NATS

TEN STEPS TO FLIGHT EFFICIENCY

WHAT'S YOUR CO_2NTRIBUTION?

This is a guide to illustrate the main opportunities to deliver **fuel and cost savings** and **reduce emissions** – it provides examples and shares some rules of thumb.

However... it is important to recognise that the most fuel efficient solution needs to be determined case-by-case as it will depend on the exact circumstances in a given piece of airspace: aircraft types, traffic volumes and traffic interactions all need to be considered.

The goal is the 'Perfect Flight', NATS' concept of the fuel optimal flight profile, but while it is impossible to deliver the perfect flight for all, NATS ambition is to deliver as close to the perfect flight as possible by making incremental changes in the following ten areas.

Why this is so important:

1. Minimising fuel costs will help keep our airline customers in business
2. Acting Responsibly will reduce the environmental effects of aviation
3. Demonstrating that aviation growth can be achieved sustainably will help secure the long term future of NATS business.

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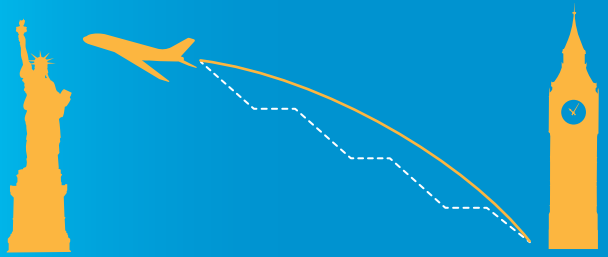


CONTINUOUS CLIMB

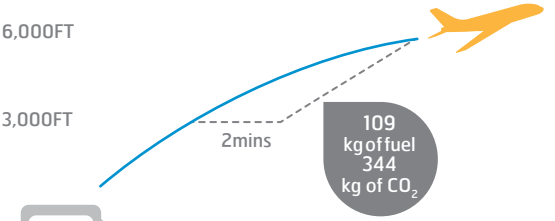
saves an average 250kg of fuel per aircraft. Just 10% more CCDs per day, will save **60 tonnes of fuel,** enough to fly from **London to New York!**

Continuous climb

In NATS, we are already routinely delivering continuous climbs tactically across much of our network and we're also working on improving airspace structures and procedures to enable more continuous climbs in the future.

Paul Waite – NATS Birmingham Airport

One of our airlines calculated that for their 737-300s the difference between continuous climb to 6,000ft and a climb to 6000ft with a level step at 3,000ft for 2 minutes is **109kgs fuel (344kgs CO_2).**



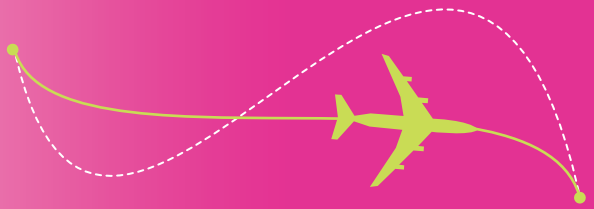
If these stepped climbs were required for 25% of the airline's departures from Birmingham, this would amount to around **123 tonnes fuel per year, worth around £80,000.**

Dean Plumb – British Airways

Comparing all British Airways 747-400 departures from Heathrow to Hong Kong during a year, the worst performing aircraft climb profile burned **1.5 tonnes** more fuel than the best which received a continuous climb to cruise.

NATS – Operational Analysis

If a Boeing 737-800 is restricted to **6,000ft for 3 minutes** on departure, its increased fuel burn is equivalent to a **track extension of approximately 35nm.**



FLIGHT PLANNABLE DIRECT ROUTES

reduce **track miles** and the need to carry **extra fuel.**

Flight plannable direct routes

Providing more direct, flight plannable routes means airlines save twice – first by flying fewer track miles and second by not needing to uplift fuel to carry the extra they would have needed on the longer route.

The cost of carrying fuel is between 3% and 8% - so as a minimum, for every extra 100kg of fuel that's needed for a flight an extra 3kg is required just to uplift that fuel.

Eurocontrol

It is estimated that up to **8% fuel saving** could be achieved across Europe by making direct routes flight plannable.

Working with the military we have improved access to many conditional routes, enabling airlines to flight plan more direct routes at certain times.

The conditional route SALCO-STU through military airspace in south west England is enabling 15-19nm fewer track miles for all weekend & night-time flights on this route to and from Ireland, saving around 150 tonnes of fuel per year.

Flybe

A flight plannable direct with a route shortening of just 5nm on every flight across our operation in a year would save over £80,000 per year **in fuel uplift alone.**

Katie O'Sullivan – Swanwick AC Red ATCO Group LAS (West)

Ryanair B738 Dublin - Gatwick in sector 8/9 cruising at FL330 was given a tactical direct routing from BAKUR – GIBSO instead of routing BAKUR MERLY DIDEL GIBSO, saving 16nm and 120kg fuel. This is not currently flight plannable but may be in future.

OPTIMUM FLIGHT LEVELS

Flying just **2,000ft below the fuel optimum level** could increase fuel burn by up to **7%.**

Optimum Flight Levels

Controllers already do their level best to get flights as close as possible to their fuel optimum level. Improving airspace structures and procedures and greater co-ordination between sectors could deliver even more fuel savings.

Katie O'Sullivan – Swanwick AC Red ATCO and Group LAS

EasyJet A319 flights from Bristol to Glasgow are capped out of Lakes and file max FL280, however we can request higher from Lakes after first rotation. For this flight, cruising at **FL360** (with continuous climb) **saves 200kg fuel** versus cruising at FL280.

James Robinson – Swanwick AC Green ATCO

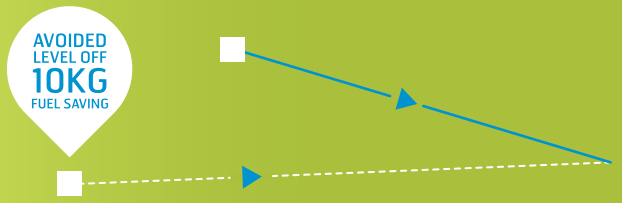
On TMA South, during quiet periods of a night shift, Gatwick inbounds through Hurn can have their standing agreement changed from FL130 Level Goodwood (GWC) to a direct route from the FIR boundary to HOLLY at FL200. This optimises their descent profile and saves around 10 track miles.

NATS

Airspace changes have enabled North Atlantic arrivals through Dublin/LIFFY to stay higher for longer, saving airlines around **1,300 tonnes fuel per year, worth over £800,000.**

Flybe

Whilst higher isn't always better due to weather, in still air conditions the fuel savings on an EMB-195 Manchester – Milan, operating at FL390, would be around 4% compared to operating at FL350 and 13% compared to operating at FL310.



AIRSPACE DESIGN & MAKING THE MOST OF NEW TOOLS

Optimum **airspace design** along with **new tools** and **precision navigation** techniques are allowing aircraft to fly closer to their **optimum profile.**

Airspace design & making the most of new tools

iFACTS

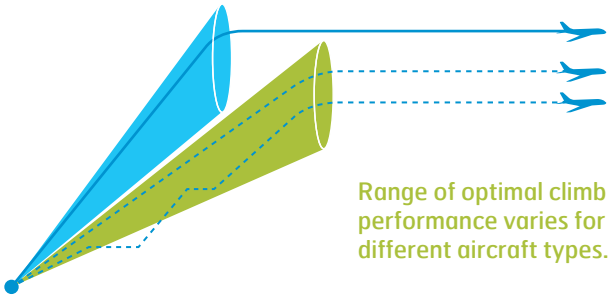
In Swanwick en-route sectors, controllers now have access to iFACTS, an innovative world leading product that can help anticipate and resolve traffic conflictions. This can save fuel by providing controllers with reassurance to give climb or descent clearances to get flights closer to their fuel optimal profile.

As controllers become more familiar with iFACTS, we expect the potential fuel saving benefits to become evident in routine ATC operations.

AIRSPACE & PROCEDURES DESIGN PRINCIPLES

There is a broad range in 'optimal' performance between aircraft types and therefore the key rules of thumb for airspace and procedures design are:

a) Minimise conflictions wherever possible particularly in climb and descent.
b) Where conflictions are unavoidable, aim to design them to take place at higher levels where aircraft are more efficient.
c) For departures, best practice would be to design 'at or above' restrictions to allow flexibility and enable aircraft to fly at their optimum climb rates.
d) Where an interaction is unavoidable, aim to design maximum vertical separation to accommodate a range of aircraft profiles.



Range of optimal climb performance varies for different aircraft types.

UP TO 100KG
FUEL BURN PENALTY

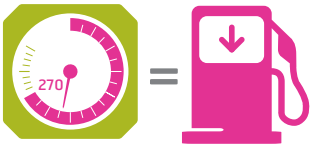
SPEED CONTROL

ECON descent speed for a Boeing 737-800 is around 255kts. Flying at 300kts incurs a **fuel burn penalty** of up to **100kg.**

Speed control

How slow can you go? Generally slower speeds are more fuel efficient but there's a balance to be struck to minimise drag and noise, maintain airline schedules and ensure efficient use of runways.

Encouraging pilots to fly at economic speeds can save fuel and reduce emissions. Letting pilots know their expected speed control early on means they can re-programme their descent to be more fuel efficient - a slow descent speed will move the TOD back to an earlier position.



In AC, when using speed control, consider the use of slower speeds, **270kts or less, this will save fuel.**

Consider asking the first aircraft in a stream for their preferred speed, then slow others down accordingly.

Donnie McCaig – Group Supervisor, TC Red Watch, Swanwick

On Heathrow APC we regularly use minimum clean speed during initial/intermediate approach, rather than a blanket 220kts. We reckon we're saving a fair bit of fuel, pollution and cost. Types to benefit include B747 and B777-300. Many controllers also use 190kts on intermediate approach for B747-400 and B777-300 types, resulting in reduced drag and fuel burn.

Cost Indexing

Used by airlines to manage fuel and time related costs & identify optimum speed. **Example: 747 Heathrow to Seattle.**

Cost Index	Cruise speed	Trip fuel	Trip time	Cost
0	m82	89,818	09:13	£71,018
150	m84	90,773	08:53	£71,494
300	m86	91,510	08:46	£71,932

QUEUE MANAGEMENT

Reducing average stack holding time at Heathrow by just **two minutes** per aircraft will save 23,000 tonnes of fuel per year, worth **£14 million to airlines.**

Queue Management

Airborne holding helps us manage air traffic flows, but it's not environmentally efficient. While we work to introduce new technology and queue management techniques please continue to help reduce holding by absorbing delay en-route where possible.

NATS – Operational Analysis

On average a Boeing 747-400 burns around **190kg fuel per minute in cruise.** In a holding stack, the same aircraft burns **290kg fuel per minute.**

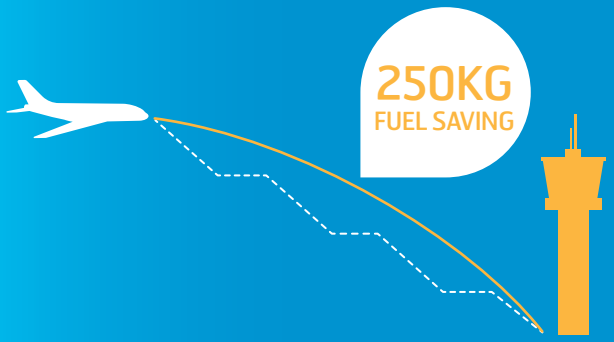
If there's significant holding, consider slowing aircraft down so that delay can be absorbed outside the hold – **no point hurtling in at 310kts only to hold for 10 minutes!**

Tom Harrison – ATCO, White Watch, AC, Swanwick

On the en-route South Sectors, with an improved AMAN system and more information from TC, we are able to get aircraft's speeds reduced earlier, phoning the previous sectors on occasion as well, so that aircraft spend less time holding.

Donnie McCaig – Group Supervisor, TC Red Watch, Swanwick

Most of us have a particular 'hobby-horse'. Mine happens to be an overwhelming desire to reduce aircraft holding to zero; none, never, not at all! I don't like seeing aircraft going round the holds burning fuel, polluting unnecessarily. Of course, it's not always NATS that creates the holding delays, however I would like to see NATS' contribution to these delays reduced to nothing.



CONTINUOUS DESCENTS

Continuous descents save **fuel** and **emissions** and **also reduce noise.**

Continuous descents

NATS is world famous for pioneering CDA. We want to continue to lead by providing more CDAs from top of descent and increasing CDA achievement at all our airport units.

Providing pilots with accurate and timely 'Distance to Go' is the key to improving CDA achievement rates.

Edinburgh Flight Profile Monitor Trial

Since August 2011 NATS 'Flight Profile Monitor' has provided monthly data on CDA achievement at all of NATS UK airport units.

Improvements in CDA rates at Edinburgh are estimated to be saving airlines over **£150,000 worth of fuel per year.**

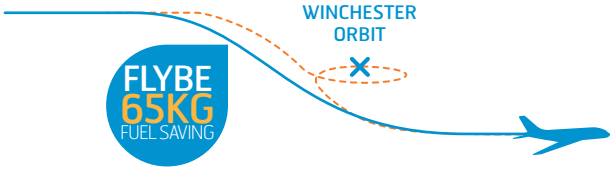
EasyJet & Katie O'Sullivan –

Swanwick AC Red ATCO Group LAS (West)

EasyJet A319 Malaga – Liverpool in sector 36 was given an optimal descent profile from cruising level FL380, removing the usual descent restriction to be FL330 at EXMOR. The crew estimated the delayed top of descent saved 100-200kg of fuel.

Flybe

Based on data collected during the Olympics, we estimate the removal of the **Winchester Orbit** (the loop flown by aircraft approaching Southampton runway from the North) and a straight in approach to R20, would save Flybe approx 65kgs fuel per flight.



X8

GROUND TAXIING

Reducing average taxi times by just one minute at a large airport could save over **3,000 tonnes of fuel,** enough to fly around the world **8 times** and worth **£2M!**

Ground Taxing

SMOOTH OPERATOR

Our aim is to promote smooth taxiing and avoid unnecessary stop/starts.

A 737-300 burns around 13kgs fuel /min during ground taxiing. The cost of taxiway stop/start is around £50.

Taxiway stop/start for a B777 can cost £200 in fuel compared to a smooth continuous taxi operation.

INTERSECTION DEPARTURES

Some airport operators and airlines are encouraging intersection departures. To support this, the GMC can ask each aircraft if they are intersection able then pass the information to the AIR controller for forward planning. Reduced taxi distance means reduced fuel burn and increased runway capacity.

REDUCED ENGINE TAXIING

Airlines are increasingly adopting reduced engine taxiing techniques, most commonly on taxi-in but also increasingly for taxi-out.

Controllers can support this by providing 'five minute warning' of departure slot to enable flight crews to start the remaining engines ready for departure.

Matt Taylor – Air Traffic Controller, Luton

At Luton, we are introducing a brief to allow controllers to give an indication of aircraft ahead in the departure to allow (specifically) EasyJet to increase their single engine taxi out performance rates. They are aiming for a minimum of 40%.

British Airways

A 747 closing down two engines on taxi-in can save 120kg fuel, worth around £60.

CO_2LLABORATION

Making decisions as a **team** will keep us on course to reach our **Acting Responsibly** targets.

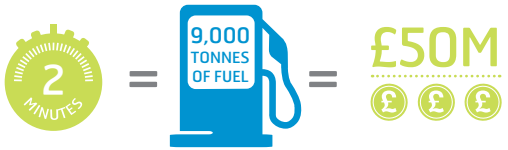
CO_2llaboration

AIRPORT COLLABORATIVE DECISION MAKING (A-CDM)

The combined effort from airports, airlines, ATC and ground handling crews can improve efficiency and reduce taxi times, fuel use, CO_2 emissions and noise. This is the goal of Airport Collaborative Decision Making (A-CDM).

NATS – Operational Analysis

Achieving the successful implementation of A-CDM at a large international airport could reduce taxi times by up to two minutes, saving 9,000 tonnes fuel, worth over £50M.

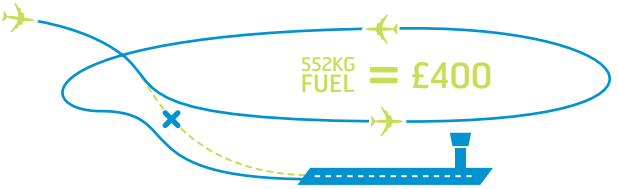


MEASURING PUNCTUALITY

Current aviation punctuality reporting is driving the wrong behaviours and causing congestion and delays at most airports. NATS is keen to promote a move to incentivising on time arrivals rather than on time departures. This is a complex challenge for the whole industry and will require effort on all parts to deliver.

MERRY GO-AROUND?

The fuel cost of a missed approach followed by a circuit to land with a 737-300 is 552kgs, worth around £400. (This example is missed approach flown from 200AGL, straight ahead to 4000QNH followed by no delay circuit to 8nm final – exercise terminated at 200AGL on second approach).



ENVIRONMENTAL SOUND BITES

Rules of thumb to help you identify **fuel saving opportunities**

Here are some data sound bites to help you identify opportunities for fuel savings. Use with caution -they are intended to provide general estimates and help with prioritisation but should not replace formal assessment.

Aircraft Type	Ground holding fuel burn (kg/min)	Taxiing fuel burn (kg/min)	Airborne holding fuel burn (kg/min) *	Continuous Descent fuel saving versus stepped descent with 10nm level off at 6,000ft (kgs) **	Continuous Climb fuel saving versus climb with 10nm level off at 6,000ft (kgs) ***	Cruise fuel burn at FL240 (kg/min) {Associated speed (kts)}	Cruise fuel burn at FL290 (kg/min) {Associated speed (kts)}	Cruise fuel burn at FL340 (kg/min) {Associated speed (kts)}	Cruise fuel burn at FL390 (kg/min) {Associated speed (kts)}
4 Engine Heavy	45	57	275	398	581	292 {478}	252 {497}	207 {487}	164 {482}
Small Heavy	19	23	148	215	300	137 {438}	119 {473}	99 {463}	79 {459}
Upper Medium	14	17	94	121	210	103 {412}	91 {445}	77 {463}	63 {459}
Medium	12	13	61	75	128	58 {412}	50 {445}	42 {452}	34 {447}
2 Engine Small Jet	7	9	38	48	77	34 {412}	29 {414}	24 {405}	19 {401}
Heavy Turboprop	4	5	17	2	29	19 {345}	-	-	-
Medium Turboprop	2	2	10	4	17	9 {242}	-	-	-

Assumptions

* Airborne holding: holding level at 8,000ft, with speed of 220kts
** Continuous Descent: Fuel saving with 10nm level off at 6,000ft compared to extra 10nm flown at cruise
*** Continuous Climb: Fuel saving with 10nm level off at 6,000ft compared to extra 10nm flown at cruise

PICTURE PERFECT

Thank you, you've made a great start in delivering **fuel savings!**

Picture perfect

Since 2007, the combined effort of teams across NATS has already enabled an estimated 110,000 tonnes of fuel savings annually, worth over £70 million per year

NATS people are continuing to work hard to deliver more fuel efficient flight profiles, taking NATS closer to achieving our 10% CO_2 reduction target and delivering each flight closer to the 3Di fuel optimum or 'Perfect Flight' profile.

By applying the principles in these ten steps, controllers can make a difference to flight efficiency now. As a company, we also need to continue to deliver improvements to tools and airspace that will enable further fuel savings in future.

Flybe estimate that if they can save just 10kg fuel per flight, over a year they would have saved more than one million!

In flight efficiency, every little helps.

WHAT'S YOUR CO_2NTRIBUTION?

To find out more visit:
www.nats.co.uk