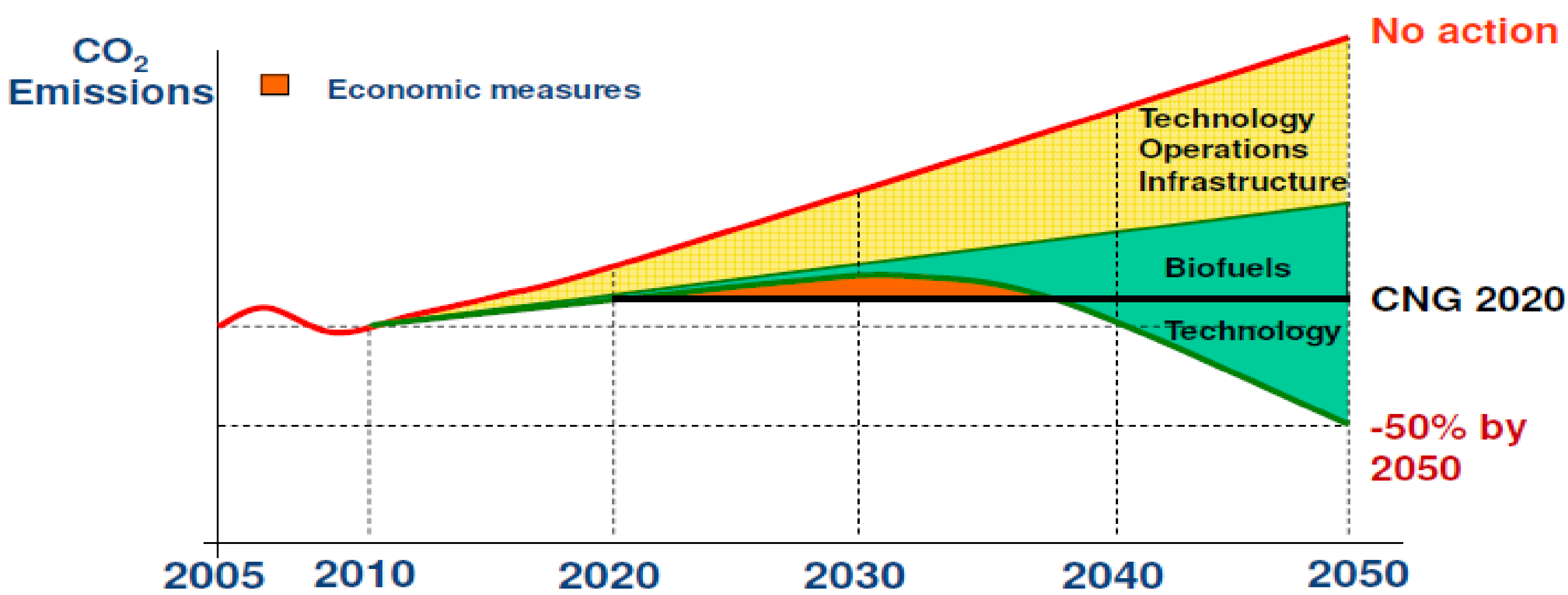
CCO / CDO
Effect on
Fuel Efficiency
&
Emission Reduction

Air Traffic Management (ATM) has an important role to play in the reduction of aircraft emissions.

Reducing aircraft emissions has now become a global environmental concern.

source ICAO website

Emissions reduction roadmap



ANSPs can help.

Air Traffic Management **(ATM)** has an important role to play in the reduction of aircraft emissions.

Today's economic situation has seriously eroded the profitability of many **ATOs** and belt tightening has become the order of the day.

- All areas of the operation are being investigated to identify initiatives to reduce expenditures and improve operational efficiency.

ATOs are making changes to their operating procedures and are attempting to improve flight planning, management and operating techniques.

Some of the changes alter the operating characteristics of aircraft and it is here that **ANSPs** becomes involved

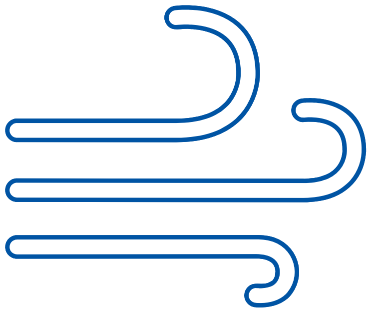
Any reduction in fuel consumption will lessen aviation's effect upon the environment and provide operators with benefit of lower costs.

There is no intent to change rules or existing **ATC** procedures – and

The primary focus must remain on Safety.

The recent rise in the price of fuel means that aviation fuel costs now account for approximately up to **40%** of the total operating costs.

strategic Air Traffic Planning and Management practices can influence and complement Operators' fuel management practices.

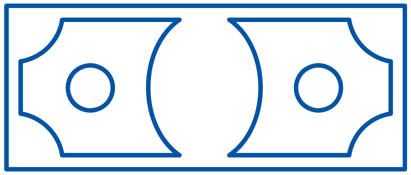


As an example, there are approximately **38.3 million** scheduled air transport operations around the globe **in 2019**.

IF The average flight time is about **1 hour and 37 minutes**.

Reducing flight time by just **1 minute** per flight would reduce airline operating costs by **US$ 3,600,000,000!**

The average transport aircraft burns **50 kg** of fuel per minute. **30 million minutes** will consume **1,500,000** metric tons of fuel and produce **4,725,000** metric tons of **CO_2**.



Airspace Planners must review routes, **SIDs** and **STARs** and to work with local airlines Representatives to ensure that established procedures and routes more closely match the capabilities of the fleets.

The use of Performance Based Navigation **(PBN)** is to be encouraged as a tool to redesign the airspace and develop procedures and enroute structures based on the **PBN** concept.

Climb

The core capabilities that should be leveraged are **RNAV; RNP** where possible, and needed continuous climb operations **(CCO),** increased classification; and Air Traffic flow Operating at the optimum flight level is a key driver to improve flight fuel efficiency, minimizing atmospheric emissions.

A large proportion of fuel burn occurs in the climb phase and for a given route length,

A/C departing on a heading away from the destination airport their climb speed will be decided by the following:

- 1st .. If departure control needs **DISTANCE** before a turn, the aircraft will complete the noise abatement procedure and accelerate to optimum clean speed to **3000** ft **AGL** before turning to on-course

- 2nd .. If altitude is required before turning, the aircraft will maintain takeoff flap setting and minimum speed (or max pitch) up to that altitude, trading speed for altitude.

3rd .. When cleared to turn to a normal climb-out heading the Pilot will use the maximum permissible bank and minimum speed until within approximately **90°** of the on course heading and will then commence flap retraction and acceleration to normal climb speed.

At many airports, it is permissible to allow aircraft to accelerate to the optimum climb speed as soon as clear of traffic.

Most aircraft will be more efficient at climb speeds approaching **300 kt**

Descent

A properly planned and executed descent provides the greatest opportunity to save fuel.

The ideal profile is an unrestricted descent from cruise altitude top of decent point **(TOD)** without using engine thrust or drag devices until on final approach.

Continuous Descent is one of several tools available to aircraft operators and ANSPs to benefit from existing aircraft capabilities and reduce noise, fuel burn and the emission of greenhouse gases.

without compromising the optimal Airport Arrival Rate **(AAR)**.

CDO is enabled by airspace design, procedure design and facilitation by **ATC**, in which an arriving aircraft descends continuously,

An optimum **CDO** starts from the top-of-descent **(TOD)** and uses descent profiles that reduce controller-pilot communications and segments of level flight.

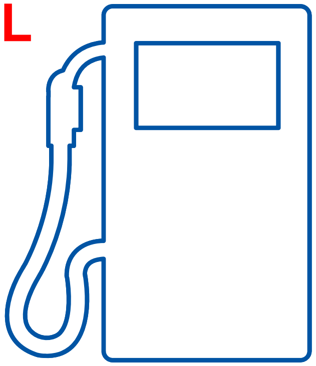
Furthermore it provides for a reduction in noise, fuel burn and emissions, while increasing flight stability and the predictability of flight path to both controllers and pilots.

A significant increase in fuel burn results when descent is commenced either too early or too late.

In cases where descent is started just ten miles early will result in a penalty of over **200 kg** of fuel on a **B777**.

If there is a message that comes in clear from all airlines, it is that

VECTORING ALONE FOR SPACING USES TOO MUCH FUEL



What Can Air Navigation Service Providers do?

Review and actualize airspace concept, **SID** and **STAR** design to utilize modern aircraft's capability

rather than the lowest common denominator or ground based navigation infrastructure approach, using **PBN**

Establish a regular interface between the **ANSP** and **ATOs**

Appoint and empower an Environment and Fuel Champion

What Can Air Navigation Service Providers do?

Introduce performance metrics and indicators for Environment Key Performance Area

Introduce environment and fuel conservation training for Air Traffic Controllers

Require Air Traffic Controllers to undertake Familiarization Flights on a regular basis

Agree to a system of structured familiarization visits for Pilots to Air Traffic Control Centers and Control Towers

What Can Air Traffic Controllers Do?

Whenever safety permits ATC should:

Accommodate aircraft taxiing with some engines shut down

Approve alternate runways when practicable

Approve takeoff in the direction of flight

Be aware of the impact of assigned levels on fuel efficiency

Offer direct routing rather than just clearing a Pilot on a direct route

Co-ordinate and issue descent clearance timely and at Pilot's discretion

What Can Air Traffic Controllers Do?

When holding is anticipated, Pilots will normally prefer to slow down to absorb as much of the delay while en-route prior to entering the holding pattern

Use speed control rather than heading vectors where possible,

otherwise use a combination of the two

Try to approve optimum altitudes

Continuous Climb Operations (CCO)

ICAO in cooperation with appropriate authorities is developing Continuous Climb Operations/procedure that will reduce the level flight segments during climb outs.

These procedures will normally require **RNP** capabilities.

Continuous Climb Operations (CCO)

This procedure will reduce fuel consumption during climb-out with associated noise and emission reduction.

Significant development work is still required before introduction as a day-to-day procedure.

The savings will be a function of the number and durations of the level offs during the climb phase.

RNP capability will be required to ensure that the aircraft adhere to the climb corridors and altitude windows during the climb.

Distance, Speed and Altitude Trade-off

As a rule, descent speeds are approximately **20 KIAS** lower than climb speeds.

The impact on fuel consumption for descent speeds between **240 KIAS** and **280 KIAS** is small.

However, for descent speeds above **280 KIAS**, the drag increases rapidly.

If descending at **VMO/MMO** instead of **280 KIAS**, the increased burn will vary from **75 kg** for an **A320/B737** to **150 kg** for an **A330/B777**.

Constant Descent Operation (CDO)

Constant Descent Operation (CDO)

In an attempt to increase the efficiency within the Air Traffic Control environment, **ICAO** (in cooperation with **IATA** and **ATSPs**) is proposing to standardize the concept of Continuous Descent Operation (**CDO**) procedures.

CDO concept presents several advantages.

Constant Descent Operation (CDO)

From an environmental point of view, **CDO** will result in a higher trajectory thereby reducing fuel consumption, noise and emissions.

Flight times will also be reduced due to less vectoring and reduced level flight segments.

The concept is to allow a flight to reduce to idle power using a low drag configuration from the top of descent for an uninterrupted descent to either the final approach fix or a metering point.

One option for employing **CDO** is the Closed Path Design, where the lateral flight track is pre-determined up to and including the Final Approach Fix (**FAF**).

The Open Path Design finishes before the **FAF** either in a downwind leg or a metering fix from where the controller will issue vectors or instructions to complete the approach.

Constant Descent Operation (CDO)

In this case, it is recommended that the Controller provide a Distance To Go to the touch down point to the Pilot who will use the estimated distance to manage the optimum descent rate to the **FAF**.

This process increases predictability, reduces Pilot/Controller communications and minimizes the possibility of Control Flight into Terrain (**CFIT**) as the profiles are accurately defined.

CDO also allows for a more efficient use of airspace as other traffic can be better accommodated because of the predictability of the descent-path profile.

CDO will reduce the Pilot and Controller workload.

The major challenge in implementing **CDO** procedures at airports is the spacing or time interval between flights.

Constant Descent Operation (CDO)

Many factors such as aircraft type, weight variation, pilot response, wind, temperature and atmospheric pressure variations, icing conditions,

weather, Special Airspace Usage, noise sensitive areas, traffic mix, airport capacity must be considered in determining the aircraft descent profile and spacing on final.

The **CDO** concept is based on Performance Based Navigation (**PBN**). As terminal traffic increases, it becomes more difficult to accommodate several aircraft simultaneously.

Constant Descent Operation (CDO)

Techniques of en-route speed adjustment (**±0.02 Mach**) and accurate estimates by aircraft (Required Time of Arrival) at metering points such as **TOD** are used to sequence aircraft.

The speed adjustment optimization must be viewed from a system wide efficiency, i.e. total burn, total flight time.

The savings associated with the **CDO** procedures when implemented at some airports during low traffic periods can generate significant savings.

The best in class airlines will use every opportunity to use the **CDO** procedure at airports where it is applicable.

THANK YOU

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