Free Route Airspace Deployment 2.1

CAP1616 documentation:
Stage 4 Update & Submit

Step 4A Options Appraisal
(Phase 3 - Final)
including Safety Assessment

NATS Uncontrolled

Roles

Action	Role	Date
Produced	Airspace Change Specialist NATS Future Airspace and ATM	March 2021
Reviewed Approved	ATC Lead NATS Swanwick Development	March 2021
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Contents

1. Introduction

This document forms part of the document set in accordance with the requirements of the CAP1616 airspace change process.

This document aims to provide adequate evidence to satisfy CAP1616 Stage 4 Submit Gateway, Step 4A Options Appraisal (Phase 3 Final), including Safety Assessment.

The implementation of Free Route Airspace (FRA) is a mandated change and as such is not benefits driven.

As indicated in Stage 4A Update Design there are no proposed changes to the airspace design as a result of the consultation (link), due to the supportive and neutral responses received from stakeholders. Therefore the forecast benefit remains the same as detailed in the Full Options Appraisal (link), and is presented within this document in line with CAP1616 guidance (Appendix F, para 14) that all environmental assessment requirements should be consistent with the information presented throughout the engagement and consultation.

CAP1616 also states that the CAA expects the change sponsor to use the most up-to-date and credible sources of data (paragraph E11). Since the submission of the consultation material to the CAA, NATS has produced an updated forecast that has considered the impact of the COVID-19 pandemic. This has been included in this submission so that the most up to date and credible data can be assessed, in accordance with CAP1616 para E11.

As there are no design changes post-consultation, the impact appraisal as presented in the Full Options Appraisal (Stage 3) remains valid and should be used by the CAA in order to ensure consistency across the two assessments.

NATS has therefore provided both a traffic prediction based on 2018 levels for direct comparison between those submitted in the Stage 3 consultation as well as a revised forecast due to the COVID-19 pandemic. However, it is important to note that there are no design amendments proposed, simply an updating of the traffic forecast and therefore an update to the expected benefits of this airspace change.

• Forecast Caveat

The CAP1616 process requires that forecasts and analyses are provided for implementation + 10 years (CAP1616) It should be noted that following the COVID-19 pandemic there has been a significant increase in uncertainty in how air traffic will be impacted in the long term. As a result, whilst the forecasts used are the best available, they still have significant uncertainty associated with them.

• Change Level

The changes proposed in this ACP impact flights above FL245. Hence in accordance with the Levels as defined in CAP1616, this proposal has been categorised as a Level 2B change. In line with the requirements for a Level 2B change the environmental impact assessment has been conducted based on CO2e emissions[1]. There would be no perceptible change to noise impacts to stakeholders on the ground; hence no noise analysis has been undertaken.

[1] A change in fuel burn (kg) can be converted to CO_2 equivalent (kg CO_2e, using a standard multiplier of 3.18), hence the equivalent estimated change in greenhouse gas impacts can be calculated.

2. Option Appraisal (Final): Option 1 Full FRA All Routes Removed 2020 Traffic Forecast

Following consultation and feedback, NATS proposes that Option 1 be implemented, in accordance with the request made by DSNA Brest to enable compliance with the mandated requirements for FRA.

FRA Option 1 is to implement FRA in the delegated ATS airspace in accordance with Implementing Regulation EU716/2014. This would remove all ATS routes and rationalise waypoints in accordance with the DSNA Brest ACC FRA design in both the PEMAK Triangle and TAKAS Box. Free route trajectories/traffic flows would be managed in the French RAD and Irish RAD.

The key analysis is given below, consistent with CAP1616 4th edition, Appendix E.

This is based on the NATS 2020 Traffic Forecast, which as explained in the Introduction, is in line with CAP1616 requirement to provide the most up to date and credible data. This data is utilised to best reflect the significant changes to the aviation industry post-COVID-19 pandemic.

The planned implementation date for FRA Deployment 2.1 is December 2021, so this updated forecast analysis reflects this and contains forecast data for 2022 (1-year post implementation) and 2032 (10 years post implementation).

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	N/A	The proposed changes to air traffic patterns are all above FL245 (circa 24,500ft). This is well above the 7,000ft threshold below which noise impacts are considered significant and analysis is required. The potential noise impacts are neither measurable nor describable.
Communities	Air quality	N/A	Government guidance[2] states that aircraft flying higher than 1,000ft are unlikely to have significant impact on local air quality. This airspace change only affects airspace 24,500 ft and above and is therefore unlikely to have a significant impact on local air quality.
Wider society	Greenhouse gas impact	Monetise and quantify	The proposed changes could enable a beneficial net reduction of CO2e emissions on implementation, which would increase in line with forecasted traffic growth. The impact assessment indicates that 27,216 flights per year would be impacted by the change by 2022, rising to 37,433 in 2032. WebTAG was used to assess the greenhouse gas impact over 10 years subsequent to the implementation of the proposed changes. The proportion of flights with origin and destination within the EU is 49.9%, with the remaining 50.1% originating from or destined to airports outside of the EU. In accordance with CAA guidance the CO2e emissions for flights within the EU are accounted for in WebTAG as traded (49.9%) and flights whose origin or destination are outside the EU are non-traded (50.1%). The FRA Option 1 concept would yield a positive Net Present Value benefit due to the reduction in CO_2e emissions per flight. The forecast reduction of CO2e emissions in the opening year (2022) is 1,606T (traded and non-traded) p.a. which would further decrease to 2,209T of CO2e saved p.a. in 2032. The monetised NPV benefit calculated by WebTAG due to the reduction in per-flight GHG emissions is £422,329. This benefit is the result of shorter average routes due to direct great circle routes in the deployment 2.1 free route airspace. The additional benefit of reduced fuel uplift and reduced CO2e emissions due to the corresponding weight reduction have not been included. It must be noted that FRA will only enable this benefit. Actual trajectories planned within FRA will be determined by airspace users.

[2] Air Navigation Guidance 2017 para 3.28

The WebTAG GHG worksheet outputs are shown at Appendix A.
Data used in compiling the WebTAG GHG results was as follows, using traffic figures from NATS analytics report:

Year	Number of Movements	Simulated Fuel Burn (T)	Simulated Fuel Burn (T) (/2)	Simulated CO2e (T)	Simulated CO2e (T) (/2)
2022	27,216	1,010	**505**	3,212	**1,606**
2032	37,433	1,389	**695**	4,417	**2,209**

Fuel burn is converted to CO_2e emissions using the ratio 3.18.
Due to the uncertainty regarding how operators will react and flight-plan within FRA, a conservative approach has been taken and simulated forecast savings have been halved, as shown in the table above. (The '/2' column shows those figures (in bold) which have been used to calculate the CO2e and WebTag analysis.)
This ACP proposes implementing FRA on the same AIRAC as FRA Deployment 1. Therefore traffic and forecast data published as part of FRA Deployment 1 ACP (ACP-2018-11) is used. Given the significant change in traffic as a result of the COVID-19 pandemic, the inclusion of the 2020 forecast provides relevant and up to date forecast data. This approach is consistent with guidance in CAP1616a.

Wider society	Capacity/ resilience	Qualitative	Increased flight planning flexibility would allow aircraft operators to flight plan efficiently and would give them the option of avoiding capacity-constrained areas. The ability to avoid restrictions by utilising alternative flight plan routes would reduce the likelihood of delay, thus improving the resilience of the wider route network.
General Aviation (GA)	Access	N/A	GA access to the higher-level airspace above FL245 would be unchanged.
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantify	N/A – there is no forecast increase in air transport movements, passenger numbers or cargo carried as an outcome of this proposal. The flight-plan options this proposal would introduce could allow airlines to avoid capacity constrained areas and avoid consequential delay and cost. However, this is not quantifiable, and no specific capacity increase is assumed or claimed by this proposal.
General Aviation/ commercial airlines	Fuel burn	Monetise	Analysis predicts a decrease in fuel burn, at a saving of £142,592 in 2022, increasing to become a saving of £196,099 in 2032 (both Net Present Value). (this is based on the halved fuel burn benefit figure) This was based on the IATA jet fuel price of 16 November 2020, at $362 USD per tonne converted to GDP at 0.78$/£ and presumes a constant fuel price and exchange rate. The forecast used was NATS 2020 base-case Forecast for traffic growth.
Commercial airlines	Training cost	N/A	N/A – there is not expected to be any airline training cost associated with FRA.
Commercial airlines	Other costs	N/A	Updates to FMS and flight planning systems will by the routine aeronautical information regulation and control (AIRAC) updates. There are no other known costs which would be imposed on commercial aviation.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative and quantitative	Infrastructure costs to the UK would be minimal in line with the normal AIRAC process. The Shannon ACC system already operates FRA, therefore infrastructure costs to the IAA would be minimal in line with the normal AIRAC process. Brest ACC are deploying FRA within a large proportion of their AoR in French airspace and are updating their infrastructure accordingly. Therefore, there are minimal infrastructure costs associated specifically with the deployment of FRA within the region of delegated ATS airspace, other than those which are in line with the normal AIRAC process.
Airport/ Air navigation service provider	Operational costs	N/A	This proposal would not lead to changes in operational costs to the UK, Irish or French ANSPs. Levels of complexity will be managed in the Irish and French RAD so they are comparable with that of today's air traffic control systems. However, it is not proportionate to quantify this impact and no specific capacity benefit is assumed or claimed by this proposal.

Airport/ Air navigation service provider	Deployment costs	Qualitative and quantitative	Deployment cost to the UK would be minimal in line with the normal AIRAC process. The overall cost estimate for the ANSP to complete the adaptation and to complete the required airspace change administrative process is approx. £320,000.

3. Cost Benefit Analysis

The monetised benefits of the final preferred option are presented in the cost benefit analysis below.

The discount rate of 3.5% has been applied as per the standard rate given in the Treasury Green Book Annex A6.

There is a significant degree of uncertainty in predicting how aircraft operators will use FRA.

CAP1616 cost-benefit example												
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Year	0	1	2	3	4	5	6	7	8	9	10	NPV
Discount factor	1	0.965	0.931	0.899	0.867	0.837	0.808	0.779	0.752	0.726	0.700	
Option 1 - Full FRA (100% benefit)												
Net community benefit (CO2)	£42,643	£49,453	£56,066	£61,742	£63,964	£67,046	£70,102	£72,487	£75,450	£81,322	£86,981	
Net airspace users benefit (Fuel)	£142,592	£156,145	£168,710	£178,028	£177,887	£180,428	£183,534	£185,087	£188,334	£192,146	£196,099	
Net sponsor benefit	-£320,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	
Present value	-£134,766	£198,402	£209,317	£215,465	£209,728	£207,093	£204,821	£200,721	£198,366	£198,450	£198,236	£1,905,834

Option 1 is the proposed final option with NPV benefits to 2032 of £1,905,834.

4. Option Appraisal (Final): Option 1 Full FRA All Routes Removed 2018 Traffic Forecast

As no changes have been made to the design further to consultation, the assessment made in the Stage 3 Full Options Appraisal is still valid and is presented here in line with the guidance in CAP1616 Appendix F. This data is presented within this document to ensure that information is consistent with that presented throughout engagement and consultation, and the CAA are able to make an assessment and regulatory decision on comparable data.

Group	Impact	Level of Analysis	Evidence
Communities	Noise impact on health and quality of life	N/A	The proposed changes to air traffic patterns are all above FL245 (circa 24,500ft). This is well above the 7,000ft threshold below which noise impacts are considered significant and analysis is required. The potential noise impacts are neither measurable nor describable.
Communities	Air quality	N/A	Government guidance[3] states that aircraft flying higher than 1,000ft are unlikely to have significant impact on local air quality. This airspace change only affects airspace 24,500 ft and above and is therefore unlikely to have a significant impact on local air quality.
Wider society	Greenhouse gas impact	Monetise and quantify	The proposed changes could enable a beneficial net reduction of CO2e emissions on implementation, which would increase in line with forecasted traffic growth. The impact assessment indicates that 33,925 flights per year would be impacted by the change by 2021, rising to 43,255 in 2031. WebTAG was used to assess the greenhouse gas impact over 10 years subsequent to the implementation of the proposed changes. The proportion of flights with origin and destination within the EU is 49.9%, with the remaining 50.1% originating from or destined to airports outside of the EU. In accordance with CAA guidance the CO2e emissions for flights within the EU are accounted for in WebTAG as traded (49.9%) and flights whose origin or destination are outside the EU are non-traded (50.1%). The FRA Option 1 concept would yield a positive Net Present Value benefit due to the reduction in CO_2e emissions per flight. The forecast reduction of CO2e emissions in the opening year (2021) is 2,001.7T (traded and non-traded) p.a. which would further decrease to 2,325.4T of CO2e saved p.a. in 2031. The monetised NPV benefit calculated by WebTAG due to the reduction in per-flight GHG emissions is £464,673. This benefit is the result of shorter average routes due to direct great circle routes in the deployment 2.1 free route airspace. The additional benefit of reduced fuel uplift and reduced CO2e emissions due to the corresponding weight reduction have not been included. It must be noted that FRA will only enable this benefit. Actual trajectories planned within FRA will be determined by airspace users. The WebTAG GHG worksheet outputs are shown at Appendix B. Data used in compiling the WebTAG GHG results was as follows, using traffic figures from NATS analytics report:

Year	Number of Movements	Simulated Fuel Burn (T)	Simulated Fuel Burn (T) (/2)	Simulated CO2e (T)	Simulated CO2e (T) (/2)
2021	33,925	1,259	**630**	4,003	**2,002**
2031	43,255	1,462	**731**	4,651	**2,325**

Fuel burn is converted to CO_2e emissions using the ratio 3.18.
Due to the uncertainty regarding how operators will react and flight-plan within FRA, a conservative approach has been taken and simulated forecast savings have been halved, as shown in the table above. (The '/2' column

[3] Air Navigation Guidance 2017 para 3.28

			shows those figures (in bold) which have been used to calculate the CO2e and WebTag analysis.) This ACP proposes implementing FRA on the same AIRAC as FRA Deployment 1. Therefore traffic and forecast data published as part of FRA Deployment 1 ACP (ACP-2018-11) is used. Given the significant change in traffic as a result of the COVID-19 pandemic, the inclusion of this 2018 data provides a consistent and equivalent comparison, with forecast data already in the public domain. This approach is consistent with guidance in CAP1616a.
Wider society	Capacity/ resilience	Qualitative	Increased flight planning flexibility would allow aircraft operators to flight plan efficiently and would give them the option of avoiding capacity-constrained areas. The ability to avoid restrictions by utilising alternative flight plan routes would reduce the likelihood of delay, thus improving the resilience of the wider route network.
General Aviation (GA)	Access	N/A	GA access to the higher-level airspace above FL245 would be unchanged.
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantify	N/A – there is no forecast increase in air transport movements, passenger numbers or cargo carried as an outcome of this proposal. The flight-plan options this proposal would introduce could allow airlines to avoid capacity constrained areas and avoid consequential delay and cost. However, this is not quantifiable, and no specific capacity increase is assumed or claimed by this proposal.
General Aviation/ commercial airlines	Fuel burn	Monetise	Analysis predicts a decrease in fuel burn, at a saving of £177,740 in 2021, increasing to become a saving of £206,474 in 2031 (both Net Present Value). (this is based on the halved fuel burn benefit figure) This was based on the IATA jet fuel price of 16 November 2020, at $362 USD per tonne converted to GDP at 0.78$/£ and presumes a constant fuel price and exchange rate. The forecast used was NATS 2018 base-case Forecast for traffic growth.
Commercial airlines	Training cost	N/A	N/A – there is not expected to be any airline training cost associated with FRA.
Commercial airlines	Other costs	N/A	Updates to FMS and flight planning systems will by the routine aeronautical information regulation and control (AIRAC) updates. There are no other known costs which would be imposed on commercial aviation.
Airport/ Air navigation service provider	Infrastructure costs	Qualitative and quantitative	Infrastructure costs to the UK would be minimal in line with the normal AIRAC process. The Shannon ACC system already operates FRA, therefore infrastructure costs to the IAA would be minimal in line with the normal AIRAC process. Brest ACC are deploying FRA within a large proportion of their AoR in French airspace and are updating their infrastructure accordingly. Therefore, there are minimal infrastructure costs associated specifically with the deployment of FRA within the region of delegated ATS airspace, other than those which are in line with the normal AIRAC process.
Airport/ Air navigation service provider	Operational costs	N/A	This proposal would not lead to changes in operational costs to the UK, Irish or French ANSPs. Levels of complexity will be managed in the IAA and DSNA RAD, so they are comparable with that of today's air traffic control systems. However, it is not proportionate to quantify this impact and no specific capacity benefit is assumed or claimed by this proposal.
Airport/ Air navigation service provider	Deployment costs	Qualitative and quantitative	Deployment cost to the UK would be minimal in line with the normal AIRAC process. The overall cost estimate for the ANSP to complete the adaptation and to complete the required airspace change administrative process is approx. £320,000.

5. Cost Benefit Analysis

The monetised benefits of the final preferred option is presented in the cost benefit analysis below.

The discount rate of 3.5% has been applied as per the standard rate given in the Treasury Green Book Annex A6.

There is a significant degree of uncertainty in predicting how aircraft operators will use FRA.

CAP1616 cost-benefit example											
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Year	0	1	2	3	4	5	6	7	8	9	10	NPV
Discount factor	1	0.965	0.931	0.899	0.867	0.837	0.808	0.779	0.752	0.726	0.700	
Option 1 - Full FRA (100% benefit)												
Net community benefit (CO2)	£49,742	£54,440	£58,595	£62,447	£66,017	£69,954	£73,305	£76,383	£79,279	£82,170	£87,387	
Net airspace users benefit (Fuel)	£177,740	£182,111	£185,188	£187,909	£190,374	£194,420	£197,268	£199,875	£202,477	£205,010	£206,474	
Net sponsor benefit	-£320,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	
Present value	-£92,518	£228,272	£227,016	£224,977	£222,336	£221,236	£218,499	£215,281	£211,881	£208,401	£205,786	£2,091,169

Option 1 is the proposed final option with NPV benefits to 2031 of £2,091,169

6. Safety Assessment

Options Appraisal Safety Assessment

6.1 The DSNA Brest ACC FRA airspace design[4] removes the ATS route structure and would manage traffic flows through the use of flight planning restrictions in the RAD. This approach is common with other FRA implementations within the ICAO EUR region. Therefore, a qualitative high-level safety appraisal for the two proposed options for FRA deployment in the region indicates that the existing level of safety performance would be maintained.

6.2 There is an extant process for safety assessing any change that may have an impact on neighbouring ANSPs through the ATS delegation agreement.

6.3 NATS has a Safety Manager and a Human Factors Specialist for the FRA project. Their role is to assess the scale of each airspace change, to ensure the CAA-compliant NATS Safety Management System is followed. In addition, their role is to submit safety arguments with supporting evidence to the CAA's en-route safety regulator, to clearly demonstrate each airspace change is acceptably safe for implementation and the right assurances are in place.

6.4 A Hazard Identification Safety workshop was undertaken. The output of this is that no safety issues or hazards have been identified as a result of this proposal. (see appendix 5)

6.5 NATS' Human Performance Specialist for the FRA Programme ensures that any potential impact on human performance is assessed and mitigated as far as practically possible, as part of the Human Performance Assurance Process. No human performance issues have been identified as a result of this proposed airspace change.

Conclusion

6.6 The safety and human performance assessments undertaken to date indicate that nothing is presently foreseen which appears to have the potential to preclude maintenance of the existing level of safety performance demonstrated within the current operation.

[4] The IAA already operate FRA (fulfilling the PCP mandate). The IAA have stated that they are content to change the airspace within the TAKAS Box in accordance with Brest ACC's airspace requirements and timeline.

7. Conclusion and Next Steps

This proposal has been developed following the submission of a Statement of Need, reference DAP1916-V2-68. Its text was:

> This ACP is part of the programme to introduce Free Route Airspace (FRA) in a phased manner across all UK upper airspace. This programme was initiated in response to SESAR PCP Implementing Regulation EU716/2014. The SESAR PCP ATM Functionality 3 (AF3) states that Free Route shall be provided and operated in the airspace for which the Member States are responsible at and above Flight Level 310 in the ICAO EUR region by 1st January 2022.
> FRA aims to improve flight efficiency by enabling aircraft to flight-plan and fly user-preferred routes, where possible. FRA is being implemented internationally and is already in operation in several neighbouring states. It is also in accordance with the CAA's Airspace Modernisation Strategy (AMS) (Sections 4.5-4.11 refer specifically to FRA as a means to improving efficiency in the upper airspace). The introduction of FRA will enable environmental benefit by enabling airline operators to reduce CO2 emissions per flight, which in turn would produce economic benefit due to reduced operating costs.
> This ACP proposes the introduction of FRA in the PEMAK triangle and TAKAS box areas of airspace (Defined in AIP ENR 2.2 1.7). Air Traffic Services are delegated to France and Ireland respectively in these areas.
> The introduction of FRA in UK airspace will ensure that the UK upper airspace is harmonised with that of neighbouring states, enabling cross-border free routing. Specifically the objective of this ACP is to allow the harmonised introduction of FRA in the PEMAK triangle and TAKAS box, in coordination with FRA implementation in the adjoining French airspace.

This document describes an option which addresses the Statement of Need by the proposed introduction of Free Route Airspace within airspace where the provision of Air Traffic Services has been delegated to the IAA and DSNA in the south west UK UIR. This will meet PCP mandated requirements for the implementation of FRA.

Additionally, this option has been developed thus far with significant assistance, input, feedback and effort from representatives of all neighbouring ANSPs, representatives from airlines and flight planning service providers.
NATS thanks all these stakeholders and looks forward to implementing this proposal.

8. Appendix A: Calculations for FRA Deployment 2.1 – 2020 Traffic Forecast

The data used for the inputs to WebTAG are given below.

8.1 Traffic forecasts

Year	Base Growth Flights (000's)	Base Growth Rate
2022	2,141	-
2023	2,346	9.55%
2024	2,534	8.04%
2025	2,673	5.49%
2026	2,670	-0.12%
2027	2,710	1.49%
2028	2,755	1.67%
2029	2,780	0.89%
2030	2,828	1.72%
2031	2,886	2.05%
2032	2,945	2.00%

Table 1 NATS 2020 Base Case forecast traffic growth 2022-2032

The CAP1616 process requires that forecasts and analyses are provided for implementation + 10 years. It should be noted that following the COVID-19 pandemic there has been a significant increase in uncertainty in how air traffic will be impacted in the long term. As a result, whilst the forecasts used are the best available, they still have significant uncertainty associated with them.

Computer modelling results

Year	Flights per year in FRA D2.1 Area	Simulated Fuel Saving (T)	Fuel Saving /2	Simulated CO2e saving (T)	CO2e Saving /2	CO2e saving traded 49.9%	CO2e saving non-traded 50.1%	Fuel saving/2 (USD)	Fuel saving/2 (GBP)
2022	27,216	1,010	505	3,212	1,606	801	805	182,810	142,592
2023	29,216	1,106	553	3,519	1,760	878	882	200,186	156,145
2024	29,816	1,195	598	3,801	1,901	948	952	216,295	168,710
2025	32,213	1,261	631	4,010	2,005	1,000	1,005	228,241	178,028
2026	33,981	1,260	630	4,005	2,003	999	1,003	228,060	177,887
2027	33,940	1,278	639	4,065	2,033	1,014	1,018	231,318	180,428
2028	35,019	1,300	650	4,133	2,067	1,031	1,035	235,300	183,534
2029	35,333	1,311	656	4,170	2,085	1,040	1,045	237,291	185,087
2030	35,941	1,334	667	4,241	2,121	1,058	1,062	241,454	188,334
2031	36,677	1,361	681	4,328	2,164	1,080	1,084	246,341	192,146
2032	37,433	1,389	695	4,417	2,209	1,102	1,106	251,409	196,099

Table 2 Computer simulation results for Option 1

The results calculated by NATS Analytics for the fuel saving and CO_2e savings are given in **Error! Reference source not found.**, columns 3 and 5. Due to the uncertainties regarding how airlines will use the FRA, and to account for the use of tactical direct routings which occur in the current day operation, these figures have been halved in columns 4, 6 & 9-10 (hence "/2" in the column headers). This is to reduce any risk that benefits are over-stated. The figures in columns 4 and 6 were used for the WebTag analysis.

8.2 GHG Workbook output 2020 Forecast

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: NATS FRA Deployment 2.1 Opt 1

Present Value Base Year	2010
Current Year	2021
Proposal Opening year:	2021
Project (Road/Rail or Road and Rail):	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): £422,329

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): -21,948
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded -10951

Change in carbon dioxide equivalent emissions in opening year (tonnes): 0
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): £304,926
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	-801.00	-4839.00
Non-traded sector	0	0	-805.00	-4860.00

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £633,494

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £211,165

Data Sources:
NATS FRA emissions analysis using AirTop Simulation
Traffic data: EUROCONTROL's Network Strategic Tool (NEST)
Aircraft performance: BADA v3.13/v4.2

9. Appendix B: Calculations for FRA Deployment 2.1 – 2018 Traffic Forecast

The data used for the inputs to WebTAG are given below.

9.1 Traffic forecasts

Year	Base Growth Flights (000's)	Base Growth Rate
2021	2669	2.27%
2022	2735	2.46%
2023	2781	1.69%
2024	2822	1.47%
2025	2859	1.31%
2026	2919	2.13%
2027	2962	1.47%
2028	3001	1.32%
2029	3040	1.30%
2030	3079	1.25%
2031	3101	0.71%

Table 3 NATS 2018 Base Case forecast traffic growth 2021-2031

9.2 Computer modelling results

Year	Flights per year in FRA D2.1 Area	Simulated Fuel Saving (T)	Fuel Saving /	Simulated CO2e saving (T	CO2e Saving /:	CO2e saving traded 49.9	CO2 saving non-traded 50.1%	Fuel saving/2 (USD)	Fuel saving/2 (GBP)
2021	33,925	1,259	629	4,003	2,002	999	1,003	227,872	177,740
2022	34,760	1,290	645	4,102	2,051	1,023	1,028	233,476	182,111
2023	35,614	1,312	656	4,171	2,086	1,041	1,045	237,420	185,188
2024	36,490	1,331	665	4,233	2,116	1,056	1,060	240,908	187,909
2025	37,388	1,348	674	4,288	2,144	1,070	1,074	244,069	190,374
2026	38,307	1,377	689	4,379	2,190	1,093	1,097	249,256	194,420
2027	39,249	1,397	699	4,443	2,222	1,109	1,113	252,908	197,268
2028	40,215	1,416	708	4,502	2,251	1,123	1,128	256,251	199,875
2029	41,204	1,434	717	4,561	2,280	1,138	1,142	259,586	202,477
2030	42,217	1,452	726	4,618	2,309	1,152	1,157	262,834	205,010
2031	43,255	1,462	731	4,651	2,325	1,160	1,165	264,710	206,474

Table 4 Computer modelling results

The results calculated by NATS Analytics for the fuel saving and CO_2e savings are given in 4, columns 3 and 4. Due to the uncertainties regarding how airlines will use the FRA, and to account for the use of tactical direct routings which occur in the current day operation, these figures have been halved in columns 5-6 and 9-10 (hence "/2" in the column headers). This is to reduce any risk that benefits are over-stated.

9.3 WebTAG GHG Workbook output 2018 Forecast

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: NATS FRA Deployment 2.1 Opt 1

Present Value Base Year 2010

Current Year 2020

Proposal Opening year: 2021

Project (Road/Rail or Road and Rail): road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): £464,673

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): -23,976
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded -11964

Change in carbon dioxide equivalent emissions in opening year (tonnes): -2,002
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): £295,046
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	-2022.30	-5367.80
Non-traded sector	0	0	-2030.40	-5389.40

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £697,009

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £232,336

Data Sources:
NATS FRA emissions analysis using AirTop Simulation
Traffic data: EUROCONTROL's Network Strategic Tool (NEST)
Aircraft performance: BADA v3.13/v4.2