GHG report

Basis of reporting for NATS' airspace, energy and environmental performance data 2021-22

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NATS Protected

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1. Introduction

1.1. Purpose

This document details the greenhouse gas (GHG) collection, conversion and reporting process used to report our annual GHG emissions. The scope of this report includes both conventional estate related environmental and energy metrics, as well as modelled enabled Air Traffic Management (ATM) related CO_2 emission performance. GHG emission data is prepared and reported with reference to the World Resources Institute's (WRI) Greenhouse Gas Protocol (GHG Protocol) Corporate Standard and ISO 14064-1:2018.

1.2. Scope of verification

The extent of verification is set out in Table 1 below. NATS considers all sources of emissions to be significant unless stated in the table below.

Scope and category	Verified to reasonable level of assurance	Verified to limited level of assurance	Not verified	Not reported	Risk assessment based justification of why not reported
Scope 1: direct	X				
Scope 2: location based	X				
Scope 2: market based	X				
Scope 3					
1: Purchased goods & services (water use and treatment and energy use at data centre)	X				
2: Capital goods				X	Working with suppliers to establish robust data set
3: Fuel and energy related activities	X				
4: Upstream transportation & distribution (Courier)	X				
5: Waste generated in operations				X	Complete data unavailable (insignificant emission source below 1% of total)
6: Business travel (including hotel nights in 2021-22)	X				
7: Employee commuting and homeworking	X				
8: Upstream leased assets				X	Not relevant to NATS operations
9: Downstream transportation and distribution				X	Not relevant to NATS operations as a service provider.
10: Processing of sold products				X	Not relevant to NATS, as a service provider, we do not have physical products that require end of life treatment.
11: Use of sold products and services		X			
12: End-of-life treatment of sold products				X	Not relevant to NATS operations
13: Downstream leased assets				X	Not relevant to NATS operations
14: Franchises				X	Not relevant to NATS operations
15: Investments				X	Outside of operational control
Scope 4: avoided		X			

Table 1 - Scope of verification of GHG emissions in 2021-22

1.3. GHG disclosure policy statement

To guarantee that the GHG assertion held within the annual GHG disclosure is a true and fair account, the principles of relevance, completeness, consistency, transparency and accuracy shall be applied.

- Relevance: Ensure the GHG inventory appropriately reflects our GHG emissions and serves the decision-making needs of users – both internal and external to the company. Relevant information is identified as potentially necessary for inclusion in the mainstream report, for the purposes of communicating the extent to which we contribute to and are affected (now or in the future) by environmental impacts. GHG emissions shall be treated as material in all cases as a contributor to climate change.
- Completeness: Account for and report on all GHG emission sources and activities within the chosen inventory boundary, with disclosure and justification for any specific exclusion. Disclosures are complete if it includes all information that is necessary for an understanding of the matter that it purports to represent and does not leave out details that could cause information to be false or misleading to users.
- Consistency: Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series. Consistency refers to the use of the same standards, policies, and procedures over time. Comparability greatly enhances the value of information to users; consistency is the means to achieving that objective.
- Transparency: Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
- Accuracy: Ensure accurate and up-to-date records through the development and introduction of procedures to form a reporting framework aligned to the GHG Protocol. The quantification of GHG emissions shall systematically neither over/under report actual GHG emissions, as far as can be judged, and uncertainties shall be reduced as far as practicable. Information shall be verifiable, i.e. characterised by supporting evidence that provides a clear and sufficient trail from monitored data to the presentation of environmental information. The information shall be sufficiently accurate to enable users to make decisions with reasonable/limited assurance as to the integrity of the reported information.

We therefore are committed to:

- Subjecting the chosen inventory boundary to regular internal review;
- Continual improvement and update of our policies and procedures to ensure they meet and comply with changes to the GHG Protocol and best practice GHG reporting;
- Regular re-assessment of GHG emission sources or development of action plans to identify and address gaps in data;
- Management of systematic processes to ensure that it meets all relevant provisions within the GHG Protocol standards;
- Including all relevant GHG emissions, as appropriate, and enable meaningful comparisons in GHG information;
- Disclosure of sufficient and appropriate GHG information to allow intended users to make decisions with reasonable confidence;

- Recording, management and reporting of reliable and timely GHG information;
- The reduction of bias and uncertainties as far as is practical;
- Appropriate levels of independent verification and/or assurance.

2. Reporting requirements

2.1. Description of NATS

NATS is the main air navigation service provider in the United Kingdom (UK). NATS provides en-route air traffic control services to flights within the UK Flight Information Regions and the Shanwick Oceanic Control Area in the North Atlantic and provides air traffic control services to airports in the UK and Gibraltar.

2.2. Person responsible for GHG reporting

The Head of Sustainable Operations is responsible for reporting GHG emissions resulting from our operations. Management and governance of scope 1, 2, 3 and 4 emissions performance is provided by two Benefits Delivery Panels, with additional oversight provided by the Board audit committee and the Environment Strategy Steering Group. An Environmental Performance Moderation Panel provides governance over GHG measurement and assessments for scope 3 category 11 and scope 4 emissions.

2.3. Competency & training

GHG emissions inventory management is led by the Sustainable Operations team, with close support from Facilities Management, Analytics, Finance, Supply Chain, Internal Audit, and other teams, who have relevant experience in GHG emissions calculations, reporting and assurance. Subject matter experts are responsible for individual areas of activity and coordination is managed by a single person reporting to the Head of Sustainable Operations.

Training requirements are kept under regular review as part of annual appraisals and internal management review. The implementation of the GHG Protocol was supported by external training in 2016.

2.4. Report period covered

This document specifies our methodology for the preparation of airspace, energy, and environmental performance data in the Annual Report & Accounts (AR&A) for the reporting period 1st April 2021 – 31st March 2022.

2.5. Base year (and recalculations)

During the 2020-2021 reporting year NATS engaged with the Science Based Targets initiative (SBTi) to validate its climate reduction targets. As part of this process the baseline reporting year was changed from 2017-2018 to 2018-2019 as there is a requirement to use a baseline up to the maximum of two years before the start of targets. See appendix 6.1 for 2018-19 (base year) GHG emission statement. Approval of NATS' application is currently pending.

Every effort is made to ensure that data we report is accurate. However, should more accurate data become available for prior years we will restate it if it results in a movement of at least 5% in

the reported data. When this is done, details will be provided in the data notes supporting the reported data.

We may restate CO_2e emissions even when there is no change in consumption data, due to corrections to the emissions factors provided by BEIS. There are no such changes in 2021-22.

For ATM emission data, any changes to increase accuracy will be restated with accompanying support notes.

2.6. Organisational boundary

We apply the operational control method in order to consolidate our organisational boundary in each reporting year.

At the legal structure level, it is considered that we have operational control over an operating entity if we or one of our subsidiaries has the full authority to introduce and implement our environment policy at the operating entity.

NATS Holdings Limited consists of two main companies which provide distinct services, with authority to implement its environment policy in each:

- NATS (En Route) plc (NERL) — the regulated part of the business which provides air traffic management services to aircraft within the UK and part of the North Atlantic;
- NATS (Services) Ltd (NSL) — the unregulated part of the business which provides air traffic control and other services at 21 civil and military airfields across the UK and Gibraltar. NSL Ltd also includes a number of subsidiary companies.

NATS Holdings Limited has various levels of shares in the following entities, but does not have authority to implement its environment policy in each:

- Aireon
- AQUILA Air Traffic Management Services
- European Satellite Services Provider
- FerroNATS
- Searidge Technologies

AQUILA's office is co-located within our head office and is included in energy and environmental performance reporting.

The same operational control approach at the legal structure level shall be applied at the facility level in order to define responsibility for energy and environmental performance within facilities. We are therefore responsible for reporting energy and environmental performance that occur within facilities over which we or one of our operations has the full authority to introduce and implement our environment policy.

NATS Holdings Limited's estate portfolio includes freehold title, rental, lease, service agreements or licences, which includes the provision of a contract service at a number of locations. All freehold sites are included in scope, unless they are sub-let, as well as leasehold sites where we have operational control. The estate portfolio includes control centres, airports, offices and warehouses,

as well various types of remote communication, navigation, and surveillance sites — some of which are co-located.

Under the operational control approach, fuel combustion, process, and fugitive emissions from all sites under our control are categorised as scope 1 and GHG emissions from consumption of purchased electricity are categorised as scope 2. Exclusions are listed in the next section.

We own vehicles (mainly for transport, logistics or engineering purposes) and lease vehicles (allocated and pool vehicles mainly for engineering purposes) using providers such as ARI (Holman). Under the operational control approach, fuel combustion for these vehicles are categorised as scope 1. Additional 'benefit' or ultra-low emission salary sacrifice vehicles are considered not under our control and are reported in scope 3 category 6.

The same operational control approach at the legal structure level shall be applied to define responsibility for the environmental performance of the aircraft we manage at airfields where we provide a tower service and within the two domestic Flight Information Regions (London and Scottish). Given the operational control NATS has of the westbound Organised Track Structure, it is sometimes necessary to measure environmental performance of Shanwick (east and west bound traffic) and/or Shanwick/Gander west bound traffic (only).

Under the operational control approach, CO_2 emissions arising from fuel combustion in aircraft under our control, or where we have available data, are categorised as scope 3 category 11.

2.7. Documentation control

All GHG emission related records are stored on SharePoint which are subject to document control and tracking.

3. GHG emission statement

Emission source		T CO_2e	T CO_2e of CO_2 per unit	T CO_2e of CH_4 per unit	T CO_2e of N_2O per unit
Scope 1 emissions	Direct emissions from combustion of natural gas (location based)	2,027	2,023	3	1
	Direct emissions from combustion of road vehicle fuel - owned fleet vehicles (owned business travel)	8	8	0	0
	Direct emissions from combustion of road vehicle fuel - leased vehicles - fuel card	87	86	0	1
	Direct emissions from combustion of stationary assets (e.g. oil boilers, Back-up generators)	208	206	0	2
	Fugitive emissions	378	-	-	-
	Total scope 1 emissions (location based)	**2,708**	**2,323**	**3**	**4**
	Direct emissions from the consumption of gas-green gas / biogas (market based)	*2*	-	-	-
Scope 2 emissions	**Emissions from generated electricity usage (location based) 55,452,130 kWh**	**11,774**	**11,654**	**44**	**76**
	Emissions from generated electricity usage (market based) 55,452,130 kWh	*718*	-	-	-
Total scope 1 and 2 emissions (location based)		**14,482**			
Total scope 1 and 2 emissions (market based – note: this is sum of biogas + market based electricity)		*720*	-	-	-
Scope 3 emissions	Category 1: Purchased goods and services-Indirect emissions from the supply and treatment of water	12	-	-	-
	Category 1: Data centre electricity use	386	383	1	2
	Category 1: Total	398	383	1	2
	Category 3: Fuel-and energy-related activities - T&D losses	1,042	1,031	4	7
	Category 3: Fuel-and energy-related activities - well to tank (electricity generation)	3,066	-	-	-
	Category 3: Fuel-and energy-related activities - well to tank (electricity T&D)	271	-	-	-
	Category 3: Fuel-and energy-related activities - well to tank (natural gas)	347	-	-	-
	Category 3: Fuel-and energy-related activities - well to tank (fuel)	48	-	-	-
	Category 3: Well to tank owned vehicles	25	-	-	-
	Category 3: Total	4,799			
	Category 4: Upstream transportation and distribution (courier)	6	-	-	-
	Category 6: Business travel - direct emissions from combustion of road vehicle fuel - private vehicles	63	63	0	0
	Category 6: Business travel - indirect emissions from business travel (public transport)	280	279	0	1
	Category 6: Business travel - hire car	79	78	0	1
	Category 6: Business travel- hotel nights	75	-	-	-
	Category 6: Total	497	-	-	-
	Category 7: Employee commuting	3,563	-	-	-
	Category 7: Homeworking	1,491	-	-	-
	Category 7: Total	5,054	-	-	-
	Total scope 3 emissions (categories 1, 3, 4, 6, 7)	10,754	-	-	-
Total scope 1, 2 and 3 emissions (categories 1, 3, 4, 6, 7) – location based		**25,236**			
Scope 3	Category 11: Emissions from use of sold products or services (i.e. airspace/ATM related tCO_2 emissions)	-	13,920,072	-	-
Outside of scopes	Lifecycle carbon of biogas	2,203	-	-	-
	Avoided / modelled enabled ATM related tCO_2 emission reduction (scope 4)	-	-22,646	-	-
	UK territorial aviation tCO_2 emissions (equivalent to domestic plus international bunker fuel use within NATS' airspace) Not included in verification	-	4,119,000	-	-

Table 2 – GHG statement quantified separately for each type per unit in 2021-22

Emission source		T CO_2e
Intensity metric	Total scope 1+2 (location based) emissions (tCO_2e) per £m revenue	19.34
Intensity metric	Total scope 1+2 (market based) emissions (tCO_2e) per £m revenue	0.96
Intensity metric	Total scope 1+2 (location based) emissions (tCO_2e) per FTE employee	3.53
Intensity metric	Total scope 1+2 (market based) emissions (tCO_2e) per FTE employee	0.18
Intensity metric	Total scope 1+2 (location based) emissions (tCO_2e) per flight handled	0.0107
Intensity metric	Total scope 1+2 (market based) emissions (tCO_2e) per flight handled	0.0005
Intensity metric	Scope 3 category 11 per flight handled (tCO_2)	10.27
Intensity metric	Scope 4 / avoided emissions per flight handled (tCO_2)	-0.017

Table 3 – GHG intensity metrics in 2021-22

Consumption		
Energy	Electricity and gas only (not included energy generated from fuel) MWh	66,520
Water	Supply and treatment m^3	27,508

Table 4 – Consumption data in 2021-22

Target		Targeted annual reduction	%
Net Zero 2035	Per cent reduction of CO_2e against 2018-19 baseline towards net zero 2035 target (scope 1 and 2 emissions)	17.6	-29.9
Net Zero 2035	Per cent reduction of CO_2e against 2018-19 baseline towards net zero 2035 target (scope 3 categories 1, 3, 4, 6, 7)	17.6	-45.3
Net Zero 2035	Per cent reduction of CO_2e against 2018-19 baseline towards net zero 2035 target (Scopes 1, 2 and 3 categories 1, 3, 4, 6, 7)	17.6	-37.4
Net Zero 2035	Per cent of electricity generated from renewable sources	17.6	95.8

Table 5 – Performance against Net Zero in 2021-22

3.1. Emission factors

For scope 1, scope 2 and selected scope 3 GHG emissions, we follow the most common approach to calculating GHG emissions from emission sources, which is to take activity data (e.g. units of electricity consumed, distance travelled, litres of oil etc.) and multiply it by an emission factor which gives an estimate of the GHG emissions figure.

tCO_2e = Activity data x emission factor

We use the UK Government GHG conversion factors in order to convert activity data into tCO_2e. These are updated annually by the Department for Business, Energy & Industrial Strategy and are available online here. The Global Warming Potential used in the calculation of CO_2e are, in the majority, based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) over a 100-year period. The only exception to this is the Global Warming Potential for hotels, which is based on the Fifth assessment. For the current reporting year (1st April 2021–31st March 2022) the 2021 emission factors have been applied.

Note - In a small number of cases, data gathered to calculate the conversion factors is based on the IPCC Fifth Assessment Report (AR5) GWPs and cannot be disaggregated into constituent gases to be converted to AR4 GWPs. This includes the "hotel stay" factors used for the first time in the 2021-22 disclosure. As non-CO2 greenhouse gases are a small contributor to all these emissions, the difference between the AR4 and AR5 based calculations will be negligible.

The table below indicates the methodology for the calculation of environmental performance metrics subject to external verification. For each metric we have provided an overview.

3.2. Methodology for calculating Scope 1 emissions

Source	Data measurement and recording	GHG emissions quantification	Estimates and assumptions
Natural gas (incomplete – subject to using Sigma system or not)	Natural gas is procured by NATS centrally for all sites within operational control. Gas combustion is measured through the gas meters included within NATS' operational boundary. NATS receives invoices from the suppliers based on actual meter reads or estimate reads. The invoice data is collected by TEAM (Energy Reporting Company) Ltd on behalf of NATS using their proprietary billing validation system (TEAM Sigma) which links together the bills and meters for a particular billing point (MPAN / MPRN / MSN).	NATS purchases green gas certificates which cover the annual consumption of gas use. These green gas certificates provide evidence that NATS has procured gas from a renewable source, such as biomethane from waste processing. For this reason, in addition to reporting gas consumption using the natural gas conversion factor, we have included a market-based emissions statement which applies a biogas conversion factor to our gas consumption. NATS uses the UK Government GHG conversion factors for company reporting (2021) in order to convert activity data in kWh into tCO_2e (primarily natural gas gross CV factor). Market based and out of scopes calculations use the Biogas emissions factors. Emissions from on-site natural gas combustion where NATS has operational control are classified as scope 1 emissions.	Gas supplied at the Corporate & Technical Centre is also used by the Joint Venture AQUILA ATMS, who are co-located at this site. Similarly, NATS have a number of site sharers (e.g. MOD) at sites where NATS has operational control. In each case we do not sub meter the consumption attributed to these entities. Therefore, while Joint Ventures and site sharers are out of scope of NATS emissions reporting, the proportion of emissions associated with their operations has not been removed from NATS Holdings Ltd scope 1 GHG emissions. **Estimates** NATS seeks to use primary consumption data to calculate emissions wherever possible, however, in some cases data may not be available or of sufficient quality (e.g. due to lack of measurement capability, equipment replacements, equipment failures or billing issues) in which case secondary data, such as proxy data and extrapolation, will be used. Estimation techniques are prioritised based on primary data and proxy data. Where there is a full month gap in primary evidence, the previous 3 months full actual data will be applied. Where there is a partial month gap in primary evidence, an average of the previous 3 months actual data is used to replace that partial month data in its entirety. Where the previous 3 months includes unrepresentative data, e.g. due to missing data, a rebate, or some other identifiable material change above/below expected consumption, the months containing that unrepresentative consumption are excluded from the average used to fill the substantive partial month gap. For new acquisitions, accruals are estimated based on a comparable site, where supplier estimates from previous tenants are unavailable. Renewable Gas Generation Obligation (RGGOs) availability for consumption RGGOs were available for 6.6 Giga Watts at point of verification (May 2022). RGGOs were not available by the close of the verification for the remaining consumption from the old gas supplier, Corona. This is being chased by NATS. However, the signed and executed contract with Corona was seen during the verification as evidence that all gas procured will be backed by RGGOs.
On-site fuel combustion (complete)	Fuel usage data such as gas oil, diesel or HVO used in machinery or in buildings is captured through the purchase order and payment system, SAP.	NATS uses the UK Government GHG conversion factors for company reporting (2021) in order to convert activity volume data into tCO_2e. Different factors were used on the different types of fuel used; HVO, burning oil and fuel oil (White Diesel)	The data is reported based upon the quantities and types of fuel purchased during the reporting period and it is assumed that all fuel that is purchased is combusted. This is a change from previous years where fuel delivery date has been used. Fuel purchase date was chosen as this was deemed more accurate as deliveries were confused during the reporting period as a result of the change of red diesel to HVO and standard diesel.

	Many of the remote sites that are fitted with back-up generators consume low levels of fuel and often have no reports of fuel consumption in any particular reporting period. Purchasing data for fuel is captured from invoices contained within NATS SAP system.	Emissions from fuel combustion on sites where NATS has operational control are classified as Scope 1 emissions.	It is assumed that electricity generated from oil usage is only used by NATS and not exported to the grid. It is possible that welding does occur on NATS sites. Currently the emissions from this activity are not captured. It is considered that the emissions from this activity is *de minims*. Exclusion: Two small biomass boilers have been excluded from this calculation.
Fugitive emissions (complete)	Fugitive emissions data is collected for all sites where we have operational control. We use two contractors to maintain the asset register information of the equipment containing refrigerant gases across our sites. This includes information about the equipment type, the charge capacity, and the refrigerant type. Details of refrigerant 'top-ups' and 'losses' during the reporting period are captured on F-gas registers. These registers are consolidated at the end of year to create an annual refrigerant loss inventory.	NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) in order to convert activity data (kg) into the component greenhouse gasses. Specific emission factors are used for specific refrigerant gases.	
Road vehicle fuel combustion	Liquid fuel combustion including diesel, petrol, PHEV and EV) within owned and allocated company cars (lease fully paid and controlled by NATS) are measured and recorded using the company expenses system as well as a report generated from the company fuel card system. In addition, for the reporting period 2021-2022 fuel for vehicles operating within Heathrow airport operations bought fuel direct from the Heathrow Airport Limited. The invoices were used to calculate total fuel purchased.	NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) in order to convert activity data (KM) into GHG emissions. Where the car size and fuel type are known, a specific emission factor relating to these will be used. Emissions from road vehicle fuel combustion in both owned and leased vehicles are classified as scope 1 emissions where mileage is conducted for business use.	Where the car type and fuel type are unknown, an average car unknown fuel emission factor is used.

3.3. Methodology for calculating scope 2 emissions

Source	Data measurement and recording	GHG emissions quantification	Estimates and assumptions
Electricity consumption- Location based method (incomplete)	Electricity consumption is measured through the electricity meters included within NATS' operational boundary. NATS receives invoices from the suppliers based on actual meter reads or estimate reads. The invoice data is collected by TEAM (Energy Auditing Agency) Ltd on behalf of NATS using their proprietary billing validation system (TEAM Sigma). The kilowatt hours of electricity used on site, as recorded on the invoices, are captured on the TEAM Sigma system. Manual meter readings are taken for some manned sites and are submitted to NATS' FM Systems team via email. Manual meter reads are not used for greenhouse gas reporting but are used to query anomalous billing and to support the emissions verification process.	NATS purchases renewable electricity which covers the annual consumption of the majority of NATS electricity use. Energy attributes certificates provide evidence that NATS has procured electricity from a renewable source, such as wind. For this reason, in addition to reporting electricity consumption using the location based conversion factor, we have included a market-based emissions statement which applies no factor (0) to our electricity consumption. NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) in order to convert KWH activity data into tCO_2e under the location-based method.	Electricity supplied at NATS' head office is also used by the Joint Venture AQUILA ATMS, as it is co-located at this site. However, it is not sub-metered. Therefore, while Joint Ventures are out of scope, the proportion associated with AQUILA ATMS usage has not been removed from NATS Holdings Ltd scope 2 GHG emissions. Electricity generated at four sets of on-site Photo Voltaic panels (located at Swanwick), is used to supplement NATS' energy usage and not exported to the grid. Estimates NATS seeks to use primary data to calculate emissions wherever possible, however, in some cases data may not be available or of sufficient quality (e.g. due to lack of measurement capability, equipment replacements, equipment failures or billing issues) in which case secondary data, such as proxy data and extrapolation, will be used. Estimation techniques are prioritised based on primary data and proxy data. Where there is a full month gap in primary evidence an average of the previous full 3 months actual data is used to replace that partial month data in its entirety. This is a change from previous years reporting where previous years data was applied. It was considered to be more accurate to use previous full months data for the reporting year due to unusual consumption resulting from Covid-19. Where the previous 3 months includes unrepresentative data, e.g. due to missing data, a rebate, or some other identifiable material change above/below expected consumption, the months containing that unrepresentative consumption are excluded from the average used to fill the substantive partial month gap. For new acquisitions, accruals are estimated based on a comparable site, where supplier estimates from previous tenants are unavailable. This was not required during 2020-2021. During this year's verification, electricity consumption data for a leased office was reviewed as there were gaps in the consumption data. On review, the source of this consumption data was unclear. Previous verifications has accepted this data as it was outside the required sampled for a reasonable

			level of assurance and only represented 0.04% of our scope 2 emissions. For this year, we have based our consumption data on previous years data to ensure that we are being consistent. We have now vacated this site and are handing back the lease in June 2022.
Electricity consumption- Market based method	Same as for location based. Certified renewable electricity is procured by NATS centrally for 136 of our 178 electrical supplies.	An emissions factor of zero has been applied to the sites within NATS property portfolio which are supplied by 100% renewable electricity tariffs. During this reporting year renewable electricity supplier 95.6 % of the total supply Where the supplier emission factor is known for the non-renewable suppliers this has been applied. Where the supplier emission factor is not available or known the AIB (Association of Issuing Bodies) 2019 residual mix factor for UK electricity has been applied. This is in accordance with the market-based hierarchy detailed in the GHG Reporting Protocol.	

3.4. Methodology for calculating scope 3 emissions

Source	Data measurement and recording	GHG emissions quantification	Estimates and assumptions
Category 1: Purchased goods and services- Indirect emissions from the supply and treatment of water	Water data is collected through water meters included within NATS' operational boundary. NATS receives invoices from the suppliers based on actual meter reads or estimate reads. The invoice data is collected by TEAM (Energy Auditing Agency) Ltd on behalf of NATS using their proprietary billing validation system (TEAM Sigma). The volume of water used on site, as recorded on the invoices, are captured on the TEAM Sigma system.	NATS records water consumption in cubic metres (m^3) as recorded on invoices from third party providers. NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) in order to convert m^3 into emissions associated with both the supply and treatment of water.	Limited sites are billed on rateable value (RV) rather than metered consumption and are not included in Scope but are considered de minimis.

	Limited sites are billed on rateable value (RV) rather than metered consumption and are not included in Scope but are considered de minimis.		
Category 1: Purchased goods and services - use of electricity at data centre	NATS uses third party data centres to host some computer systems. The electricity use resulting from NATS equipment within third party data centres is obtained from billing, based on actual use multiplied by the reported Power Usage Effectiveness.	The total electricity consumed from NATS equipment at third part data centres is provided in kWh and converted to GHG emissions using the 'managed assets' UK Government GHG conversion factors (which is the same as the UK grid average emissions factor). No T&D impacts are captured as these relate to our third party providers.	
Category 3: Fuel- and energy-related activities - T&D losses	See Scope 2 for the collection of electricity data	The electricity data is converted into T&D losses using the UK Government GHG conversion factors for the relevant reporting period (2021) kWh*conversion factor for T&D losses for UK electricity.	
Category 3: Fuel- and energy-related activities - well to tank (electricity)	See Scope 2 for the collection of electricity data	The electricity data is converted into Well-to-tank using the UK Government GHG conversion factors for the relevant reporting period (2021) kWh*conversion factor for well to tank. kWh*conversion factor for well to tank electricity losses for UK electricity.	
Category 3: Fuel- and energy-related activities - well to tank (natural gas)	See Scope 1 for the collection of Natural Gas	Natural gas activity data multiplied by the conversion factor for well to tank-natural gas using the UK Government GHG conversion factors for the relevant reporting period (2021).	
Category 3: Fuel- and energy-related activities - well to tank (fuel)	See Scope 1 for the collection of fuel activity data	Fuel data (allocated and pool cars, and fuel-combusted on site) is multiplied by the conversion factor for Well to tank for the relevant fuel using the UK Government GHG conversion factors for the relevant reporting period (2021) e.g. WTT fuel oil, petrol, diesel, bio-diesel etc.	
Category 4: Upstream transportation and distribution -courier	Courier emissions data refers to the emissions generated resulting from courier deliveries for NATS business purposes.		Estimates No courier data was made available for 2021-2022 reporting period. For this reason, the verified emissions for 2017-18 and 2018-2019 were used to generate an average

			total. This average total was applied to the 2020-2021 reporting year. This emission source is very low (less than 7 tonnes of CO_2e).
Category 6: Business travel - emissions from combustion of road vehicle fuel - private vehicles	This refers to transportation to support business needs in vehicles owned by employees, third parties, but not NATS. Mileage data is extracted from the NATS expenses system. This includes; • people using their own vehicles • vehicles on the company low emission car scheme, • benefit cars, • and employees receiving cash for benefit in kind.	Extracted milage data is multiplied by the relevant GHG factor. NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) in order to convert milage data (km) into GHG emissions. Fuel type is always known, and the relevant emissions factor applied. The size of vehicle is unknown and therefore an average car size emissions factor is applied.	Data is grouped by fuel type and size and the relevant emissions factors applied
Category 6: Business travel - emissions from air travel	Flight data is obtained from our third part travel agent and booker. In addition, a small number of flights are booked directly with an airline and the cost is claimed back through the company expense system.	Flight emissions are calculated based on departure date, which is an improvement from previous years calculations which used invoice date. NATS uses the UK Government GHG conversion factors for the relevant reporting period (2021) to convert km travelled into emissions. Flights are organised into four categories according to distance to match with the BEIS methodology for calculating flight emissions: Domestic, to/from UK 755km or less Short-haul, to/from UK 756-3km-700km Long-haul, to/from UK 3,700km International, to/from non-UK Flights are also categorised according to class of travel: The GHG emissions for each flight are calculated with RF (Radiative Forcing) The equation is: Flights: Domestic/short/long haul X Class X passenger.km X with RF emissions factor (kg CO_2e)	**Estimation** An estimation has been made for the small number of domestic flights not booked through NATS travel agent and claimed via NATS expenses system. The average CO_2e kg of domestic flights (128kg CO_2e) was applied as all such instances because they were all domestic flights. CH_4, N_20 and CO_2 constituent calculations were scaled using a back calculation based of the proportions in the emissions factors. Total estimated GHG equated to 15 tonnes of CO_2e for this source of emissions.

		Flights: Domestic/short/long haul X Class X passenger.km X without RF emissions factor (kg CO2e)	
Category 6: Business travel - emissions from train and ferry travel	Train and ferry travel information is supplied by NATS travel booker and agent.	Train and ferry travel are calculated based on the time frame when tickets are booked not from the date of travel. Each journey is split up into different legs where more than one type of rail transport is used, i.e. national, international, light rail & tram and London Underground journeys. The total km travelled on each type of rail transport is calculated and the relevant UK Government GHG conversion factors 2020 is applied.	**Estimation** An estimation has been made for a small number of rail and ferry journeys not booked through NATS travel agent and claimed via NATS expenses system. Total KM travelled for train journey was estimated using cost. A cost of 55p per mile was taken from https://www.vouchercloud.com/ a 2019 source and spot checked against real data. Other sources on the internet suggest over £1 per mile and spot checks of commuting trains into London found cost/mile of c. £1.40. We chose 55p/mile for conservatism as it generates higher km figures and therefore emissions assessments as conservatively high. Distance estimates for ferries between ports have been derived from shiptraffic.net or rome2rio, or inferred by similar cost where no origin/destination was present.
Category 6: Business travel - car hire	Total number of hires and number of days hired report is provided by NATS car hire booking agent.	Distance travelled in hire cars (miles) is multiplied by the UK Government GHG conversion (business travel land) emissions factors 2021. Unknown vehicle and unknown fuel emission factor were applied.	**Estimates** During the 2021-2022 reporting period, miles travelled during hire was recorded by the hire car suppliers in the majority of cases. Where gaps where present (c18%), an average distance of the completed data was applied.
Category 6: Business travel - taxi	This refers to the emissions generated from taxi use. Total spend on taxi was obtained from the expenses system SAP Concur.	Estimated km's from taxi use are multiplied by the UK Government GHG conversion emissions factors 2021.	**Estimates** During the 2021-2022 reporting period, km's travelled by taxi was not recorded and the only data to inform the emissions estimation is cost. It has been assumed that all taxi journeys are UK based. Data from an external source (nimblefins.co.uk) suggests that the average cost of a taxi in the UK starts from around £3-£4. Taxis are likely to cost between £1.20 to £3 per mile (depending on location, day of the week, time of day, etc.). For the purposes of calculation the taxi costs have removed a £3 flat rate, back calculated km travelled and applied regular taxi emissions factors. Estimated taxi journeys equated to 3.6 tonne CO2e.
Category 6: Business Travel - Hotels	Reported for the first time in this reporting year. Hotel nights were obtained from the NATS travel booking system Concur.	The number of hotel nights is multiplied by the UK Government GHG conversion emissions factor for the relevant country of stay.	If an international factor was not available an average was applied. For example there was no factor for Gibraltar, Isle of Man and Denmark hotel nights so an average for all countries was applied.
Category 6: Business Travel - Tube and Bus	Excluded – deminimous.	Excluded – deminimous.	Excluded – deminimous.

Category 7: Employee homeworking	Given the change in working practices resulting from Covid-19, which has led to a significant proportion of NATS non-operational workforce working from home, the associated emissions from home working have been calculated. The calculation has been developed based on the Ecoact whitepaper methodology.	Number of homeworkers was estimated using HR and occupancy data. Average home electricity and gas data was calculated using the information supplied within the Ecoact whitepaper. The total emissions were then calculated by multiplying the estimated electricity and gas use per homeworking employee by the relevant UK Government GHG conversion factors for 2021.	
Category 7: Employee commuting.	NATS conducted a travel survey in 2020 to determine the average emissions per week for each employee.	NATS has used the average emissions per daily commute per employee factor (8.741 KG/CO_2e per commute) and multiplied this by the number of staff travelling into work during the 2020-2021 reporting period. To understand the number of people commuting to the business two sources of data have been obtained. 1. For our main air traffic control centres and head office, the security access system numbers have been applied. 2. For all other sites, timesheet data has been applied to determine those working on site for a given month.	**Estimate** Due to the low number of people commuting into the office during the pandemic, it was decided that using the average weekly emissions factor per employee from the 2020 staff travel survey which used the BEIS 2019 (more conservative approach) would provide a more accurate emissions inventory. It was concluded that conducting a travel survey during the reporting year would yield a low response rate and therefore an inaccurate picture. This is a divergence from the GHG Protocol Scope 3 Guidance which suggests conducting an annual staff travel survey.

3.5. GHG inventory quality management & calibration requirements

NATS has no calibration duties.

Emission source	Quality management process	Uncertainties and calibration requirements
Electricity, gas, and water data	TEAM (Energy Auditing Agency) Ltd performs an on-going validation process on electricity, gas and water data which is designed to highlight:	**Gas** Swanwick (one of our major sites) until 2021 was included in the EU Emissions Trading Scheme. Following a literacy search we feel it appropriate that the principles (detailed below) are followed with respect to statements of our overall uncertainty.

	• Meters without data when data is expected • Meters where invoiced and AMR data do not align • Meters where consumption variance outside of tolerance • Meters where Year on Year variance is outside of tolerance The validation results in queries being generated directly with suppliers. Where necessary queries will be address to the NATS FM Systems team to validate discrepancies identified. This is an on-going process which results in a monthly query report.	There is a principle described on page 57 of the document "European Union Emissions Trading System (EU ETS) Phase III: Guidance for installations" to assume all gas metering has an accuracy class of 1.5 and therefore to adopt 6% as its Maximum Permissible Error in Service (MPES) for gas consumption. **Electricity** For the consumption of electricity in the UK, "The Meters (Certification) Regulations 1998" [21] state that: The permitted margins of error shall be an error not exceeding + 2.5 %. or -3.5% at any load at which the meter is designed to operate
On-site fuel combustion	The NATS Finance team check the fuel invoicing as part of the standard financial internal audit process. In addition, the fuel combustion data is checked via both internal and external audit at the Swanwick site (the largest consumer of fuel).	Following a literature search we feel that the UK ETS guidance is an appropriate source of uncertainty. That is, commercially delivered liquid fuels have a 0.5% uncertainty.
Fugitive emissions	NATS completes regular compliance audits across the estate as part of the management of ISO14001:2015, this includes an assessment of the compliance with fluorinated gas regulations.	Applying the GHG Protocol uncertainty guidance an uncertainty of 3.8% has been calculated for this emission source. See appendix 6.2 for further information.
Airspace/ATM related CO_2 emissions	NATS has two primary internal standards for quality management, in addition to governance systems. The first standard focuses on ATM fuel / CO_2 emissions benefits from small scale airspace changes and inventory management. The second standard focuses on all remaining ATM fuel/CO_2 emission benefit claims, other than large scale airspace change benefits, and includes the process for internal auditing of data and controls.	For airspace/ATM related CO_2 emissions savings, the majority of assessments are modelled. As industry standards and best practice is followed when undertaking this assessment, uncertainty is minimised. Other assessments are based on full year actual data with the exception of FUA analysis. In the latter case the analysis is deliberately conservative to avoid overestimation of fuel savings. None of the potential sources are thought to be material. Scope 4 emissions figures are positive to indicate a saving, i.e. CO_2 emissions have been avoided, or negative to indicate a dis-benefit, where performance has dropped compared to the year previous.

4. Airspace / ATM related CO_2 emissions

4.1. Acknowledgements

Airspace / ATM related CO_2 emissions data is prepared using the Base of Aircraft Data (BADA) models and data. This product has been made available by the European Organisation for the Safety of Air Navigation (EUROCONTROL). All rights reserved.

4.2. Emission factors

For airspace / ATM related emissions, we take fuel activity data and multiply it by an emission factor which gives an estimate of the CO_2 emissions figure. We do not calculate CO_2e emissions given the complexity of estimating non-CO_2 emissions at altitude.

tCO_2 = Activity Data x Emission Factor

We use a fuel: CO_2 ratio of 1:3.18 as specified by our regulator[1] in order to convert activity data into tonnes CO_2. This conversion factor is consistent over time.

4.3. Baseline

Estimates of the CO_2 emissions that resulted from the operation of aircraft handled in 2006 is the original baseline and consists of emissions from aircraft engines in the following locations:

- UK airports where we provide a tower service, i.e. aircraft taxiing
- UK domestic airspace i.e. London and Scottish Flight Information Regions (FIRs)
- North-Atlantic operations (Shanwick FIR)

A number of changes to data sources, data platforms, models and tools have taken place since 2006, and while we track performance since the baseline, the comparability of individual KPIs may differ over time since 2006.

The original taxiing baseline from 2006 was based on a sample of flights from a sample of airports and scaled up. This approach was updated between 2010 and 2011 with an approach which modelled CO_2 for flights using actual data from airports with the appropriate systems in place, described in section 5.5.1.

The original domestic FIR baseline from 2006 was based on a sampling of flight trajectories which were then modelled using the NATS fuel model Kermit and scaled up. This was updated between 2010 and 2011 with an approach which modelled CO_2 for flights using actual data from a range of airports with the relevant systems in place described in section 5.5.1.

[1] CAA CAP1616 Airspace Design: Environmental requirements technical annex

The original Shanwick FIR baseline from 2006 was based on a sample period and scaled up. This was updated in 2018-19 with an approach which modelled CO_2 for each flight individually based on the OATS model and described in section 5.5.3.

4.4. Principles of scope 3 category 11 and modelled enabled emission reductions

4.4.1. Airspace / ATM related CO_2 emissions and the GHG protocol

Our scope 3 emissions are overwhelmingly influenced by airlines' scope 1 emissions. We refer to Air Traffic Management (ATM) related emissions, i.e. the emissions from fuel burnt in aircraft engines in airspace we manage or at airports where we provide a tower service. Under the GHG Protocol, we opt to include these emissions in scope 3 category 11, which refers to use of sold goods or services. We have calculated an estimated uncertainty for this emission category as 2.5%.

We have opted to refer to the outcome of our efforts (and working with the aviation industry) to reduce these scope 3 category 11 emissions, as scope 4 emissions or avoided emissions.

We were the first air traffic control company to adopt a commitment to reduce ATM related CO_2 emissions by 10% per flight on average, in 2008. This has been replaced by a UK industry commitment to achieve net zero emissions by 2050. We wish to track our progress in avoiding emissions which would have otherwise occurred, were it not for the work we have done. These avoided emissions are what we track and report as modelled enabled emission reductions, or scope 4.

There are a growing number of companies reporting indirect avoided emissions. While we wait for agreed guidance and standards to catch up with this innovation, we seek to be transparent and consistent in our approach to GHG inventory management and reporting of scope 4 emissions.

Aircraft fuel burn/CO_2 emissions avoided as a result of our actions are modelled for the domestic UK FIRs, airports where we provide a tower service and Shanwick airspace. Using various data sources, tools and assumptions avoided ATM related CO_2 emissions are calculated for a given year (as set out below).

4.4.2. Types of savings

Our approach to analysis of ATM related CO_2 emissions is to categorise savings as follows:

- Savings enabled by airspace change i.e. savings based on a procedure versus procedure comparison which an airline can flight plan;
- Savings enabled by network management and air traffic controller tools i.e. based on a change to network management and/or controller toolsets which reduce fuel burn, but which don't affect flight plan routes;
- Savings realised from controller intervention i.e. based on a non-flight plannable change and/or intervention by controller to reduce fuel burn;
- Realised savings from trials for any project, tool, or intervention type.

The modelled savings delivered during the financial year are aggregated on the basis of the project having been implemented in the given year, i.e. the changes we have implemented have enabled savings which are available to airlines to flight plan accordingly. We have no direct control over how the airlines flight plan across our network, but we can estimate how much traffic is likely to take advantage of the change we have enabled. As a result, and with the agreement of our stakeholders who are interested the pace of implemented change, benefits from airspace projects (i.e. safety, cost, fuel/CO_2, capacity, etc.) are accrued in full in the year of implementation, typically aligned with the AIRAC cycle[2], rather than split pro-rata based on the implementation date in the reporting year.

4.4.3. Data modelling

All ATM related fuel/CO_2 emission data is modelled based on the best available data, tools, and estimation techniques, in the absence of access to airline flight management system data.

Model output is calculated in tonnes of fuel and may be abbreviated in reports to the kilo tonne, which is aggregated and then converted to CO_2. As a result, some rounding may occur, but is *de minimis*.

Estimated uncertainty: 2.7%

4.4.4. Primary data sources

We use a number of data sources to undertake these assessments. The primary sources are:

- Central Flow Management Unit (CFMU) flight plan data, sourced from Eurocontrol and stored in NATS' data warehouse;
- Radar data of actual flight tracks, also stored in the data warehouse;
- Airspace data, covering routes and navigation points, sourced from the CFMU and stored in our data warehouse.

4.4.5. Fuel uplift

Fuel uplift is fuel which is burned merely to carry other fuel. For example, an airspace change may save 50 kg of fuel per flight, but extra fuel would have been uploaded and burned merely transporting that 50 kg until it was burned. We have analysed the relationship between distance flown and the percentage of fuel uplift using flight planning software and found it to be linear. We use this linear relationship to calculate the percentage of fuel uplift which should be applied to fuel savings based on the distance flown from the origin airport to the end of the procedural change that is being quantified.

4.4.6. Toolset

A number of industry standard and bespoke tools are used to model ATM fuel/CO_2:

- Aviation CO_2 emissions data is prepared using the Eurocontrol Base of Aircraft Data (BADA) models and data. This product has been made available by the European Organisation for the Safety of Air Navigation (EUROCONTROL). All rights reserved;

[2] Aeronautical Information Regulation And Control (more information available here)

- We have implemented the BADA aircraft performance and fuel models in an in-house toolset called NEMO (NATS Environmental Model). NEMO is used to calculate fuel burn for all aircraft trajectories held within the NATS data warehouse;
- To make comparisons between a current procedural profile and a proposed procedural profile (for example for Airspace Efficiency Database), we have also created a Profile Generating Tool that uses the BADA aircraft performance data to generate 4D flight profiles. We also make use of the fast-time simulation software AirTOp to generate 4D flight profiles to compare procedural profiles where multiple trajectories need to be modelled simultaneously. NEMO is used to calculate the fuel burn for these simulated procedural profiles;
- NEMO calculates the fuel using: altitude; speed; aircraft type; phase of flight (i.e. cruise, climb or descent); and aircraft mass. NEMO uses these inputs combined with the BADA performance models to calculate the mean fuel flow for each radar point;
- Simulated trajectories, from the Profile Generating Tool, are defined by a series of 'flight legs' — sections of the flight profile for which the height, speed and phase of flight of the aircraft is constant. NEMO uses the same inputs (altitude, speed, aircraft type, phase of flight, aircraft mass) and BADA performance models and calculates the fuel flow for each flight leg;
- The Oceanic Air Traffic Simulator (OATS) is a bespoke fast-time simulation model which estimates the environmental performance of flights crossing the North Atlantic under various operational concepts. The tool simulates daily demand and optimises the routes for total fuel burn, using meteorological data to adjust aircraft speed, flight time and calculates the changes to fuel burn as a result of airspace network changes;
- The Flexible Use of Airspace (FUA) profile generating tool was developed to improve the accuracy of Special Use Areas usage and maximise network efficiency for airlines. The tool analyses the relevant airspace sectors and calculates the benefits.

4.5. Scope 3 category 11

We estimate total aircraft fuel burn / CO_2 emissions in airspace NATS manages and some airports where we provide a tower service and data is available, in each reporting period. These CO_2 emissions are airline scope 1 emissions arising in part from the service we provide. The total comprises of CO_2 emissions from aircraft in domestic airspace (Scottish and London FIRs), oceanic airspace (Shanwick FIR) and at some airports where we provide a tower service. Military flights and rotary wing aircraft are excluded from the total.

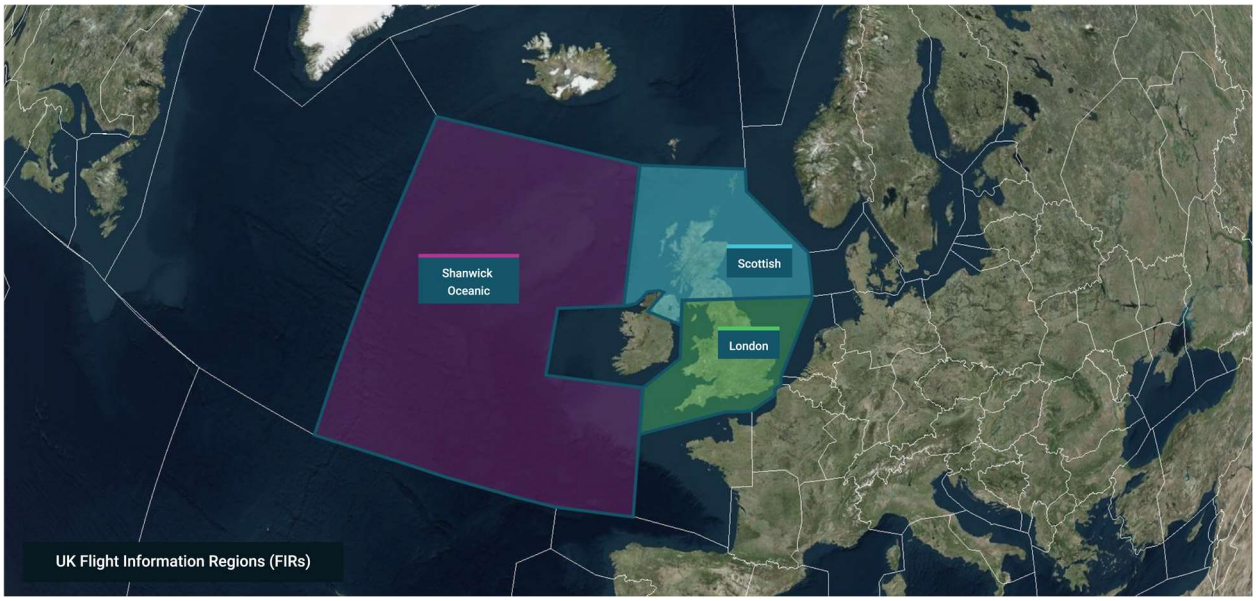

Figure 1 - Flight Information Regions managed by NATS

Data and models used:

- Data source: All flights in NATS data warehouse, EFPS and NASCAR
- Tools: NEMO and OATS
- Models: BADA 4.2 aircraft performance and fuel models as contained in NEMO

4.5.1. Airport taxi

Aircraft fuel burn/CO_2 emissions are modelled for five airports equipped with Electronic Flight Progress Strips (EFPS). Other airports where we provide a tower service are excluded at this time. Airports included are:

- Aberdeen (excluding rotary wing aircraft which are not included in BADA)
- Heathrow
- Luton
- Stansted

Using the EPFS data from a NATS data platform and tools reviewed elsewhere in chapter 5, the CO_2 emissions are modelled for actual flight taxi-times and aircraft type fuel flows for traffic within the reporting year.

Note: Glasgow International data was unavailable to be used for reporting for FY2021-22 having historically been available. Once resolved, the Glasgow data will be included within the reports and figures re-stated.

4.5.2. Domestic airspace

The trajectory for each flight (based on its radar track) recorded in domestic airspace, i.e. London and Scottish FIRs, is extracted from the data platform and run through the BADA model to estimate its fuel/CO_2 emissions. This is repeated for all flights in the reporting period (excluding aircraft that is not available in the BADA model, e.g. helicopters or military aircraft). These fuel estimates are stored in a separate table within the data warehouse for each flight.

The UK FIR total fuel burn and CO_2 has been extracted from the BI and Cloud data warehouses for the period 1st April 2021 - 31st March 2022.

This data is separately filtered to estimate the UK's territorial / domestic aviation CO_2 emissions for net zero reporting[3]. The query is filtered to show only domestic flights within the UK FIR, i.e. excluding flights to/from UK Crown dependencies and Overseas territories.

4.5.3. Oceanic airspace

Aircraft fuel burn/ CO_2 emissions are modelled for the Shanwick FIR, i.e. the north east part of the Atlantic which NATS is responsible for. The oceanic NATS Analytics Safety Clearance And Route (NASCAR) data contains flight times, flight levels and locations as determined by aircraft Automatic Dependent Surveillance - Contract (ADS-C) messages. These inputs are combined with the BADA fuel model to calculate the fuel burn for each flight segment from entry to exit point within Shanwick and aggregated for all flights (except those outlined in Section 5.5.2 based on BADA model data availability) in the reporting period.

4.6. Scope 4 / avoided emissions

4.6.1. Types of operational changes and assessment methodologies

On an on-going basis we operate a number of different project types which contribute to the enabled savings through planned and tactical changes. These initiatives are from small-scale projects, large airspace change projects, new tools, and tactical improvements, detailed below. For all changes that can affect airline flight planning, the benefit to fuel uplift is also calculated and claimed. The following initiatives outline where the modelled enabled CO_2 emission savings arise from.

4.6.2. Operational Service Enhancement Project (OSEP) / AEDs

Periodically, NERL makes small airspace changes relating to routings or level restrictions, usually developed by controllers at our units, which don't require a formal airspace change described in CAP1616. For example, a minor re-definition of a high-level route to remove a dog-leg, or raising a standing agreement level for traffic to improve fuel efficiency. These are referred to as Airspace Efficiency Database (AED) changes or small projects. The OSEP project is also delivering a number of these changes, either individually or as part of bulk implementation of many small changes collectively.

The methodology for calculating the change in fuel burn is to compare the current planned route to the proposed planned route. We enable fuel benefits through AEDs by making changes to the airspace structure, within controlled airspace. As such the enabled savings performance reported is based on changes to planned routes. The metric is not designed to validate CO_2 emission reductions based on actual flight routes taken.

[3] https://www.ons.gov.uk/economy/environmentalaccounts/articles/netzeroandthedifferentofficialmeasuresoftheuksgreenhousegasemissions/2019-07-24

For route changes, the approach is to compare the existing flight procedures/plan to the proposed (or scenario) flight procedures/plan. The NATS data warehouse is used to identify the total number of aircraft per year that would be affected by the change. A summary of the methodology is:

- Extract traffic that would be affected by the route/level change for the most recent; complete calendar year from the NATS data warehouse;
- Obtain the current flight procedures and create scenario procedures for each aircraft type;
- Calculate the fuel of the current procedures and scenario procedures for each aircraft type;
- Calculate the total enabled benefit by summing the (benefit) × (annual number of aircraft) over all aircraft types;
- Calculate the additional fuel uplift benefit.

Data and models used:

- Data source: Flights in NATS data warehouse;
- Data sample: All flights that used the route in the most recent calendar year;
- Tools: NEMO and NATS Profile Generator;
- Models: BADA aircraft performance and fuel models as contained in NEMO;
- NATS fuel uplift equation.

4.6.3. Cobra advanced combat airspace (CACA)

The UK FIRs contains numerous military zones that civil aircraft can make use of on an ad-hoc basis when the zones are deactivated by the military. The Future Combat Airspace (FCA) programme ran a trial during this FY looking at altering the size and shape of the military zones over the North Sea.

The methodology for calculating the change in fuel burn was to compare the planned route during the trial for impacted flights to the typical planned route (baseline) they would fly with the existing airspace structure. An assessment of the distance saving was then made for impacted flights with comparable flight plans in the baseline which was converted to a fuel saving by multiplying the distance saving by the fuel flow per mile at cruising altitude for each respective flight and aircraft type. The total trial benefit summed these flight fuel saving across all comparable flights in the trial period. As this is a trial impact, the figure is not annualised.

Data and models used:

- Data source: Flight plans in the data warehouse;
- Data sample: All flights on the trial dates impacted by the Danger Area change;
- Tools: No bespoke tools;
- Models: BADA aircraft performance tables.

4.6.4. Taxi-time

Fuel burnt whilst taxiing between stands and the runway at airports (taxi-time) can be reduced by initiatives to reduce ground holding times. Similarly, fuel burn can be reduced by aircraft taxiing on less than all engines. We seek to minimise taxi-times and reduced engine taxi at the airfields we operate a service at an d so includes any changes in this ground fuel use in the annual assessments.

Changes in taxi time performance year-to-year are monitored and captured in annual assessments. A summary of the methodology is set out below.

The data warehouse contains records from the airports' electronic flight strips (EFPS) which record the instructions which controllers give to aircraft. The average arrival taxi-time is calculated as the difference between the touch down and arrival at the stands. The average departure taxi-time is calculated as the time between push-back from the stand and the line-up at the runway.

The yearly fuel burn change at each airport is calculated by multiplying:

- Average ground fuel burn (incorporating any Reduced Engine Taxi (RET) claimed separately);
- The change in taxi time from the previous year;
- The number of movements.

Year on year comparisons can be either positive i.e. fuel saving benefit, or negative i.e. fuel saving dis-benefit and are recorded accordingly.

Data and models used:

- Data source: Flights in the data warehouse;
- Data sample: All flights in the financial year at each of the NATS-controlled airfields with EFPS;
- Tools: No bespoke tools;
- Models: BADA aircraft performance tables.

4.6.5. Continuous climb and descent operations

Arrivals and departures to and from airfields are most fuel efficient if aircraft can perform continuous climb and descent operations (termed CCOs and CDOs). We enable improvements in this performance through engagement at a strategic level with airlines and airports providing data on achievement levels to target improved performance, through Sustainable Aviation[4]. Controllers also enable improved performance in their day-to-day control and through provision of distance-to-run information to pilots.

Changes in continuous CCO and CDO performance, and the resulting impact on fuel burn, are captured in our annual assessment. A summary of the methodology is:

- The radar data within the data warehouse is queried to identify whether climbs and descents out of and into airfields are continuous or whether a level-off occurs;
- Continuous climbs are generally measured up to 10,000 ft and continuous descents are measured from variable altitudes which take into account the configuration of airspace around the airfield;
- An improvement to the methodology was adopted in 2021-22. Level off altitudes identified in the raw radar data are now adjusted to account for airfield pressure setting experienced by the flight at the time of operation. This pressure adjusted altitude is compared against the measurement height range to determine if a flight can be classed as continuously climbing or descending;
- The fuel benefit based on the fuel difference between a typical CCO/CDO versus a non-CCO/CDO with a 5 nautical mile level-off for all aircraft types at the airfield in question;

[4] https://www.sustainableaviation.co.uk/wp-content/uploads/2018/06/A-Guide-to-CDOs-Booklet1.pdf

- Year on year comparisons can be either positive i.e. fuel saving benefit, or negative i.e. fuel saving disbenefit and are recorded accordingly.

Data and models used:

- Data source: Flights in the data warehouse;
- Data sample: All flights in the financial year at each of the NATS-controlled airfields;
- Tools: NEMO and NATS Profile Generator;
- Models: BADA aircraft performance and fuel models as contained in NEMO.

4.6.6. Free Route Airspace (FRA)

Airlines are required to flight plan their desired routeing through controlled airspace using a pre-defined routeing structure and therefore the flight plan list a series of airways and fixes that a flight will fly along and past. With the introduction of FRA, that routeing network has been removed in the upper airspace within the Scottish FIR, enabling airlines to plan direct routeings from entry to the UK to exit in this airspace. This should mean a reduction in track mileage for flights within the airspace and potentially a reduction in aircraft requiring to level off also.

The methodology for calculating the change in fuel burn was to compare the planned route prior to FRA implementation for impacted flights to the expected planned route they would fly under an FRA airspace structure. Those flight plan trajectories are modelled within our fast-time simulation toolset, AirTOp, which generates multiple 4D trajectories for all aircraft input in to the simulation (the sample) for both the pre and post implementation scenarios. These simulated trajectories are then processed through the NEMO toolset to estimate fuel burnt of all trajectories simulated. The fuel burn figures are then compared for the pre and post implementation scenarios and a total difference estimated for the sample analysis. The sample total is then annualised to provide an estimate of the implementation of FRA for a full year.

Data and models used:

- Data source: CFMU Flight Plan data in the data warehouse;
- Data sample: Sample day from 2019;
- Tools: NEMO and AirTOp;
- Models: BADA aircraft performance and fuel models as contained in NEMO.

4.6.7. Swanwick Airspace Improvement Project (SAIP)

Airlines are required to flight plan their desired routeing through controlled airspace using a pre-defined routeing structure and therefore the flight plan list a series of airways and fixes that a flight will fly along and past. With the introduction of SAIP, that routeing network has been changed for aircraft routeing around in the terminal control environment around the Stansted and Luton area. enabling airlines to plan direct routeings from entry to the UK to exit in this airspace. This should mean a reduction in track mileage for flights within the airspace and potentially a reduction in aircraft requiring to level off also.

The methodology for calculating the change in fuel burn was to compare the planned route prior to SAIP implementation for impacted flights to the expected planned route they would fly under an SAIP airspace structure. Those flight plan trajectories are modelled within our fast-time simulation toolset, AirTOp, which generates multiple 4D trajectories for all aircraft input in to the simulation (the sample) for both the pre and post implementation scenarios. The modelling also makes an

assessment of the expected arrival airborne holdings as a result of the airspace structure and traffic demand and builds this in to the 4D trajectory that is simulated.

These simulated trajectories are then processed through the NEMO toolset to estimate fuel burnt of all trajectories simulated. The fuel burn figures are then compared for the pre and post implementation scenarios and a total difference estimated for the sample analysis. The sample total is then annualised to provide an estimate of the implementation of SAIP for a full year.

Data and models used:

- Data source: CFMU Flight Plan data in the data warehouse;
- Data sample: 6 days from 2018;
- Tools: NEMO and AirTOp;
- Models: BADA aircraft performance and fuel models as contained in NEMO.

4.7. Changes to quantification methodologies previously used

ATM GHG data marked * has been restated to reflect improvements in the accuracy of modelling and in the quality and availability of industry data, updates to traffic forecasts, and changes to NATS' airport portfolio. In particular:

- An improvement to the CDO/CCO methodology was adopted in 2021-22. Level off altitudes identified in the raw radar data are now adjusted to account for airfield pressure setting experienced by the flight at the time of operation. This pressure adjusted altitude is compared against the measurement height range to determine if a flight can be classed as continuously climbing or descending;
- Airport ground movement data hosting platform transitioned to an alternative cloud platform on 31st March 2021. This has affected the availability of data available for the reporting, namely:
    - Heathrow ground movement radar data is not available and has been replaced by EFPS data for the report, which mirrors the other airports reported. There is no expected marked change to the accuracy of the Heathrow data as a result
    - Glasgow International EFPS data was unavailable to be used for reporting for FY21/22 having historically been available. Once resolved, the Glasgow data can be included within the reports and figures re-stated.

5. Appendix

5.1. Base year emission statement (1st April 2018 - 31st March 2019)

Emission source		T CO_2e	T CO_2e of CO_2 per unit	T CO_2e of CH_4 per unit	T CO_2e of N_2O per unit
Scope 1 emissions	Direct emissions from combustion of natural gas (location based)	2,347	2,342	0.11	0.00
	Direct emissions from combustion of road vehicle fuel - owned fleet vehicles (owned business travel)	12	12	0	0
	Direct emissions from combustion of road vehicle fuel - leased vehicles - fuel card	210	209	0	1
	Direct emissions from combustion of stationary assets (e.g. oil boilers, Backup generators)	499	458	0.02	0.15
	Fugitive emissions	1,024	-	-	-
	Total scope 1 emissions (location based)	4,094	3,022	0.13	0.16
	Direct emissions from the consumption of gas-green gas / biogas (market based)	n/a	n/a	n/a	n/a
Scope 2 emissions	Emissions from generated electricity usage (location based)	16,561	16,433	1.38	0.34
	Emissions from generated electricity usage (market based)	21,024	21,024	-	-
Total scope 1 and 2 emissions (location based)		**20,655**	**-**	**-**	**-**
Total scope 1 and 2 emissions (market based)		*21,024*	-	-	-
Scope 3 emissions	Category 1: Purchased goods and service-Indirect emissions from the supply and treatment of water	68	-	-	-
	Category 1: Data centre electricity use	Not reported			
	Category 1: Total	68	-	-	-
	Category 3: Fuel-and energy-related activities - T&D losses	1,412	1,399	4	8
	Category 3: Fuel-and energy-related activities - well to tank (electricity generation and T&D)	2,665	-	-	-
	Category 3: Fuel-and energy-related activities - well to tank (natural gas)	326	-	-	-
	Category 3: Fuel-and energy-related activities - well to tank (fuel)	106	-	-	-
	Category 3: Well to tank owned vehicles	57	-	-	-
	Category 3: Total	4,566	4,566	-	-
	Category 4: Upstream transportation and distribution (courier)	7	7	0	0
	Category 6: Business travel - direct emissions from combustion of road vehicle fuel - private vehicles	245	243	0	2
	Category 6: Business travel - indirect emissions from business travel (public transport)	5,168	5,141	1	26
	Category 6: Business travel - hire car	229	227	0	1
	Category 6: Total	5,641	5,611	0.04	0.11
	Category 7: Employee commuting	9,384	-	-	-
	Category 7: Homeworking	Not reported			
	Category 7: Total	9,384	-	-	-
	Total scope 3 emissions (categories 1, 3, 4, 6, 7)	19,666	-	-	-
Total scope 1, 2 and 3 (categories 1, 3, 4, 6, 7) – location based		**40,321**	**-**	**-**	**-**
Scope 3	Category 11: Emissions from use of sold products or services (i.e. airspace/ATM related tCO_2 emissions)	-	25,074,000	-	-
Outside of scopes	Life cycle carbon of biogas	n/a	n/a	n/a	n/a
	Avoided / modelled enabled ATM related tCO_2 emission reduction	-	113,532	-	-
	UK territorial aviation tCO_2 emissions (equivalent to domestic plus international bunker fuel use within NATS' airspace)	Not reported			

Table 5 - Base year (2018-19) GHG emissions statement

5.2. Uncertainty assessment calculations

Emission source	Uncertainties and calibration requirements
Scope 1	
Gas	As Swanwick (one of our major sites) is included in the EU Emissions Trading Scheme, we feel it appropriate that the principles (detailed below) are followed with respect to statements of our overall uncertainty. As a "low emitter" [from the consumption of gas], there is a principle described on page 57 of the document "European Union Emissions Trading System (EU ETS) Phase III: Guidance for installations" to assume all gas metering has an accuracy class of 1.5 and therefore to adopt 6% as its Maximum Permissible Error in Service (MPES) for gas consumption.
On-site fuel combustion	Under EU ETS guidance, gas oil has a 0.5% uncertainty for commercially delivered fuels. We have adopted this uncertainty figure due to Swanwick being in the EU ETS and this site is our largest consumer of on-site fuel.
Fugitive emissions	Applying the GHG Protocol uncertainty guidance an uncertainty of 3.8% has been calculated for this emission source. See below for further information on the calculations
Scope 2	
Electricity	For the consumption of electricity in the UK, "The Meters (Certification) Regulations 1998" [21] state that: The permitted margins of error shall be an error not exceeding + 2.5 %. or -3.5% at any load at which the meter is designed to operate
Scope 3: Other indirect emissions	See table below.

Table 6 - Uncertainties and calibration requirements

Category	Precision	Completeness	Temporal representation	Geographical representativeness	Technological representatives	Basic uncertainty factor	Uncertainty (%)
Scope 1: Natural Gas	1	1	1	1	1	1.05	2.47
Scope 1: On-site fuel combustion Gas oil	1.1	1	1	1	1	1.05	2.51
Scope 1: Fugitive emissions	1..1	1	1	1	1.2	1.05	2.60
Scope 1: Direct emissions from combustion of road vehicle fuel	1	1	1	1	1	2	3.00
Scope 2: Emissions from generated electricity usage	1	1	1	1	1	1.05	2.47
Scope 3: Category 1- Purchased goods and service-Indirect emissions from the supply and treatment of water	1.2	1.2	1.2	1.02	1.2	1.05	2.81
Scope 3: Category 1-Purchased goods and service-Energy use at data centre	1	1	1	1	1.2	1.05	2.57
Scope 3: Category 3- Fuel and energy related activities not included in Scope 1 or 2	1	1	1	1	1	1.05	2.47
Scope 3: Category 6-Business Travel	1.1	1	1.1	1.21	1	2	3.08
Scope 3: Category 7-Commuting	1.5	1.2	1.5	1.1	2	2	3.89
Scope 3: Category 7-Homeworking	1.5	1.2	1.5	1.1	2	2	3.89
Scope 3 Category 11: use of sold products and services	1	1	1.1	1	1	1.05	2.5
Modelled enabled ATM related CO_2 emission reduction	1.2	1.1	1.2	1.02	1.02	1.05	2.7

Table 7 - Uncertainties and calibration requirements

Based on the GHG Protocol guidance note on quantitative inventory uncertainty.

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