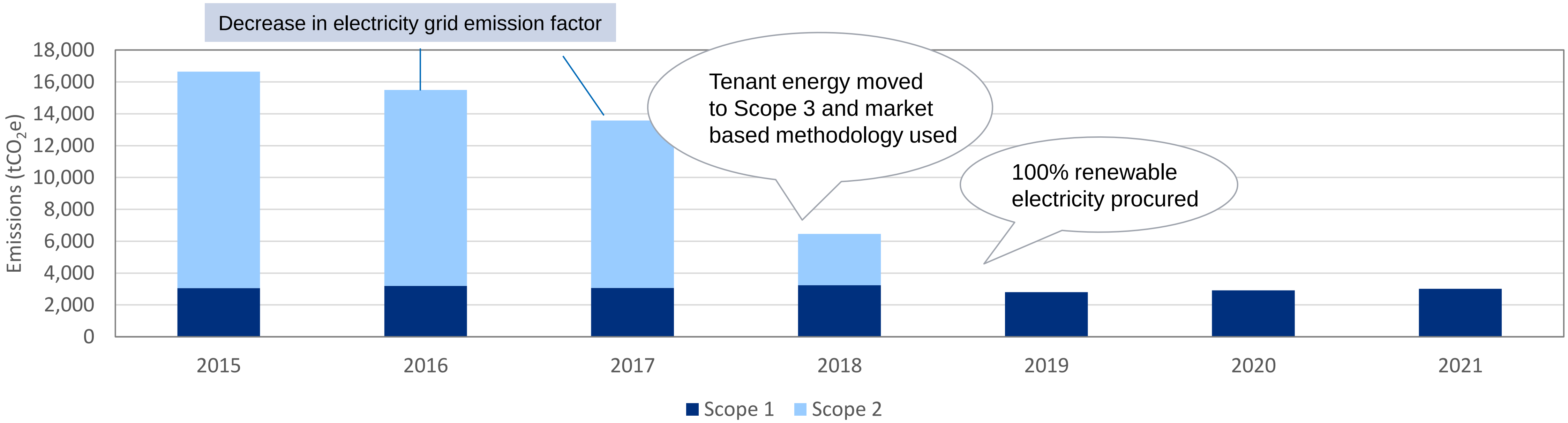
Landing Take-Off Cycle (LTO) emissions account for aircraft movements which occur below 3,000 feet during flight. Total LTO emissions for 2021 are **30,484 tCO_2e.**

EasyJet offset 100% of their aviation fuel emissions as per ACA guidelines and can therefore be claimed as carbon neutral. AGS airports have decided to continue reporting these emissions in their carbon footprint for clarity.

Total emissions from EasyJet that are offset are **7,344 tCO_2e** which is 24% of total LTO emissions.

Annual Emissions Trends – 1





Annual Emissions Trends – 2

The table below shows the figures from the charts on the previous slide, as well as the % year-on-year (y-o-y) change of the different emissions scopes. All emissions below are in tCO_2e.

Emissions by Scope	2015	2016	2017	2018	2019	2020	2021
Scope 1	3,061	3,199	3,066	3,234	2,806	2,915	3,007
Scope 2	13,584	12,301	10,518	3,228	0	0	0
Scopes 1 & 2	**16,645**	**15,500**	**13,584**	**6,461**	**2,806**	**2,915**	**3,007**
Scope 3	171,658	180,603	162,967	128,396	135,629	40,495	49,925
Outside of Scope	6	5	5	4	5	7	6
Total	**188,309**	**196,107**	**176,556**	**134,861**	**138,440**	**43,417**	**52,938**

% y-o-y change							
Scope 1	N/A	4%	-4%	5%	-13%	4%	3%
Scope 2	N/A	-9%	-14%	-69%	-100%	N/A	N/A
Scope 1 & 2	**N/A**	**-7%**	**-12%**	**-52%**	**-57%**	**4%**	**3%**
Scope 3	N/A	5%	-10%	-21%	6%	-70%	23%
Outside of Scope	N/A	-11%	5%	-19%	23%	32%	-3%
Annual Difference	**N/A**	**4%**	**-10%**	**-24%**	**3%**	**-69%**	**22%**

* Due to changes in methodology, 2015-2017 emissions are reported using location-based methodology and tenant energy is in Scopes 1 and 2. for 2018 onward, emissions are reported using market-based methodology and tenant energy is moved to Scope 3.

Annual Emissions Trends – 3

Almost all emission sources experienced an increase in 2021.

The following sources experiences the largest decrease in emissions from 2020, likely due to ongoing impacts of the Covid-19 pandemic:

- Operational Vehicles (Scope 1) decreased by 48%
- Business Travel (Scope 3) decreased by 77%

The following sources experienced an increase in emissions from 2020:

- Utilities increased by 31%, largely due to the inclusion of electricity Well-To-Tank (WTT) emissions for the first time in 2021. Excluding WTT emissions, there has been an decrease of 4%.
- Passenger Surface Access increased by 10%, which is likely due to the lifting of travel restrictions during the year. While the numbers are increasing, they have yet to reach pre-pandemic levels, and are likely to continue to increase in the future as passenger traffic returns to pre- pandemic levels.
- Staff Commute increased by 56%, likely due to the end of the furlough scheme. As with Passenger numbers, these numbers are still below pre-pandemic levels, and can be expected to increase in the future.
- Waste emissions have increased by 65%, likely due to increased operations and passenger traffic in the airport since the lifting of travel restrictions in May. These numbers are still below pre-pandemic levels and can be expected to increase in the future.
- Fire Training increased by 92%, which was a return to pre-pandemic levels, and likely due to increased operations since the lifting of travel restrictions.
- Aircraft movements increased by 23%, due to a 15% increase in movements and also due to less engine types matching to the databases under the advance calculation methodology.
- Engine Testing increased by 174% from 2020 to 2021. The number of engine runs increased 369%. The reason the increase in 2021 emissions is not in line with the increase in engine runs is because the average run time in 2020 was 1162 seconds compared to 768 in 2021.

Data Sources Review

Data source	Glasgow	Comments
Aircraft movements	🟢	Automated data based on real time aircraft data
Passenger surface access	🔴	Assumptions made around mode of transport and distance travelled, and scaled up from sample population.
Electricity (Scope 2)	🟢	Data based on supplier invoices.
Waste	🟡	Data split into relevant waste streams and measured in tonnes.
Tenant Electricity (Scope 3)	🟢	Data based on recharge invoices with kWh units recharged. Average data used for 3 months.
Natural gas (Scope 1)	🟢	Data based on supplier statements.
Operational vehicle fuel (airport)	🟢	Data based on centrally collated data.
Operational vehicle fuel (third parties)	🔴	Data estimated for multiple third parties. Some evidence based on email assumptions
Staff commute	🔴	Assumptions made around mode of transport and distance travelled, and scaled up from sample population.
Aircraft engine testing	🟡	Automated data based on aircraft type and duration of test. Assumptions required for time at high thrust. Not all data available from third parties.
Refrigerants (R410A, R134A, R407C, R32)	🟢	Refrigerant usage log.
Water supply/treatment	🟡	Manual meter readings used.
Fire training	🟡	Fuel consumption provided by central log and from emails.
Business travel	🔴	Assumptions required to convert cost to distance.
Other utilities (Gas oil and Deisel)	🟡	Data provided in litres and fuel type.

Key		
🟢	🟡	🔴
Verifiable, regular, automated and/or non-editable data source (e.g. data provided is based on half hourly meter readings, supplier invoices, contractors' worksheet, etc.)	Verifiable, manual readings/data of non-consumption data (e.g. data provided is based on recorded usage, expenses, etc.)	Non-verifiable data (e.g. data is based on estimates/calculations, scaled from previous years or assumptions, etc.)

Recommendations for improving your GHG footprint

Recommendation	Benefit
Provide evidence that does not require assumptions	Evidence such as employee commuting surveys that have gaps e.g. have not been populated with responses, should be addressed through data cleaning exercises. For example, surveys could notify the respondent when they have not answered a question correctly. This will result in a more robust data collection process that doesn't require assumptions to be made. Additionally, when units are given in a question (e.g. miles) answers should only be allowed in numeric form. This will save time when processing the data.
Collaborate with 3rd parties to ensure streamlined data collection	This would increase the quality of data provided for operational vehicles and aircraft engine testing, and reduce the amount of assumptions needed to convert data into the same correct format. Ideally, data on operational vehicles should include: amount of fuel used (L) and fuel type. This year assumptions had to be made due to lack of data that was provided last year.
Consider broadening staff commuting and passenger surface access survey questions	Additional questions such as fuel type, engine size, number of passengers during journey, will ensure a more comprehensive dataset that improves the accuracy and granularity of emissions captured.
Provide distance and/or fuel data for business travel rather than just financial costs	At present, data provided for business travel is mainly cost data which is converted to distance travelled using several assumptions. To improve on emissions calculation accuracy the following data should include: Mode of transport, distance travelled, travel provider, class travelled (flights/trains only)
Collect more accurate data for aircraft engine testing	At present, only the start and end time of the engine tests have been provided. No information is collected on the number of engines tested, or accurate timings for engine run duration at different thrust settings. Ideally, the provided data should include: Engine type, engine UID number, number of engines tested, time at low thrust, time at high thrust
Improve data collection processes & accuracy	Devise a uniform data collection process to accurately track and monitor emissions sources.
Consider collecting sub metered Fixed Electrical Ground Power (FEGP) data	This would enable electricity used from Fixed Electrical Ground Power to be moved to scope 3

Other Environmental Initiatives to be Considered

- Engage third parties and on-site tenants to explore further carbon management opportunities and improve benefits of carbon management measures across the airport site.
- Investigate the reduction in operational carbon on local air quality
- Change airside vehicles to electric vehicles in order to optimise use of lower carbon fuels
- Incorporate green policies of procurement
- Continue incentive for alternative aviation fuel use by aircraft, such as Sustainable Aviation Fuel
- Improve water management and water treatment, such as considering water recycling on site
- Improve resource efficiency to reduce food and general waste
- Site development considerations to reduce environmental impacts

All of the above initiatives should be considered in combination through the development of a carbon reduction plan, or Net Zero Strategy.

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Appendix – Calculation Methodologies and Assumptions

This appendix provides and insight into how Ricardo Energy & Environment (REE) has calculated the carbon footprint emissions for Glasgow Airport. To convey this, three questions are answered for each emissions area of Glasgow Airport's carbon footprint:

- How was the CO_2e figure calculated?
- What was the data that was used?
- Have any assumptions been made?

Appendix – Outside of Scope Emissions

As per UK Government GHG Conversion Factors for Company Reporting guidance, Outside of Scope factors should be used to account for the direct carbon dioxide (CO_2) impact of burning biomass and biofuels. The emissions are labelled 'outside of scope' 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 CO_2 during the growth phase as the amount of CO_2 released through combustion). As a result, full reporting of any fuel from a biogenic source should have the 'outside of scope' CO_2 value documented to ensure complete accounting for the emissions created.

Out of Scope = 6 tCO_2e (0.01% of total emissions)

Appendix – Aircraft Movements: Climb, Cruise and Descent (CCD) emissions

Climb, Cruise and Descent (CCD) emissions have been calculated for the first time in 2021. This accounts for aircraft movements which occur above 3000 feet during flight. See the methodology section for more information.

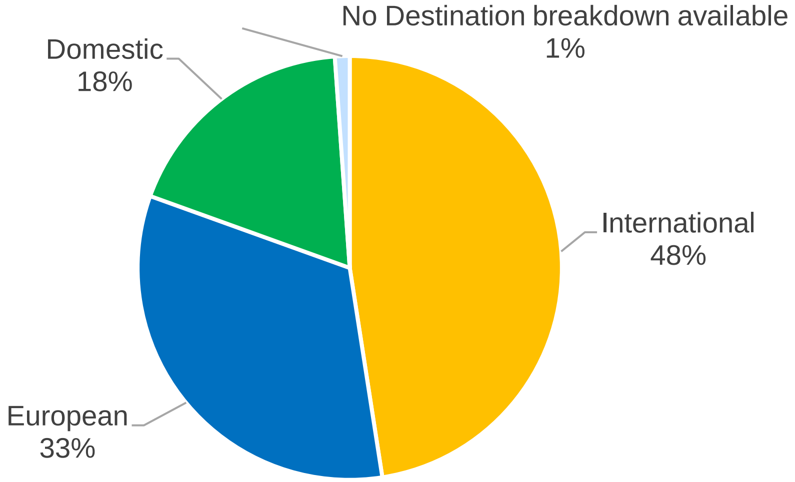
2021= **95,230.8 tCO_2e**

This figure is separate to the footprint specified in this report.

Emissions by Destination, Aircraft Carrier, and Type

The tables below show a breakdown of aircraft CCD emissions by destination, carrier and aircraft type. The top 5 contributors to emissions have been included.

Emissions by Destination	Percentage
International	48%
European	33%
Domestic	18%
No Destination breakdown available	1%
Total	100%



Carrier	Percentage
EMIRATES	25%
JET2.COM LIMITED	24%
BRITISH AIRWAYS PLC	13%
RYANAIR	7%
SIGNATURE FLIGHT SUPPORT UK	6%
Other	25%

Plane Type	Percentage
B737-800 WINGLETS	30%
B777-300ER	20%
B777-200LR	7%
B737-800	7%
A320-100/200	6%
Other	30%

Represents CCD emissions.

Methodology

The following sections provide a summary of the methodology adopted by Ricardo Energy & Environment to calculate the 2021 carbon footprint for the Airport.

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 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. Airports' emissions that are included are: natural gas use, company owned vehicles fuel use, fuel use for refrigerant gas use (from leaks during maintenance or malfunction), wood pallets and diesel use for fire training, propane combustion and kerosene combustion.

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. 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 emissions is a category that includes the emissions from all other indirect sources. Scope 3 emissions are the consequence of the activities of GLA but arise from sources not owned or controlled by GLA. Airports do have some influence over Scope 3 emissions but the activities are not under its control. Sources included by Airports include aircraft (all aircraft movements up to a height of 1,000m above aerodrome level, and half the distance travelled between the airport and the origin/destination), employees commuting to the airport, passenger surface access to the airport, airside vehicle activities by third party operators, waste disposal and material supply (including production of the virgin materials), water (supply and treatment) and airport business travel.

Methodology

The uncertainties associated with carbon footprint calculations can be broadly categorised into scientific uncertainty and estimation uncertainty. Scientific uncertainty arises when the science of the actual emission and/or removal process is not completely understood. For example GWP values involve significant scientific uncertainty. Estimation uncertainty arises any time GHG emissions are quantified. Estimations have been made within this footprint where areas of uncertainty have arisen.

Business Travel

Accounts data was provided for business travel (Scope 1 & 3). All transport mode data was provided in £ value and converted to distance travelled using the cost/km from Carbon Footprint and Project Register Tool (CFPRT) which can be found at https://sustainablescotlandnetwork.org/resources/carbon-footprint-and-project-register-tool . The CFPRT collates cost data for all forms of public transport across the UK, and is managed and updated by Sustainable Network Scotland and Resource Efficient Scotland.

Passenger Surface Access
Emissions are based on a survey undertaken in 2018, scaled to 2021 GLA passenger numbers. Information was collated on the mode of travel and location of those who answered the survey. Methodology has been improved in the 2020 and 2021 calculations.

Staff Commute
For staff commute, a 2021 survey completed by airport and third party staff was utilised to reflect staff commute during and after the Covid-19 furlough scheme. This includes staff commute for both GLA and AGS staff. There were 105 complete responses from airport staff, and so final data was scaled up to the full 248 staff. There were also 149 responses for third party employees, which was scaled up to the full 3,348 active third party passes. The survey respondents provided information on their modes of transport, distance travelled to work and number of days worked per week. The survey included questions on these before and during the Covid-19 pandemic, including time on furlough. An assumption was made that the first 39 weeks of the year were affected by the furlough scheme and the following 13 weeks weren’t. An average of 19% of employees were marked as furloughed, and so furlough commute data was adjusted to be in line with this.

Methodology

De-icer

We have calculated de-icer emissions using the emissions factors provided in the latest version of the ACERT tool from the Airport Carbon Accreditation scheme. This includes the emissions from glycol based de-icer only, under ACA methodology. Where diluted glycol was used (e.g. 50:50 glycol to water), the dilution rate has been taken into account in calculations to ensure only the amount of undiluted glycol was considered.

Engine Tests

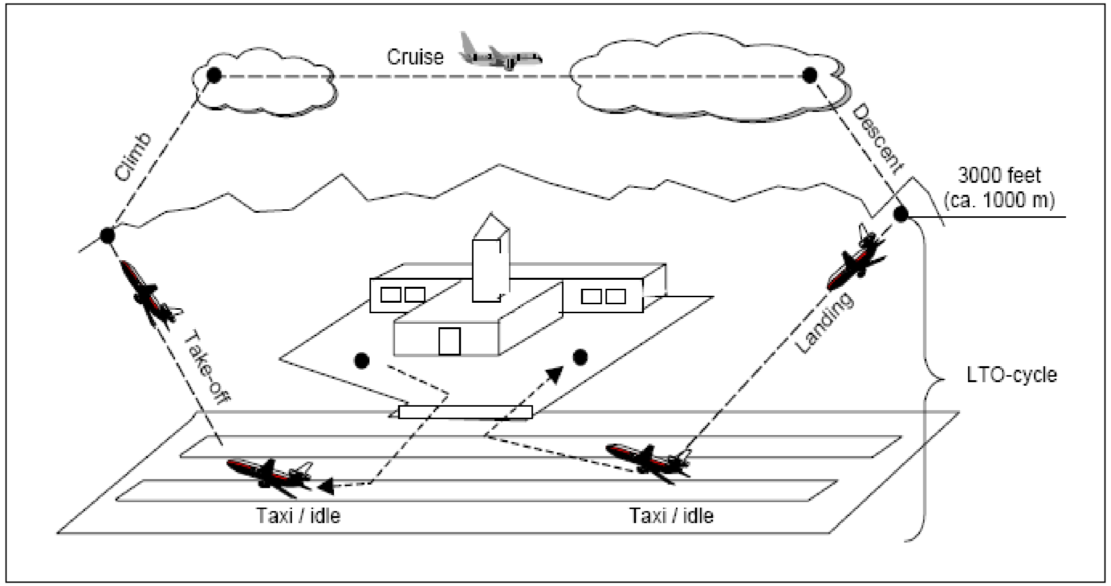
To calculate the emissions from engine testing at Glasgow airport, a similar process was carried out to identify the engine type as per the LTO cycle detailed on the next slide. Data was provided giving the length of each test and other identifying information for each engine tested. Other assumptions used for the calculations are:

1. It was assumed that two engines were tested in absence of further information within the data to be conservative and maintain assumptions used previously
2. High power testing occurred for 10% of the full test time

Aircraft Movements: Landing and Take off cycle (LTO)

Data provided by Glasgow airport included the following information for each aircraft movement in 2021: Carrier, Aircraft registration, aircraft IATA code, aircraft ICAO code, engine type, arriving/departing, date of movement and hold time.

This data is used to identify the number and type of engines that each aircraft has, and the fuel burn per second at each stage of the landing take-off cycle (shown below highlighted in green) can be referenced from the latest version of the ICAO databank. The LTO cycle covers the time idling on the runway, distance spent in taxi, and both ascent and descent between the ground and 1,000 m.



Methodology

Aircraft Movements: Climb, Cruise, and Descent (CCD)

The ACA scheme outlines three methodologies for the allocation of CCD emissions:

1. **Half way approach**: Where emissions from half of the distance of all flights going to/from the airports is allocated to the reporting airport.
2. **Departing only approach**: Emissions for the full flight distance for departing aircraft are allocated for the reporting airport.
3. **Fuel sales approach**: Emissions for all fuel sold at the airport is allocated to the reporting airport.

Of the three options above, it was decided to utilise the first approach as this is perceived to be the most neutral and comprehensive methodology.

Data provided by Glasgow airport included the following information for each aircraft movement in 2021: carrier, aircraft registration, aircraft IATA code, aircraft ICAO code, engine type, Arriving/departing, date of movement and hold time.

Flight distance was calculated with the great circle equation, utilising the origin and destination airport latitude and longitude. This flight distance was uplifted by 5.5% to reflect the fact that aircraft do not fly in a perfect straight line from one airport to another. This figure has come from studies carried out by Ricardo Energy and Environment for the UK Department for Transport, and is an update to the commonly used figure of 9%.

Fuel kg/km in-flight for each aircraft type is calculated using data from the EMEP-EEA Fuel Database.

Emissions are calculated from the fuel consumption per flight, using the BEIS emissions factor for aviation turbine fuel.

No non-carbon warming impacts have been taken into account as part of the CCD emissions.

Assumptions

- Some ICAO codes were unavailable as some flights were General Aviation flights taking off and landing at the same airport, thus these have been removed from CCD calculations in the absence of adequate information on their flight paths

Location v Market Based

Market-based method: All of the 20,750,876 kWh of electricity consumption was supplied to Aberdeen Airport by a single supplier. Glasgow Airport contacted the supplier in 2021 and asked for the details of the fuel mix. The following breakdown was provided for the year-ending 31st March 2021 (Source of Electricity, Percentage):

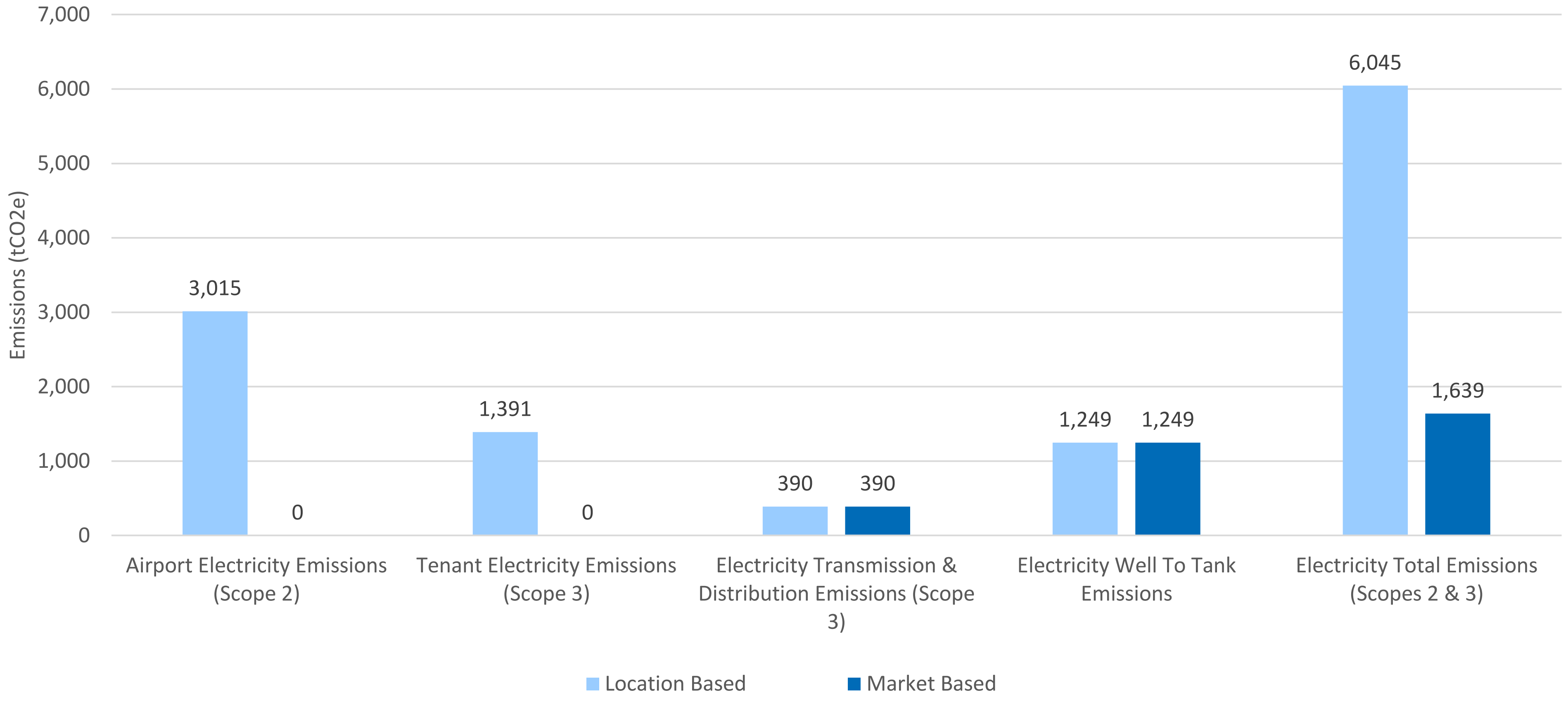
- **Renewables - 100%**

A supplier statement has been provided, which indicates that the supply is 100% renewable and REGOs will be available in mid-2022.

The weighted emission factor was provided as 0 gCO_2/kWh (or 0 $kgCO_2$/kWh). Multiplying the electricity consumption of 12,606,103 kWh by the emission factor of 0 $kgCO_2$/kWh calculates the emissions as 0 tCO_2e.

Location vs Market Based Emissions 2021

Scope 2 and 3 emissions due to electricity consumption (airport and tenant), calculated using either the location or market based emissions factors.



Location Based Electricity Emissions Historical Comparison

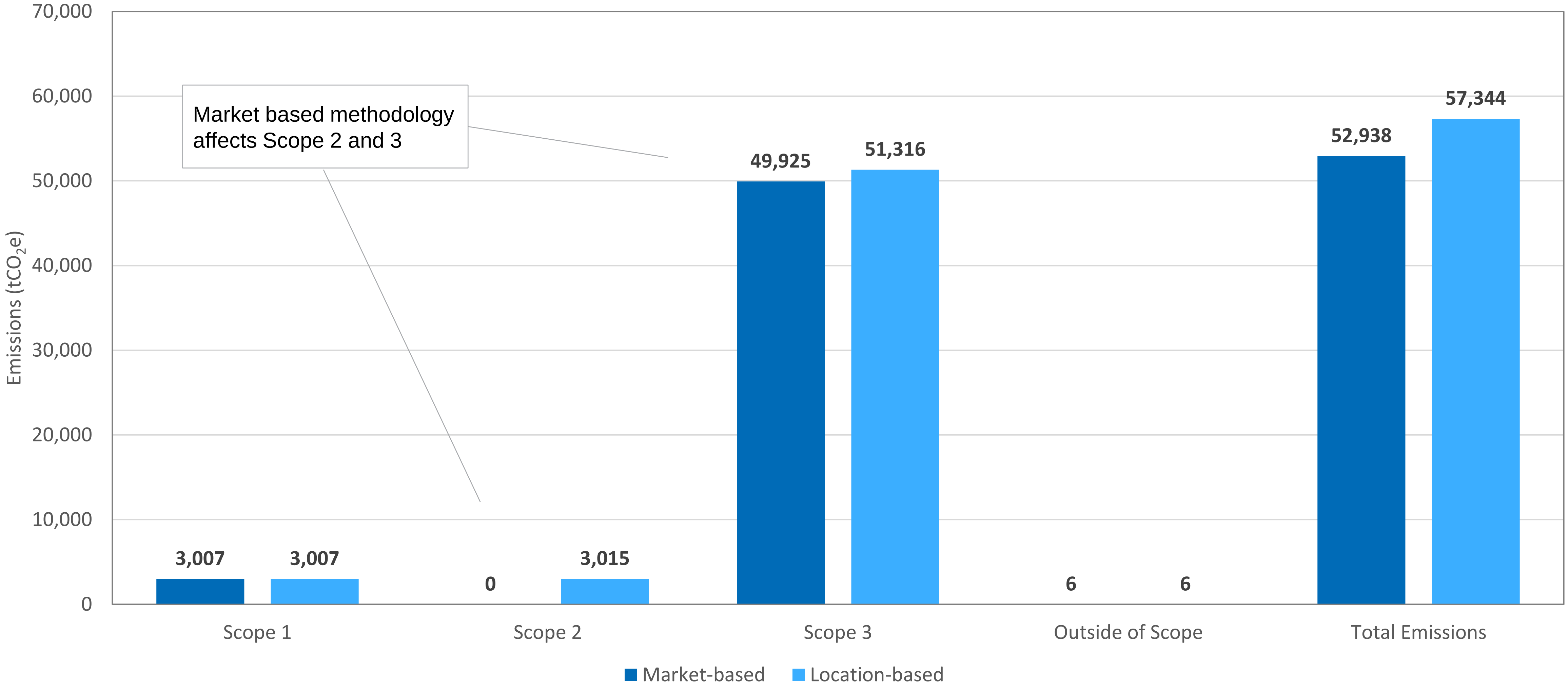
To allow for a fair comparison to previous years, the figures for electricity emissions below include tenant electricity use (classified as Scope 3 in 2020 methodology).

	2017 (Location Based)	2018 (Location Based)	2018 (Market Based)	2019 (Location Based)	2019 (Market Based)	2020 (Location Based)	2020 (Market Based)	2021 (Location Based)	2021 (Market Based)
Electricity (Scope 2 and 3) $kgCO_2e/kWh$ Airport (Scope 2) + Tenants (Scope 3)	0.35156	0.28307	0.19220	0.25560	0	0.23314	0	0.21233	0
Electricity T&D* losses (Scope 3) $kgCO_2e/kWh$	0.03287	0.02413	0.02413	0.02170	0.02170	0.02005	0.02005	0.01879	0.01879
Electricity usage (kWh) total Airport + Tenants	29,918,625	29,483,045	29,483,045	29,323,939	29,323,939	20,682,743	20,682,743	20,750,876	20,750,876
Electricity (Scope 2 and 3) emissions tCO_2e Airport + Tenants	10,518	8,346	5,667	7,495	0	4,822	0	4,406	0
Electricity T&D* losses (Scope 3) emissions tCO_2e	983	711	711	636	636	415	415	390	390
Electricity WTT* losses (Scope 3) emissions tCO_2e	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,249	1,249
Total electricity (Scope 2 and 3) emissions tCO_2e Airport + Tenants	**11,502**	**9,057**	**6,378**	**8,132**	**636**	**5,736**	**415**	**6,045**	**1,639**

*T&D = transmission and distribution
WTT= Well-To-Tank

Location vs Market Based Emissions 2021: All Scopes

Emissions totals by scope calculated using either the market or location based emissions factors. Tenant energy is included in Scope 3.



Historical Emissions Trends: Location Based

The table below shows emissions figures where for all years Scope 2 emissions are reported using the location based methodology and tenant energy is included in Scope 2 for 2015-17 and in Scope 3 from 2018-21. All emissions below are in tCO_2e.

By Scope	2015	2016	2017	2018	2019	2020	2021
Scope 1	3,061	3,199	3,066	3,234	2,806	2,915	3,007
Scope 2	13,584	12,301	10,518	4,754	4,303	3,101	3,015
Scopes 1 & 2	**16,645**	**15,500**	**13,584**	**7,987**	**7,109**	**6,017**	**6,022**
Scope 3	171,658	180,603	162,967	129,549	138,821	42,216	51,316
Outside of Scope	6	5	5	4	5	7	6
Total	**188,309**	**196,107**	**176,556**	**137,540**	**145,935**	**48,239**	**57,344**
% Change y-o-y							
Scope 1	N/A	4%	-4%	5%	-13%	4%	3%
Scope 2	N/A	-9%	-14%	-55%	-9%	-28%	-3%
Scope 1 & 2	**N/A**	**-7%**	**-12%**	**-41%**	**-11%**	**-15%**	**0%**
Scope 3	N/A	5%	-10%	-21%	7%	-70%	22%
Outside of Scope	N/A	-11%	5%	-19%	23%	32%	-3%
Annual Difference	**N/A**	**4%**	**-10%**	**-22%**	**6%**	**-67%**	**19%**

Glossary

Term	Definition
Well-To-Tank (WTT)	Well-To-Tank Emissions. The emissions relating to the extraction, refinement, and transport of fossil fuels, including those used for electricity generation.
Air Traffic Movements (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_2e)	The carbon dioxide equivalent (CO_2e) allows the different greenhouse gases to be compared on a like-for-like basis relative to one unit of CO_2. CO_2e 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_2e).
Transmission & Distribution Losses (T&D)	Transmission & Distribution Losses. Emissions relating to electrical losses within the UK National Grid.
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.
Greenhouse Gas (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 Scope (OoS)	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 are created. The emissions are labelled ‘Outside of Scope’ 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 CO_2 during the growth phase as the that CO_2 is released through combustion).
Passenger Surface Access (PAX)	Number of passengers.