CLIMATE ACTION
TAKES FLIGHT

DOMESTIC AIR TRANSPORT ACTION AND THE NDCs

ADVANCING APPROPRIATE DOMESTIC AVIATION CLIMATE ACTIONS

Aviation connects the world. Some 50,000 routes bring together over four billion passengers each year, connecting remote communities with global cities and building bridges between States at different levels of development whilst carrying a third of world trade by value and over half of global tourists. The air transport sector has a crucial role to play in sustainable development around the world, which includes a responsibility to do what it can to limit its environmental footprint.

Aviation's largest climate change impact is from the burning of jet fuel, accounting for around 2% of global carbon dioxide (CO_2) emissions, with around 65% being generated by international flights and the remaining 35% from domestic operations.

- The International Civil Aviation Organization (ICAO) has a mandate to work on the reduction of CO_2 emissions from international flights. ICAO, with the support of the commercial aviation sector, has put in place a robust framework of action in this regard, including advancing CO_2 reductions through technology, operations and infrastructure measures and adopting the world's first global market mechanism for any single sector's emissions growth.

  See www.enviro.aero for further information on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

- Emissions from domestic aviation activities (domestic flights, non-aircraft airport operations and the 'ground-based' activities of the other parts of the aviation value chain) are subject to country-specific actions and therefore fall under the scope of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement's nationally-determined contributions (NDCs) structure. NDCs communicate to the UNFCCC Secretariat country-level commitments and strategies to reduce carbon emissions and increase resilience for the post-2020 period

  This report intends to provide some smart actions (highlighted in » blue) that governments can take to help implement to reduce CO2 emissions from domestic aviation activities.

Regardless of whether a country has expressly spelled out domestic aviation-related goals or measures in its NDC, there is opportunity for governments to work with the aviation sector to advance CO_2 emissions reductions from domestic aviation. While the frameworks for climate action for international and domestic aviation differ, many of the technology, operations and infrastructure measures taken in respect of international aviation can provide CO_2 reduction benefits domestically, and vice versa.

Aviation is, by its very nature, an extremely mobile activity. Very few of the actions suggested in this paper relate solely to domestic aviation. For example, a measure that enhances efficiency in taxi, take-off and landing at an airport will assist the reduction of CO_2 from both domestic and international flights. Likewise, today's modern, efficient, aircraft sometimes undertake missions to both domestic and international destinations in a single day. Therefore, there is often no clear line between what is a 'domestic' mitigation action covered by the Paris Agreement and one which is done under ICAO guidance. Indeed, several ICAO projects have benefits for domestic operations:

- The **ICAO CO_2 Standard** is the world's first certification standard for the CO_2 emissions of new aircraft. Whilst fuel efficiency has always been a driving goal in aircraft design, from 2020, new aircraft types will need to demonstrate that they can meet stringent fuel efficiency (and therefore CO_2) standards and be certified to those standards. And from 2023, such fuel efficiency standards will apply to new deliveries of all aircraft types. This process involved a technical working group of governments, industry and environmental groups. While, strictly speaking, the standards will only have to be met by aircraft used for international flights, in practice no distinction will be made between aircraft manufactured and used for domestic or international routes.

- ICAO has invited all States to develop **State Action Plans** to identify and implement measures to address CO_2 emissions from international aviation. The ICAO State Action Plans project[1] is an excellent way to identify suitable mitigation options for individual States. Over 100 States have already submitted these plans, aided by two joint assistance programmes with the European Union and UNDP. Whilst these plans are primarily aimed at international aviation actions, most of the actions will also help mitigate domestic emissions or can be dual-purpose.
- ICAO has also developed the **Global Air Navigation Plan**[2], approved by States, which will lead to the modernisation and improvement in efficiency of air traffic management around the world. Although developed by ICAO, this also has domestic-level efficiency improvement benefits.

This paper outlines a range of 'smart' mitigation options for domestic aviation climate action. Some of the suggestions are applicable in all States, whilst some (particularly in the technology section) are more suited towards States with an active aerospace manufacturing sector.

These options tend to focus on what governments are able to achieve, as many mitigation efforts are already underway across the aviation industry. For information about the full range of activities being undertaken by the aviation sector, refer to www.enviro.aero.

SUPPORTING INDUSTRY MITIGATION ACTION

THE INDUSTRY STRATEGY

In 2008, the aviation industry presented the world's first global transport sector climate action framework. The strategy is based on a set of three global goals, underpinned by four pillars of climate action. It is a joint effort, with collaborative action taking place across the aviation sector. Airports, airlines, air traffic management organisations, the manufacturers of aircraft and engines and partners across the supply chain are working together on action that will reduce aviation CO_2 emissions.

Goal one: from 2009 until 2020: average 1.5% efficiency improvement per year

Whilst efficiency measures have already delivered significant fuel use reductions – a flight taken today will produce around half the CO_2 that the same flight would have in 1990 – the industry committed to pre-2020 action with a further increase in fleet-wide fuel efficiency of 1.5% improvement on average each year (17% overall). This goal is being met by the industry.

Goal two: from 2020: capping net CO_2 emissions growth from aviation through offsetting

The aviation sector has agreed to cap its net CO_2 emissions at the 2020 level. From this point on, emissions the aviation industry is unable to reduce through operational, technological or infrastructure measures, or by using sustainable aviation fuels, will be subject to offsetting under a globally-agreed market-based measure. Indeed, in October 2016, governments meeting at ICAO agreed the mechanism to help make this possible: the CORSIA.

Goal three: by 2050: halving net CO_2 emissions based on 2005 levels

After 2020, the industry will start seeing some of the larger emission reduction possibilities of advanced technologies and sustainable aviation fuels. These two major factors, as well as continuing work on infrastructure and operations efficiency, will allow the industry to aim for the most ambitious goal: that net carbon emissions from aviation in 2050 will be half of what they were in 2005 (around 320 million tonnes of CO_2), despite the growth in passenger numbers and cargo.

Below are a number of options that States may wish to make part of their NDCs to help towards these goals. These are in addition to actions already being taken by the industry itself, including investment in new technology aircraft.

It is important to recognise that circumstances and challenges vary from one country to the other. States should assess the effectiveness and costs of potential mitigation options in cooperation with, and based on the input of, the industry. This will ensure that policies implemented take into account the requirements of everyday operations.

SUSTAINABLE AVIATION FUELS

Sustainable aviation fuels present a unique opportunity to significantly reduce aviation CO_2 emissions. These fuels, which must meet stringent jet fuel certification specifications, making them virtually identical to traditional jet fuel, have been tested and certified over the past seven years. They are currently being used in commercial flights from a number of airports, with more to follow. They can be generated from sustainable sources (such as non-food crops and waste by-products) and can lead to an up to 80% reduction in lifecycle CO_2 emissions when compared with fossil fuels. However, commercialisation in significant quantities remains a challenge.

» States can develop policies that help support the growth in sustainable fuel deployment, promoting its use for aviation, either providing a level playing field with other uses, or prioritising its use in air transport.
» De-risking private investment in new (or refurbished) processing and refining production facilities can help supply aviation with cleaner fuel whilst creating new clean energy industries.
» Providing academic support to research into new feedstocks and production pathways could generate new ideas for sources of sustainable aviation fuels.
» Supporting the sustainable aviation jet fuel specification review and approval process administered by ASTM International and which provides the basis for sustainable aviation fuel acceptance around the world.
» Ensuring that any fuels used for air transport align with globally-accepted standards of sustainable production will ensure airlines are willing to use these fuels.
» Whilst mandates for the use of sustainable aviation fuels are not recommended, to the extent they are considered a "smart regulation" approach is best: assessing the potential for commercially-viable production and cost-effective deployment; exploring the options with airlines that will use the fuel; and carefully and gradually increasing the mandate over time are among the best practices that must be considered.

TECHNOLOGY

New technology aircraft are, on average, around 15-20% more fuel-efficient than the models they replace. Over 12,500 new technology aircraft have been added to the world's airline fleets since 2009 and a further 4,500 will be produced in the next few years. Many of these replace older, less efficient, aircraft.

A range of technological advancements, including more efficient engines that burn less fuel and the use of lighter weight composite materials will help ensure the efficiency of aviation continues to improve.

Recently, there has been a significant increase in research and innovation on new technologies, designs and aircraft configurations to reduce the environmental impact of aviation. This includes new and radical long-term concepts such as hybrid electric-powered aircraft or blended-wing bodies.

New technology is making air traffic management more efficient. Automation enables aircraft to reduce their separation distances from each other while maintaining safety, optimising the flow of

traffic thereby increasing capacity and reducing delays. Space-based surveillance will enable aircraft to be tracked in remote and oceanic areas not currently covered, also enabling aircraft to reduce separation minima.

- States can support investment in efficiency research and development in academic institutions and with joint research programmes with industry. Currently, the major manufacturers of aircraft and engines invest around $15bn per year in efficiency R&D. These research programmes can support new aircraft technology, improved air traffic management technology and techniques (such as the European SESAR, United States NextGen and Asia-Pacific CARATS initiatives), or development of sustainable aviation fuels.

OPERATIONS

Emissions from aviation can be reduced through operational measures (measures that improve the way aircraft are flown). These include taxiing on a single engine, electric taxiing, continuous climb on departure, reaching the optimum efficient cruising altitude faster, or ensuring aircraft can use ground power when parked at the airport.

Operational measures are typically within the remit of the industry itself, but States can support efficiencies through some simple measures.

- Establish working groups where aircraft operators, airports, air navigation service providers and government agencies cooperate to identify operational opportunities to reduce fuel consumption and emissions, while also addressing interdependencies with other environmental impacts of aircraft operations such as noise.

INFRASTRUCTURE

A lot of fuel is consumed and CO_2 emitted through circumstances outside of the aviation industry's full control – having to navigate around military airspace or around national borders, for example.

However, new satellite-based surveillance and air traffic management tools and better coordination between aviation industry partners are able to help us with more flexible use of airspace and more direct routing. Collaborative decision making by airline, airport and air traffic management agencies can allow for more joined-up thinking and ensure that pilots do not start their engines until taxi and take-off are available, for example, or otherwise providing the most efficient landing procedures.

- Implement performance-based navigation (PBN), which uses global navigation satellite systems and computerised on board systems rather than fixed ground based beacons. It allows aircraft to fly more efficient routes with greater accuracy thus reducing CO_2 emissions. PBN is the highest air navigation priority of ICAO and it has set States targets to implement PBN; however, many States have fallen behind in implementation.
- Work with other States in your region to harmonise airspace, particularly in congested areas.
  - Work with industry to implement 'air traffic flow management': the regulation of air traffic to ensure available capacity is used efficiently. Combined with collaborative decision-making it enables air traffic management to work with airlines and airports to manage traffic from gate to gate more efficiently; increasing capacity, reducing delays and saving CO_2 emissions. It works best when States cooperate over a whole region. Recent evaluation in Asia Pacific show significant fuel savings.
  - Traditionally, aircraft have flown along fixed routes in the sky and this does not always offer the most direct route. Free route airspace, which is being developed in Europe, allows aircraft to plan more efficient routes with more stable trajectories, saving flying time and reducing emissions. Free route airspace requires cooperation across those States over which an aircraft flies.
- States need to invest in and modernise ATM infrastructure if they are get the benefits of aviation, avoid capacity crunches and reduce aviation CO_2 emissions.
  - States should ensure they implement one of the key elements of the ICAO Global Air Navigation Plan: the Aviation System Block Upgrades. These set the course for operational improvements and aviation technology investments over 20 years and allow States to modernise at their own pace. They help States identify priorities; and advise on cost-effective solutions. For example, less developed States can make the jump straight to the latest technology; using satellite-based and digital systems rather than investing in ground-based systems and expensive infrastructure. The ASBUs will enable future aviation systems worldwide to efficiently manage demand and enhance safety, capacity predictability, and environmental stewardship.
- Free up military airspace, or make it flexible-use. This is a particular issue in some parts of the world, where up to 50% of the airspace is reserved for military use (and it is often not used for much of the time). Civil aircraft must fly around these areas, adding time and fuel burn. By reducing the size of these areas, or making them flexible-use, more direct flights are possible and this can bring significant fuel (and CO_2) savings.

ACTIONS ON THE GROUND

A number of non-aircraft projects for ground-based airport operations are being pursued. These include airport terminal energy efficiency initiatives and low-carbon energy in ground service vehicles. Such measures tend to be covered in national climate change plans for ground-based sources of emissions. Whilst not subject to the cross-industry global emissions targets, the aviation industry is working in collaborative ways to limit and reduce CO_2 emissions from ground-based facilities.

- The Airport Carbon Accreditation programme[3] is an excellent airport-based CO_2 measuring and reduction system, established by Airports Council International and available to airports of all sizes worldwide. States are invited to encourage airports to take part in this programme and strive for the highest level of accreditation.
- Many airports are perfect locations for the use of different types of renewable energy on-site, such as wind, solar or geothermal energy. For instance, over 100 airports worldwide have already installed photovoltaic plants on airport property. Whilst careful consideration must be given to the placement, direction and angle of the solar cells (due to potential glare for pilots), States are encouraged to assist airports in identifying the most relevant renewable energy sources for on-site use depending on the local climatic, geographic and economic contexts. Governments worldwide can support airports in establishing these installations, where they make sense.
- States undertaking transport infrastructure planning should consider the intermodal opportunities that exist in linking airports with urban transport networks, as surface access is one of the most significant local emissions sources at airports. At the same time, intermodal connections can reduce traffic and congestion for both passengers and airport employees, thus contributing to better airport experience and working conditions. Convenient connections to long-distance and high-speed rail also create inter-ticketing options that can have benefits.

MARKET-BASED MEASURES

To the extent that market based measures are considered, they must be carefully calibrated so they do not harm traffic growth and connectivity. Further, any such measures should support – rather than detract from – the array of technology, operations and infrastructure measures being pursued to reduce aviation CO_2 emissions.

Following several years of deliberations at ICAO, a global offsetting scheme was identified as the most appropriate measure to be used to deal with aviation emissions growth. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) will apply offset requirements to international flights between participating States starting in 2021. The first phases of CORSIA are voluntary for States; however the latter years are mandatory for all but the smallest States and States in special circumstances. Consequently, over 80% of the growth in aviation CO_2 post-2020 will be offset through the CORSIA.

The CORSIA is a cost-effective solution in comparison with the costs that would result from multiple national or regional schemes, which would create differing compliance requirements and the risk of market distortions. This observation is reflected in *ICAO Assembly Resolution A39-3*, which determines that the CORSIA is to be the market-based measure applying to CO_2 emissions from international aviation. In other words, the CORSIA is the single mechanism that should be applied to international flights – no other carbon pricing instruments, such as CO_2 levies or emission trading schemes, should be levied on international aviation.

When it comes to domestic operations, taxes and levies can add significant costs to airlines and do not have the desired environmental effect. Properly designed domestic emissions trading schemes may have positive CO_2 mitigation impacts, but are often complex. In addition, as all airlines will have to monitor and report CO_2 emissions to their authorities under the CORSIA, implementing an additional scheme for domestic aviation could result in a high administrative burden for both operators and authorities.

» If a State assesses that a market-based mechanism for domestic aviation activity is necessary to complement other mitigation measures in a cost-effective way, the preferred option would be an offsetting scheme that could be made compatible with the ICAO CORSIA. This could ensure ease of compliance and no double-counting of either emissions or offsets. The monitoring, reporting and verification infrastructure is being developed already as part of the CORSIA rollout, so countries that wish to explore an offsetting option for their domestic aviation would have information and resources to work with when considering such a scheme.

ADAPTING TO THE CHANGING CLIMATE

With safety as the number one priority of the sector, aviation has always needed to deal with weather-related disruption. From fog, to snow, to storms, air transport is a sector that is well used to changes in the skies and on the ground impacting operations. Many of the impacts that climate change may have on the sector can be responded to as part of the normal operational reaction of the industry. These could include impacts due to[4]:

- Increased storminess leading to flight diversions or cancellations.
- Increased turbulent weather at flight level altitudes.
- Ambient weather extremes: more snow-impacted operations; higher temperatures can impact aircraft take-off performance; increased rainfall could impact runway conditions.
- Changes in passenger destination preference: increasing temperatures could make some destinations too hot during certain times of the year; conversely some destinations may become more attractive.

However, there may need to be more fundamental investment in some locations, particularly at low-lying airports in many developing nations.

» Aviation infrastructure resilience should form part of any State review of infrastructure adaptation planning, or changes in building codes of construction. Consultation with stakeholders (including airport operators, airline companies, air navigation service providers, ground transport providers) is a vital step in helping to build resilience of the aviation infrastructure that can help maintain connectivity. Key facilities include airports and associated runways, air navigation equipment, electrical supply lines and airport ground transport infrastructure (roads, rail connections).

PARTNERSHIP FOR ACTION

Air transport relies on collaboration and partnerships – between industry players and with governments and external stakeholders. It is a complex business and each State and region has unique aviation situations and experiences, so consideration of air transport-related actions relative to a State's NDCs should be undertaken in consultation with local experts from aircraft operators, air navigation service providers, airports, aerospace suppliers and civil aviation authorities.

» All States are encouraged to submit voluntary ICAO State Action Plans and renew those plans in collaboration with industry stakeholders.

» All States are encouraged to actively work with local industry experts to develop mitigation and adaptation plans and options for aviation. Air transport is a complex and interlinked business that can present challenges for those unfamiliar with the operational and strategic requirements.

REFERENCES AND RESOURCES

1. Further information can be found on the ICAO website: http://bit.ly/2foU0zs
2. The *Global Air Navigation Plan* can be found on the ICAO website: http://bit.ly/2wvtvOt
3. This programme, recognised by both UNFCCC and ICAO, is based on four ascending levels of accreditation of airport carbon management, with carbon neutrality being the highest one. As of 1st September 2017, 193 airports worldwide are accredited under this programme, representing 38.5% of world air passenger traffic. See the website: www.airportCO2.org
4. More analysis on aviation climate resilience was incorporated into the Eurocontrol *Challenges of Growth 2013* report: http://bit.ly/1gDf1lu