

Allocating aviation CO2 emissions; **The airspace-based approach and its alternatives**

Introduction

The ICAO Council established a High Level Group in International Aviation and Climate Change (HGCC) last November to consider political questions relating to a global market based measure (MBM) for international aviation and a Framework for MBMs. The Framework basis should harmonise state/regional MBM schemes that could build over time into a global scheme. Provisions for geographic scope in the Framework and global architecture should be consistent in order to avoid duplication. The Framework should presumably contribute towards a workable resolution of the dispute over the EU ETS. However, some states see the Framework as merely intended to “contain” the EU ETS, in which case the two architectures – Framework and global – might not be compatible. So a key question for ICAO is how geographic scope is treated in the national/regional MBM Framework.

The EU stopped the clock on enforcing the aviation ETS for flights to/from Europe last November in order, according to the Commission, to give ICAO time to decide a global measure at its 2013 triennial Assembly next September and agree a Framework that would presumably enable the clock to be restarted on accepted terms. Opponents of the EU ETS reject their carriers being unilaterally subject to regulation and want “mutual agreement” by governments; allege infringement of sovereignty because emissions allowances must be surrendered for flight emissions outside EU airspace and over their territory; and reject unilateral measures in favour of a global ICAO solution. The EU, supported by the ECJ, argued that full flight fuel burn was merely the basis for calculating an obligation as a condition of landing in the EU.

Current Options

The HGCC is considering three alternatives for carbon allocation and for the geographic scope of market-based measures when implemented at a national or regional level or for allocating responsibility to states under a global scheme. They are based on:

1. all departing international flights from a state;
2. all international flights carried out by operators registered in a given state;
3. international flights on the basis of the nationality of airspace travelled through.

1. Departing flights

Possibly the fairest, most straightforward, option for a global measure. Southgate recommends the UNFCCC reporting method to determine emissions; via fuel sales by country¹ Figures would need to be apportioned to carriers if required. There is a standard conversion factor for fuel burn to

¹ David Southgate, ICAO Options for Allocating International Aviation CO2 Emissions Between Countries - An Assessment, <http://southgateaviation.wordpress.com/2013/01/11/icao-options-for-allocating-international-aviation-co2-emissions-between-countries-an-assessment/>

emissions. The EU ETS holds air operators responsible for all emissions of all flights both departing from and arriving in Europe and uses actual fuel burn not fuel sales.

2. Operators registered in a given state

For a global scheme countries would account for the emissions of all their registered operators worldwide. Carriers would presumably report fuel burn including that uplifted in foreign countries if ICAO decided they were to be the responsible entities.

For a national/regional scheme all registered carriers would report their fuel burn to their national authority. Whether to report global or regional fuel burn is unclear. If regional, what is the definition of regional? – regional airspace (option 3) or departing flights (option 1)?

This option effectively requires mutual agreement – attractive to developing country concerns. If no or only some states agreed, potential competitive distortions, carbon leakage and evasion (indirect routings), would render the whole scheme unworkable. Industry has been clear in rejecting schemes involving competitive distortions.

Airspace

Under global airspace, countries would be responsible for all flight emissions over their national territory – or out to their 12 mile territorial sea limit. Emissions of overflights (aircraft not landing in their territory) would be included.

National/regional schemes would capture emissions over sovereign territory although Flight Information Regions (FIRs) could also be the basis. If, the argument goes, foreign carriers were only required to surrender permits for pollution created over European airspace, the ETS sovereignty dispute would presumably be resolved.

Allocating international aviation CO₂ – history

The issue is longstanding and contentious having eluded negotiators for more than 15 years. One reason is that countries' carbon obligations can vary significantly depending on the option.

SBSTA: airspace not an option

In 1996 SBSTA² considered 8 allocation options, ruling out 4 as impractical but failing to agree on the other allocation options:

- the country where the fuel is sold;
- the nationality of airlines;
- the country of destination or departure of aircraft. Alternatively emissions could be shared by the countries of departure and arrival;
- parties according to the country of departure or destination of passenger or cargo. Alternatively, the emissions related to the journey of passengers or cargo could be shared by the countries of departure and arrival.

SBSTA never deemed airspace-based allocation of CO₂ emissions as a viable option. The other two HGCC approaches were on their shortlist.

IPCC: departing/arriving flights

² Report of the Subsidiary Body for Scientific and Technological Advice on the work of its fourth session, Geneva 16-18 December 1996, Item IV.B.2. – conclusions.

In 2006 the Intergovernmental Panel on Climate Change (IPCC) produced *Guidelines for National Greenhouse Gas Inventories*. These guidelines represent the state-of-the-art technical guidance of experts in the aviation, maritime, and inventory fields to clarify how countries differentiate between emissions from domestic and international flights. Emissions from international aviation (International Bunkers) are defined as “Emissions from flights that depart in one country and arrive in a different country, including take-offs and landings for these flight stages” while Emissions from domestic aviation are defined as “Emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages” Most UNFCCC Annex 1 countries report their domestic and international (as a footnote) emissions based on fuel sales as a proxy for flight fuel burn.³

ICAO guidance on emissions trading

In 2004 ICAO balked at developing global emissions trading, citing concerns about acting in a regulatory capacity as scheme administrator. The 2004 Assembly did, however, recommend that states/regions could implement emissions trading – the origins of the EU ETS - and asked that guidance be developed. Initial text on such guidance put to the 2007 ICAO Assembly identified the pros and cons of the route and airspace based options. These were the only two options considered and while an ICAO preference was not explicitly stated, the airspace option was described as impractical, open to significant administrative problems and enforcement difficulties and complex if overflights were included;

ICAO Guidance on the Use of Emissions Trading for Aviation
Chapter 3. Regulatory Considerations;

Routes

3.2.22 This option corresponds to delimiting the scope of the scheme to incorporate emissions from flights operated on selected routes. State(s) participating in an emissions trading scheme will need to decide which international routes are covered by the scheme. It is not necessary to cover all routes to and from a country.

3.2.23 State(s) would need to decide whether to include in the scheme emissions from flights arriving or departing on predetermined routes. A combination of the two could also be formed, corresponding to 50 per cent of emissions from all arriving flights and 50 per cent of all departing flights (an apportionment would be necessary to avoid duplication). Given that most routes are generally operated with the same frequencies in both directions, the three variants are more or less equivalent in emissions coverage.

Advantages

3.2.24 A benefit of not initially including all routes would be the increased ease of implementation and administration.

3.2.25 An advantage of using solely the country of departure or arrival would be that should additional States cover international aviation emissions in their schemes over time, this would avoid duplication and would promote compatibility.

Disadvantages

3.2.26 A disadvantage to not including all routes would be the potential for inducing competitive distortion. To avoid competitive distortion, it would be desirable to include routes to locations that are geographically proximate.

³ See for example David Southgate, ICAO Options for Allocating International Aviation CO2 Emissions Between Countries - An Assessment, <http://southgateaviation.wordpress.com/2013/01/11/icao-options-for-allocating-international-aviation-co2-emissions-between-countries-an-assessment/>

3.2.27 The “50 per cent and 50 per cent” option would require for each flight an additional data report (of trip fuel and/or emissions) and essentially double the number of flights to be accounted for in a given scheme. This could create an additional administrative burden.

3.2.28 Another potential disadvantage is that it could encourage carriers to shift operations to neighbouring States not participating in the scheme, causing market distortions and potentially adding to flight distance and emissions.

Airspace

3.2.29 Under this approach only emissions within the national airspace of the State (or States) administering the scheme would be included.

Advantages

3.2.30 This option is similar to how emissions from stationary sources are handled.

3.2.31 It treats carriers on the same routes over a designated airspace equally, reducing possibility of market distortion.

3.2.32 It also averts political sensitivities about including emissions from operators outside of the airspace of the emissions trading scheme.

Disadvantages

3.2.33 Options defined solely on the basis of national airspace are inherently limited in their coverage as emissions over the high seas will never be included and have the complication that they would automatically include overflights, unless these were somehow exempted. This could create significant administrative problems and enforcement difficulties.

3.2.34 Also, delimitation of geographical scope based on national airspace appears impracticable. The inclusion of overflights is already complex to administer and the inclusion of other measures to complete the coverage is increasingly complex with the added risk of double counting emissions.

Mutual agreement

The 2007 Assembly was dominated by the question of pending EU action with non-EU States calling for mutual agreement if a state wished to include foreign carriers in its scheme. This issue had not been discussed in 2004. 42 states lodged reservations against this view, but ICAO’s Council subsequently agreed additional text in the final document published in 2008; “States that wish to incorporate emissions from international aviation into their emissions trading schemes consistent with ICAO A36-22⁴ (Appendix L) should not implement an emissions trading system on other Contracting States’ aircraft operators except on the basis of mutual agreement between those States.”⁵

This formulation on mutual agreement was superseded at the 2010 Assembly by a Resolution urging “States to respect the guiding principles listed in the Annex, when designing new and implementing existing MBMs for international aviation, and to engage in constructive bilateral and/or multilateral consultations and negotiations with other States to reach an agreement”. The 2010 Resolution also recognised that some member states may take more ambitious action on GHG prior to 2020 yet those opposed to the EU ETS continued to argue that the EU’s move should have been decided in the ICAO context of a global solution.

⁴ 4. Forty-two States have expressed their reservation on the text contained in Appendix L of A36-22. The full text of their reservation is available in the Extracts of A36-MIN. P/9 (Minutes of the Ninth Plenary Meeting) at http://www.icao.int/icao/en/assembl/a36/docs/A36_MIN_P_9_en.pdf.

⁵ http://ec.europa.eu/clima/policies/transport/aviation/docs/icao_guidance_2008_en.pdf

Dissecting the Airspace Approach

Inadequate and inequitable coverage

The limitations of a global airspace scheme were set out 13 years ago by Wit and Velzen (2000)⁶. Emissions were allocated to 23 selected countries according to the original 8 SBSTA options. Emissions that remained unallocated to any other country above oceans and seas in an air space approach were found to represent 52.09% of total global emissions in 2010. Emissions based on airspace averaged 0.54% of total domestic emissions for the 23 countries, whereas those based on the other 7 SBSTA options averaged 1.14%. There were dramatic variations in some countries' allocations; the US share of global emissions under departing flights (2010 scenario below) dropped from 17.44% to 4.26% under airspace; the UK's from 6.48% to 1.31% while the former Soviet Union share rose almost fivefold from 0.78% to 3.75% under airspace.

Table 13 National allocations of international aviation CO₂ emissions, by allocation option, as a percentage of global international aviation emissions (2010)

Option	Allocation according to:							
	No allocation	National emissions	emis- Country of fuel	Airline sale nationality	Country of craft departure	air- Country of or pax dest.	Country of origin of pax or cargo	Emissions in national airspace
Country	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Australia		1.28%	3.00%	2.41%	3.05%	1.94%	1.29%	1.54%
Austria		0.23%	0.35%	0.32%	0.35%	0.33%	0.73%	0.45%
Belgium		0.46%	0.77%	0.76%	0.81%	0.82%	0.85%	0.26%
Brazil		1.54%	1.09%	1.27%	1.08%	1.10%	2.89%	0.84%
Canada		1.89%	2.30%	3.12%	2.33%	2.34%	1.98%	3.76%
Denmark		0.18%	0.71%	0.65%	0.68%	0.68%	0.60%	0.43%
Finland		0.23%	0.57%	0.52%	0.58%	0.34%	0.43%	0.21%
Former Soviet Union		13.71%	0.72%	1.48%	0.78%	0.69%	1.66%	3.75%
France		1.64%	3.76%	4.47%	3.76%	3.83%	4.79%	2.61%
Germany		3.47%	5.31%	6.25%	5.21%	5.24%	7.16%	2.08%
Greece		0.46%	0.69%	0.40%	0.73%	0.70%	0.41%	0.19%
Ireland		0.15%	0.32%	0.31%	0.31%	0.28%	0.28%	0.31%
Italy		1.75%	1.72%	1.54%	1.71%	1.71%	3.92%	0.70%
Japan		4.58%	8.97%	6.09%	8.98%	9.30%	11.38%	1.37%
Luxembourg		0.04%	0.17%	0.03%	0.15%	0.22%	0.06%	0.02%
Netherlands		0.68%	2.07%	2.72%	2.08%	2.38%	1.31%	0.34%
Norway		0.16%	0.20%	0.37%	0.22%	0.19%	0.50%	0.13%
Portugal		0.26%	0.45%	0.43%	0.45%	0.48%	0.37%	0.23%
Spain		1.13%	2.30%	1.69%	2.29%	2.13%	1.89%	0.79%
Sweden		0.25%	0.64%	0.53%	0.66%	0.54%	0.77%	0.28%
Switzerland		0.18%	1.36%	1.75%	1.36%	1.29%	0.91%	0.44%
United Kingdom		2.21%	6.45%	7.59%	6.48%	6.79%	4.54%	1.31%
USA		19.97%	17.20%	21.57%	17.44%	18.82%	28.11%	4.26%
Total		56.44%	61.12%	66.24%	61.49%	62.16%	76.81%	26.29%
Total, other countries		43.56%	38.88%	33.76%	38.51%	37.84%	23.19%	21.63%
Total, non-allocated	100.00%							52.09%
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%



⁶ Wit and Velzen, National allocation of international aviation and marine CO₂-emissions, 2000, available at: http://www.cedelft.eu/publicatie/national_allocation_of_international_aviation_and_marine_co2-emissions/195?PHPSESSID=ad8353cb75ccfd097561c2fc46a6f6a

Issues with overflights under airspace

Including overflights is problematic and complex (ICAO Guidance). Enforcement is complicated if aircraft do not land on the regulating territory. Southgate argues that such emissions more properly belong to the country benefitting from the flight itself – i.e. country of departure/arrival. Overflight charges have caused many disputes in the past, particularly involving states with large airspaces. Retaliation is one danger. Excluding overflights from EU airspace reduces emissions currently regulated to 35%.⁷

Implementation

Measuring fuel burn is the only option

Under the EU ETS, initial fuel on board is recorded - a known quantity for obvious safety reasons - and measured again on arrival to calculate flight fuel burn (APU consumption included). Per flight data is collated and an annual airline report is validated by an approved verifier. Verified reports of actual fuel burn are more accurate than using fuel sales as a proxy for fuel burn.

Modelling fuel burn is not an option

An alternative to using actual fuel burn figures would be to apply fuel burn modelling which is well developed and widely used by countries and organisations including ICAO to forecast traffic and emissions growth. During the drafting of the ETS Directive, industry rejected modelling as the incentive to reduce actual emissions was at the heart of emissions trading:

“There was a general agreement in the group that reporting of actual fuel use by airlines would be most accurate method and that it would provide the broadest possible range of incentives to implement reduction measures including operational measures that would not be encouraged if modelled consumption were used. It should therefore be the preferred approach. An airline association pointed out that airlines hold the most accurate information and that the information held by EUROCONTROL is mainly provided by the airlines”⁸

Legal issues with airspace definition

Determining airspace fuel burn requires a measurement when aircraft leave national airspace. In Europe there is no agreed definition of EU airspace; sovereign airspace of the EU 27 is a legal concept but presumably a suitable definition of “EU airspace” could be found. Defining national airspace elsewhere encounters territorial disputes such as over the Spratly and other islands in the South and East China Seas. China’s declaration of its sovereign airspace out 200nm to its EEZ has already been disputed. The ICAO Guidance notes that the “delimitation of geographical scope based on national airspace appears impractical”.

Measuring and reporting Fuel Burn in airspaces;

To determine fuel burn when exiting airspace, aircrew could manually read the fuel tanks (a routine safety measure) but these readings could not be the basis of a statutory obligation to surrender emissions permits since no verification would be possible to underpin enforcement. A tamperproof electronic system, verified prior to installation on the aircraft would be needed. Instantaneous

⁷ See Commission Staff Working Document, Annex to the Communication from the Commission “Reducing the Climate Change Impact of Aviation” *Impact Assessment* COM(2005) 459 final

⁸ European Climate Change Programme II, Aviation Working Group, Final report, April 2006: http://ec.europa.eu/clima/policies/transport/aviation/docs/final_report_en.pdf

instrument readings of fuel tanks would require flight management systems upgrades synchronised with autopilot systems. Modifications would need to be certified by authorities, and probably an ICAO technical standard agreed under Annex 16 of the Chicago Convention. The whole procedure including fleet installation could easily take up to a decade.

Multiple airspace jurisdictions per flight

A global airspace system could subject such flights as London/Singapore, Helsinki/Capetown, or Toronto/Buenos Aires to 10-15 jurisdictions. The cost of a global system to log and verify all cross border movements can only be imagined. Would industry bear the financial and administrative burden?

Monitoring regional airspace would be problematic even for the EU: how Eurocontrol or anyone else could perform this function for flights to places currently included in the EU ETS like French Guiana, Guadeloupe, Martinique, Reunion, St Martin, French Polynesia, Mayotte, New Caledonia, St Barthelemy, Saint Pierre and Miquelon, Wallis and Futuna, Aruba, Bonaire, Saba, Sint Eustatius, Curacao, St Helena, Asuncion, Tristan da Cunha, Montserrat, Pitcairn Is, South Georgia, etc (there are many more) is not immediately clear. Would excluding them out of administrative difficulty be feasible for, say, the Falkland Islands?

Perverse outcomes due to evasion would also be a problem; airlines already deploy sophisticated routing systems to minimise overflight charges. Diversions from direct routings to minimise carbon charges would mean increased emissions.

Airspace manoeuvres

Airspace as the basis for a global or national/regional Framework MBM is unrealistic as the ICAO guidelines recognise, yet it features high in the current ICAO discussions. Manoeuvring sunk the SBSTA work nearly 20 years ago yet it is reappearing as serious proposals; Wit and Velzen suggest the carbon emissions liability of the US/A4A carriers under airspace in 2010 would be slashed more than 75% compared to the departing flights or nationality of carrier options to a mere 4.26% of global aviation emissions. The US share of assessed contributions to ICAO's budget, based on national income per head and involvement in civil aviation, is set at the maximum 25% capped by Congress.⁹ Applying airspace to Singapore's 710km², home to Changi, Asia's 7th busiest (ACI) airport, would confront flight crew with the ludicrous prospect of having to report fuel burn while still trying to get the wheels up.

So what are the Options?

An effective ICAO Framework implemented by all States should achieve 100% coverage of international aviation emissions and be consistent with the guiding principles for MBMs agreed at the 2010 Assembly; MBMs should be transparent, administratively simple, cost-effective, minimise carbon leakage and market distortions and fairly treat international aviation vis a vis other sectors.¹⁰ Airspace fails on all these grounds. Only 50% of emissions would be covered. Less actually; ICAO is

⁹ http://www.un.org/auditors/panel/docs/icao_auditors_report_2010_en.pdf. Section 1v 6 Table C p78.

¹⁰ Resolution A37-19, ICAO 37th Assembly 2010 Annex; The guiding principles for the design and implementation of market-based measures (MBMs) for international aviation.

¹¹ <http://dgca.nic.in/env/Carbon%20Footprint%20Report%202011.pdf>
<http://www.icao.int/environmental-protection/Pages/action-plan.aspx>

not presently planning to account for the non-CO2 effects of aviation emissions which are potentially double or triple those of CO2 citing scientific uncertainty.

The nationality of carrier Framework option is hardly workable as it depends entirely on a web of mutual agreements. An agreed Framework which falls at the first hurdle because States do not agree, is not in fact an agreed Framework. Would states opposing the EU ETS today start helping administer it tomorrow?

That leaves us with the route-based departing flights option - where the EU started, and which just so happens to be the basis upon which ICAO is now developing its new CO2 Reporting and Analysis System (ICORAS) to enhance modelling, trend work and UNFCCC CO2 reporting. It will also track progress towards ICAO global aspirational goals. India's 2011 report on its domestic/international carbon footprint also uses this emissions methodology as do the forecasts in the Climate Change Action Plans of the USA, Canada, China, Australia and EU countries published on ICAO's website.¹¹

A variant to departing flights could be the SBSTA and ICAO 50/50 option; carriers in a national/regional scheme would account for 50% of their emissions on both incoming and outgoing legs. At least emissions on the runway of the other State would be left untouched.

If ICAO is not ready to agree a global MBM this year, then issues like the cap may take precedence over questions of global allocation. Yet the 2010 Assembly resolution calls for agreement on the Framework by 2013, in which case questions of geographic scope and mutual agreement become central. The HGCC is a political, not technical body. But political solutions having no basis in practicality merely serve to kick the can down the road, fuelling continued dissension.

Does ICAO have the political will and capability to discharge a responsibility handed to it 16 years ago? The position of one ICAO member may be key; as Senator Kerry said last June at a transportation committee hearing:

"The Europeans are right to question the motives of those who oppose their efforts, including India and China, and they're right to question whether the United States is serious about this issue, because we haven't been...the only way to deal with this is through global consensus, through hard outreach and I would urge our Europeans friends to follow it, and I urge us to follow it.

Global emissions belong to all of us, not to anyone's single airspace".¹²

¹²<http://www.greenaironline.com/news.php?viewStory=1642>