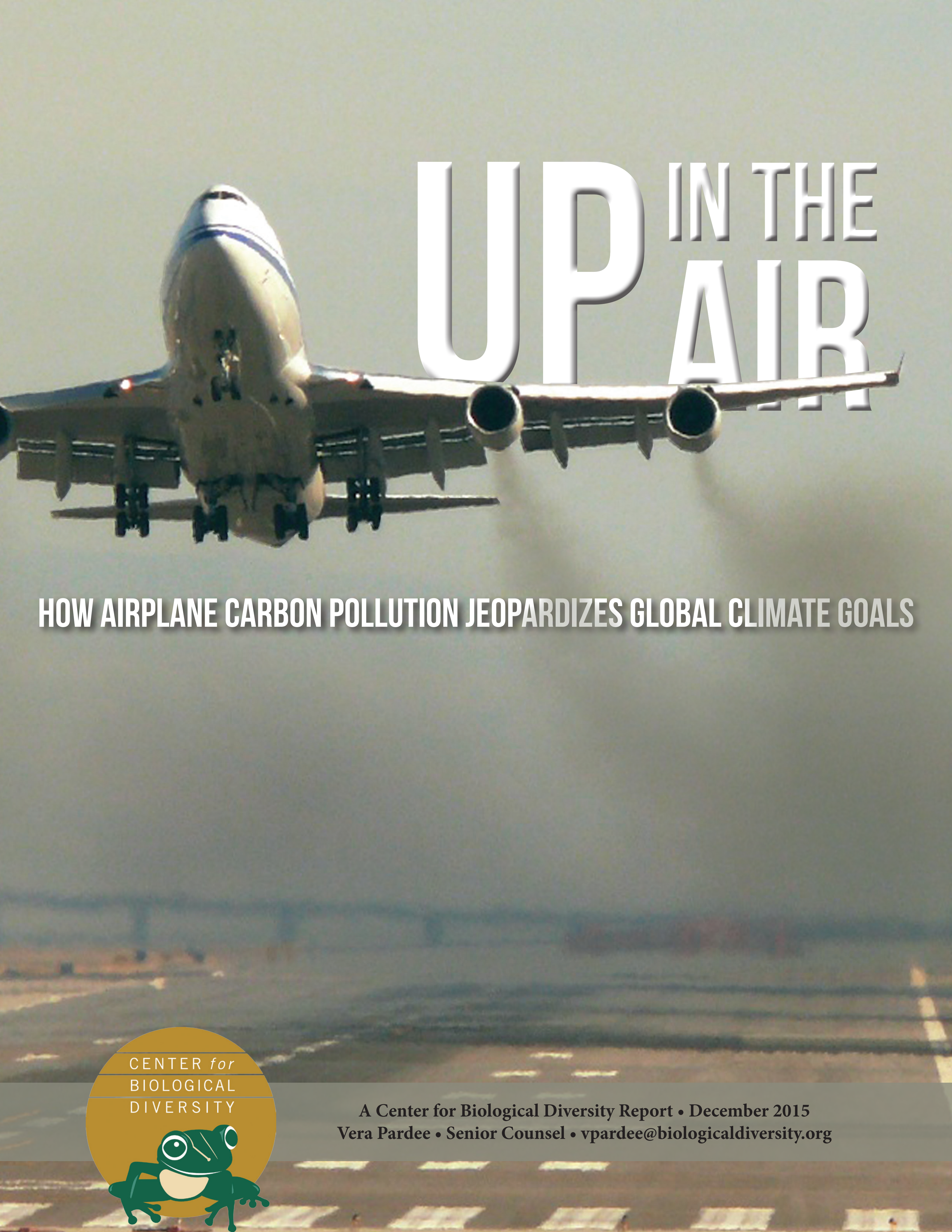

UP IN THE AIR

HOW AIRPLANE CARBON POLLUTION JEOPARDIZES GLOBAL CLIMATE GOALS

CENTER for BIOLOGICAL DIVERSITY

A Center for Biological Diversity Report • December 2015

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EXECUTIVE SUMMARY

If commercial aviation were considered a country, it would rank seventh after Germany in terms of carbon emissions. Yet as the world prepares for the Paris climate conference, it is uncertain whether or how negotiators will produce an international treaty that reduces airplanes' planet-warming pollution.

For this report, we analyzed projected global airline travel in the coming years to determine the cost to the climate crisis under a business-as-usual scenario.

We found that by 2050, aircraft emissions are projected to more than triple. Unchecked, between 2016 and 2050 global aviation will generate an estimated 43 gigatonnes of carbon dioxide emissions. That amounts to more than 4 percent of the world's entire remaining carbon budget – the amount of pollution that can still be emitted before catastrophic planetary warming becomes virtually certain.

The international response to airplane pollution has been weak. The overall goal of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris is to reduce all greenhouse emissions sufficiently to keep temperature increases below 1.5/2 degrees Celsius. But language folding aviation emissions into this goal was recently deleted from the Paris negotiating text and replaced by vague language that makes no mention of a temperature cap. These developments suggest that some parties would like to see this highly polluting industry exempted from the Conference's critical climate goal.

The International Civil Aviation Organization (ICAO), the U.N. agency responsible for addressing international aircraft pollution, so far has failed to tackle aviation carbon emissions. Over the last 18 years, ICAO has rejected, in turn, efficiency standards, fuel taxes, emissions charges and global emissions trading. The carbon emission standards now under consideration at ICAO barely bend the industry's steeply rising emission trend.

Despite the projected tripling of aviation emissions and the lack of any regulations, the aviation industry proclaims that it can attain its professed goal of carbon-neutral growth by 2020 by means of carbon offsets. But offsets are difficult to verify and monitor and should not displace readily available, cost-effective technical measures that can prevent and avoid – rather than merely offset – carbon pollution from new and existing airplanes.

Airplane pollution could be reduced dramatically. A recent International Council on Clean Transportation (ICCT) report evaluating the top 20 transatlantic air carriers found a 51 percent gap in fuel efficiency separating the top performers from the least-efficient airlines. The report highlights not only that technical improvements are an obvious and cost-effective first step before turning to offsets, but also that technological and operational advancements and fuel efficiency are inextricably linked.

Therefore, aviation emissions standards must be built on technology-forcing provisions that will drive fuel-efficiency gains. But ICAO's currently proposed standard is built on technology between 8 to 12 years *behind* the technology curve. Moreover, it would likely apply only to airplane types newly designed after 2023, and thus would cover just 5 percent of the global aircraft fleet in 2030 – barely bending the industry's ever-rising emissions curve.

The U.S. Environmental Protection Agency need not follow ICAO's ineffectual standards proposal. Instead, as the U.S. EPA points out, ICAO's standards must be consistent with U.S. law and appropriate for U.S. domestic needs. The U.S. Clean Air Act is designed to advance technology-forcing standards and protect public health and welfare. If ICAO fails to adopt an adequate aviation standard that also complies with U.S. law, the U.S. EPA will need to set more stringent domestic standards.

The U.S. is by far the largest contributor to aircraft carbon pollution and thus bears a special responsibility to combat the problem. Combined greenhouse gas emissions from U.S. aircraft are 7 times higher than aircraft greenhouse gas emissions from China, which itself ranks second in the world for aircraft emissions. Should the U.S. EPA set U.S. domestic aviation carbon standards, they will likely serve as a catalyst for international action.

Reducing airplane emissions is critical to the overall goal of the Paris climate summit. Unless the international community confronts this rapidly growing source of pollution, the world will find it nearly impossible to combat the climate crisis.

KEY FINDINGS

1. If global aircraft CO_2 emissions were compared to emissions of individual countries, they would rank *seventh* just behind Germany, outranking Belgium, the Czech Republic, Ireland, Sweden and some 150 other countries.[1]

2. Global aviation's contribution to manmade climate change is forecast to *triple* by 2050.[2]

3. According to the Intergovernmental Panel on Climate Change (IPCC), total cumulative future anthropogenic emissions of CO_2 must remain below 2,900 gigatonnes.[3] Of that amount, 1,890 gigatonnes of CO_2 was already emitted by 2011, leaving 1,010 gigatonnes of CO_2 left to emit.[4]

4. The International Energy Agency (IEA) projects that the world's estimated remaining carbon budget, consistent with a 50 percent chance of keeping temperature rises below 2° C, will be consumed by 2040 without aggressive international carbon emission cuts.[5]

5. Even if all emissions reductions pledged by countries this year are implemented, the Earth will still suffer 2.7[6]-3.5[7] Celsius of warming by century's end.

6. On its current trajectory, global aviation will generate an estimated 43 gigatonnes of CO_2 emissions under business as usual scenarios between 2016 and 2050 and consume more than 4 percent of the world's entire remaining carbon budget.[8]

7. For the last 18 years, the International Civil Aviation Organization (ICAO) has failed to implement any greenhouse gas regulations or other control measure.[9] Emissions standards currently under discussion would barely bend the climbing emissions curve.[10]

8. The United States is by far the largest aviation carbon polluter. The U.S. EPA estimates that emissions from U.S. aircraft "are *about 7 times higher* than aircraft greenhouse gas emissions from China," which itself is ranked *second* in the world for its aircraft emissions.[11]

9. U.S. aviation alone is estimated to release 9 gigatonnes of CO_2 from 2016 through 2050 under business as usual scenarios.[12]

10. The U.S. EPA has proposed to determine that U.S. aviation greenhouse gas emissions endanger human health and welfare.[13] Once the "endangerment finding" becomes final, U.S. law mandates that standards be set.[14] The standards now under discussion at ICAO do not meet U.S. legal requirements.

11. The Obama administration's *Cost of Delaying Action to Stem Climate Change* report conservatively values the cost of *delay alone* as at least $150 billion for *every year* of delayed action that leads to overshooting the temperature increase by just 1 degree Celsius over pre-industrial levels, and sharply higher annual costs for every degree of warming thereafter.[15]

AIRCRAFT EMISSIONS: UP, UP AND STEEPLY CLIMBING

A. Global aviation's contribution to climate change is forecast to triple by 2050

Global greenhouse gas emissions from aircraft are a surprisingly large and steeply growing contributor to the climate crisis. If global aircraft emissions were compared to those of individual countries, they would rank *seventh*, just behind Germany, and ahead of Belgium, the Czech Republic, Ireland, Sweden and some 150 other countries.[16]

Moreover, aircraft are one of the fastest-growing emission sources. Under business-as-usual scenarios, global aviation emissions are scheduled to *triple* by 2050.[17] ICAO confirms the trend, projecting 4.9 percent annual growth in air-passenger traffic[18] and 5.2 percent annual growth in air-freight traffic from 2010,[19] more than doubling global air traffic by 2030.[20]

If global emissions triple by 2050 as forecast, that year aviation alone could emit over 3 gigatonnes of carbon under a high-growth, business-as-usual scenario.[21] By comparison, Germany, the sixth largest emission source by country, currently emits 0.84 gigatonnes per year.[22] Cumulatively, from 2016 to 2050, some estimates put global aviation emissions as high as 43 gigatonnes.[23] Yet carbon from aviation remains unregulated.

As of the date of this paper, some 146 countries, including the European Union submitting as a bloc, have pledged emissions reductions in anticipation of the Paris negotiations, and many industries are responding to the global climate-change challenge.[24] For example, the U.S. light-duty vehicle sector is projected to reduce its emissions by approximately 30 percent from a 2010 baseline by 2035,[25] and the U.S. Clean Power Plan is projected to decrease emissions from U.S. power plants by 32 percent over 2005 by 2030.[26] In Europe, emissions have fallen 23 percent between 1990 and 2014,[27] and the European Union has pledged emission reductions of 40 percent by 2030 over a 1990 baseline.[28]

The sum of these efforts and pledges remains insufficient, as discussed below; aviation, however, has so far contributed nothing at all. That failure undermines global climate efforts and is neither fair nor justifiable.

B. The U.S. aviation industry is by far the largest carbon polluter in the sky

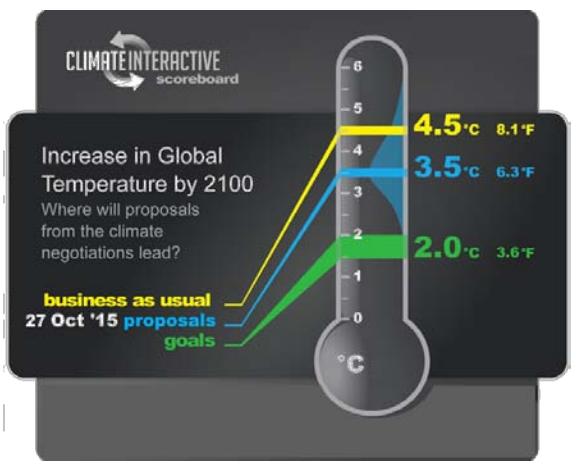
In 2014, the U.S. aviation industry alone emitted about 0.2 gigatonnes of greenhouse gases.[29] Aircraft are the third-largest source of greenhouse gas emissions in the U.S. transportation sector, accounting for some 11 percent of the sector and some 4 percent of U.S. emissions overall.[30] This carbon pollution makes U.S. aviation by far the largest contributor to the industry's global problem. According to U.S. EPA, emissions from U.S. aircraft "are *about 7 times higher* than aircraft greenhouse gas emissions from China," which itself is ranked *second* in the world for its aircraft emissions.[31] As another comparison, in 2014, CO_2 emissions from the entire U.S. electricity generation sector attributed to burning coal released 1.6 gigatonnes of CO_2.[32] That same amount (1.6 gigatonnes) has been released from U.S. airplanes since 2007, when the Center for Biological Diversity and others first petitioned the U.S. EPA to begin regulating aviation emissions.[33]

Cumulatively, U.S. aviation emissions from 2016 through 2050 will be 9 gigatonnes, assuming emissions grow as forecasted by the Federal Aviation Administration.[34]

C. Unchecked, aviation is set to consume some 4 percent of the world's remaining carbon budget.

Six years ago, at the 2009 Conference of the Parties, both industrialized and developing countries made pledges to keep global temperature increases below 2° C.[35] Even if every new emissions reduction pledged by countries this year is implemented, however, the Earth will still suffer 2.7[36]-3.5° C[37] of warming by century's end.

Figure 1 Climate Interactive, *Climate Score Board*, https://www.climateinteractive.org/tools/scoreboard/.



The 2° C target itself, however, is dangerously high. The UNFCCC released a report stating that surpassing even 1.5° C of warming will lead to "unacceptable" impacts.[38]

According to the Intergovernmental Panel on Climate Change (IPCC), total cumulative future anthropogenic emissions of CO_2 must remain below 2,900 gigatonnes.[39] Of that amount, 1,890 gigatonnes of CO_2 was already emitted by 2011, leaving 1,010 gigatonnes of CO_2 left to emit.[40] The International Energy Agency (IEA) projects that the world's estimated remaining carbon budget will be consumed by 2040 without aggressive international carbon emission cuts.[41] On its current trajectory global aviation will consume 43 gigatonnes of the world's remaining carbon budget by 2050.[42] The global climate budget, however, has no room to spare for that amount of carbon pollution.

While the light-duty vehicle sector will reduce its emissions by approximately 30 percent by 2035, global aviation emissions are scheduled to triple by 2050.

D. Cost of Delay

The IPCC and the United Nations Environment Program (UNEP) agree that immediate action is by far more cost-effective than deferred action.[43] UNEP warned that "after 2020, the world will have to rely on more difficult, costlier and riskier means of meeting the [emissions reduction] target."[44]

These conclusions are supported by the Obama administration's *Cost of Delaying Action to Stem Climate Change* ("Cost of Delay Report").[45] The report conservatively values the cost of *delay alone* at 0.9 percent of global output for *every year* of delayed action that leads to overshooting the temperature increase by just one degree Celsius over pre-industrial levels, and the next degree increase would incur additional costs of 1.2 percent.[46] Put into perspective, 0.9 percent of the United States' gross domestic product translates to approximately $150 billion.[47]

As it stands, nations are struggling to make it to 1.5/2° C. Reining in unchecked aviation pollution is a critical task as the world runs out of time for meaningful action.

What is the International Civil Aviation Organization?

ICAO is a specialized agency within the United Nations responsible for establishing international standards for aircraft.

In 1998, the Kyoto Protocol to the United Nations Framework Convention on Climate Change directed developed "Annex I" countries to work through ICAO to reduce emissions of greenhouse gases from international aviation.

In the 18 years since ICAO was assigned that responsibility, the organization has not adopted any measure to tackle greenhouse gas emissions.

Sources:

International Civil Aviation Organization, *About ICAO*, http://www.icao.int/about-icao/Pages/default.aspx.

Kyoto Protocol to the United Nations Framework Convention on Climate Change, art. 2(2), Dec. 10, 1997, UN Doc. FCCC/CP/1997/7/Add.1, 37 ILM 22 (1998), *available at* http://unfccc.int/resource/docs/convkp/kpeng.pdf.

Transport & Environment, *Grounded: How ICAO Failed to Tackle Climate Change and What Should Happen Now* (2010), http://www.transportenvironment.org/publications/grounded-how-icao-failed-tackle-aviation-and-climate-change.

A ROLE FOR REGULATORS

In light of the crucial need not just to decrease the upward slope of aviation greenhouse gas emissions but also to reduce that pollution quickly and dramatically, regulators must promptly set stringent regulatory standards. The standards now under consideration at ICAO, however, do next to nothing to curb aviation's carbon pollution. If ICAO does not set sufficiently stringent standards, the U.S. EPA must step in to do so.

A. International Civil Aviation Organization's History of Poor Regulation

Eighteen years — that is how long ICAO has failed to regulate aviation carbon pollution.[48] During that time, ICAO has failed to adopt a single measure to curb aircraft-induced global warming.[49]

ICAO's technical group, the Committee on Aviation Environmental Protection (CAEP), did not begin to work on a CO_2 efficiency standard until 2010, projecting the delivery of a completed standard by 2016.[50] CAEP's work progressed in two phases: first, the development of a certification requirement or "metric" by which fuel efficiency would be measured; and second, setting the stringency level at which certification would be set.

Examination of both the metric and the stringency proposals reveals that the eventual standard will do little, if anything, to affect the ever-increasing aviation emissions and will in fact allow significant emissions *increases* from the sector.

1. ICAO's Inaccurate CO_2 Metric

In 2013, ICAO finalized a CO_2 certification requirement, or metric, to serve as the basis for a global CO_2 standard for new aircraft.[51] That metric, however, fails to accurately account for aviation CO_2 emissions.

First, as ICCT identified, by failing to take into account the fuel used in "landing and takeoff, taxi, climb and descent"[52] and instead considering only cruise fuel burn, the metric does not accurately capture typical flight operations or their emissions.[53] It omits approximately 8 to 10 percent of fuel used for medium- to long-haul flights and 20 to 25 percent of fuel consumed during short-haul flights.[54] According to ICCT, this omission also means that any regulatory standard will not require the use of cost-effective and available fuel-efficiency technologies aimed at increasing efficiency during those operations, "such as electric taxi or more efficient auxiliary power units that reduce fuel burn on those flight segments."[55]

ICAO's approach fails to account for approximately 8 to 10 percent of aircraft fuel used during medium- to long-haul flights and 20 to 25 percent used during short-haul flights.

Second, because ICAO gives no credit to lightweight materials, the metric does not incentivize the adoption of crucial design mechanisms or technologies such as lightweight composites that reduce aircraft weight and increase fuel efficiency.[56]

Finally, ICAO's approach selects test points for identifying fuel efficiency that ICCT says "are not representative of typical operations,"[57] and "improvements measured on the metric may not necessarily translate to real emissions reductions in-service."[58] In sum, ICAO's metric fails to capture airlines' true fuel burn and is unacceptable.

2. ICAO's Insufficient Proposed CO_2 Stringency Levels

ICAO's proposed CO_2 stringency levels suffer from the following flaws:

(1) *Limited Applicability:* ICAO is considering three potential stringency levels, but appears likely to adopt the least stringent among them. This stringency level would apply only to those future aircraft types that are *newly designed* after the standard's proposed implementation date of 2023.[59] This limitation, if adopted, would mean that only a tiny fraction (as low as 5 percent) of the fleet would be covered by any standard *by 2030.*[60]

(2) *Pass/Fail Basis:* the proposed standard would be applied on a pass/fail basis to individual aircraft only; as such, it would do nothing to achieve fleet-wide reductions despite dramatic industry growth.[61]

(3) *2016 Technology Levels:* ICAO's stringency standard is proposed to be based on technology in effect in 2016, 4 to 7 years *behind* technology in existence on the proposed implementation date of 2023,[62] and some 8 to 12 years *behind* the date that newly designed aircraft covered by the standard are expected to enter into service.[63]

Judged by what is known about purchase orders for aircraft to be delivered over the next 8 to 10 years, the ICAO standard will do next to nothing to reduce emissions below business-as-usual scenarios.

i. Limited Applicability

To determine which aircraft would have to comply with its regulations, ICAO identified three possible options in order of increasingly broad coverage.

- *Weakest*: The weakest option involves applying the standards solely to completely new aircraft type designs.

  Under this option, covered aircraft are defined by U.S. EPA as aircraft that "have never been manufactured prior to the effective date of a standard." [64] According to an ICCT researcher, Anastasia Kharina, considering the 25- to 30-year operational lifetimes of aircraft, most airplane types "already announced" will essentially be "grandfathered into the standard in perpetuity."[65] By 2030, the standard would cover only 5 percent of the global fleet.[66] As the International Coalition for Sustainable Aviation (ICSA) points out, the standard may "in fact increase emissions" by incentivizing delay in the release of new designs to avoid regulation.[67]

- *Intermediate*: The intermediate option also involves limiting applicability to new aircraft types only, but would also include new "in-production aircraft that have a significant change in CO_2 emissions" according to U.S. EPA.[68]

  This option would cover newly produced aircraft undergoing either (a) "changes in type design that may adversely affect . . . CO_2 emissions" – that is, physical changes causing CO_2 emissions increases by a yet to be determined amount[69] – or (b) "extensive" changes to "design, configuration, power or mass" that would trigger "new investigation of compliance with the applicable airworthiness regulations."[70] Yet, as U.S. EPA has pointed out, "adverse" changes of this nature are rare due to "substantial market forces to alleviate any adverse effects on aircraft fuel burn or CO_2 emissions."[71]

- *Most Expansive*: The most expansive applicability option under consideration at ICAO involves standards that apply to both new aircraft types and new in-production aircraft.

Whereas newly designed aircraft types and adverse changes to in-production designs are and will remain rare, as U.S. EPA has pointed out, "incremental improvements [of in-production aircraft] will likely be frequent and occur in the near term."[72]

Notably, regardless of which of these three alternatives ICAO may adopt, *none requires any efficiency improvements for existing aircraft* already in service, regardless of the cost-effectiveness and availability of technology that could boost the efficiency of the existing fleet.

The standard would be set at technology levels *8 to 12 years behind* the technologies available when covered new aircraft types enter service.

ii. Pass/Fail Basis

Applying a standard only as a pass/fail requirement for individual aircraft types means that industry need only focus on making improvements to its least-efficient planes, rather than develop the kind of fleet-wide technology improvements incentivized by the corporate average standards already in wide use for vehicles.[73]

iii. 2016 Technology Levels

The stringency levels would be based on technologies *in common use as of 2016*[74] for aircraft entering into service in the 2024 to 2028 timeframe. Thus, any standard would be set at technology levels *8 to 12 years behind* the technologies available when covered "new aircraft types" enter service.

As U.S. EPA recognizes, this "would likely result in no additional CO_2 reductions beyond what would have occurred absent a CO_2 standard, either for the near- and mid-term, about 5 to 10 years from 2016, or even in the longer term of 20 years plus."[75]

The limited scope of applicability, distant implementation dates, and outdated technology requirements mean that ICAO's CO_2 proposed standards are wholly inadequate.

B. The Role of U.S. EPA

Spurred by litigation by the Center for Biological Diversity and allies, the U.S. EPA finally moved to begin setting U.S. domestic aircraft carbon pollution standards in July of 2015 with two concurrent actions:[76]

- *Proposed Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare ("Endangerment Finding"),* and
- *Advance Notice of Proposed Rulemaking ("ANPR").*

Clean Air Act, Sec. 231(a)(2)(A):

"The Administrator shall, from time to time, issue proposed emission standards applicable to the emission of any air pollutant from any class or classes of aircraft engines which in his judgment causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare."

The Endangerment Finding proposes to find that greenhouse gas emissions from aircraft endanger public health and welfare under section 231(a) of the U.S. Clean Air Act.[77] When the Endangerment Finding is finalized next year, U.S. law *compels* the agency to set domestic aircraft CO_2 emission standards.[78]

The ANPR discusses and seeks input related to setting those standards. Specifically, the U.S. EPA has stated that its adoption of any ICAO standard is "contingent on" whether any such "international aircraft CO_2 standard . . . is consistent with [U.S. law] and is appropriate for domestic needs in the United States."[79] U.S. EPA's adoption of a future ICAO standard is by no means automatic: if ICAO's standard does not pass muster under U.S. law, EPA must set more stringent standards.

CASE STUDY: Mobile Sources

The U.S. EPA has previously determined that greenhouse gas emissions endanger the public health and welfare and has taken action to regulate light, medium, and heavy duty vehicles.

In the summer of 2015, the U.S. EPA and the National Highway Traffic Safety Administration proposed fuel efficiency and greenhouse gas standards for medium- and heavy-duty vehicles. While the proposal is less ambitious than it could be, the proposed standards would cut emissions by 1 billion metric tons and provide net social benefits of over $200 billion.

Benefits come from total fuel savings and from significant climate benefits, improvements in public health, and increased U.S. energy security.

Sources:
EPA, *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles Phase 2,* 80 Fed. Reg. 40,138 (Jul. 13, 2015).

Environmental Protection Agency, *EPA and NHTSA Propose Greenhouse Gas and Fuel Efficiency Standards for Medium- and Heavy-Duty Trucks: By the Numbers* (2015), *available at* http://www3.epa.gov/otaq/climate/documents/420f15903.pdf.

The White House, *Fact Sheet: President Obama to Announce Historic Carbon Pollution Standards for Power Plants,* https://www.whitehouse.gov/the-press-office/2015/08/03/fact-sheet-president-

C. Why Adopting ICAO's Standard Will Not Satisfy Clean Air Act Requirements

In 2011, CAEP, ICAO's technical group, proclaimed the purpose of an international CO_2 emissions standard to be the achievement of "reductions from the aviation sector beyond expected 'business as usual.'"[80] Under this unambitious goal, saving a single gallon of fuel beyond an undefined and uncontrolled maximum would suffice.

By contrast, the U.S. EPA has an obligation under the Clean Air Act to protect public health and welfare by *reducing* or even *preventing pollution* altogether.[81] An ICAO standard that contemplates no more than *de minimis* reductions in emissions relative to a steeply rising business-as-usual scenario is incompatible with the U.S. EPA's mandate.

Moreover, the U.S. Clean Air Act is intended and designed to be technology-forcing and to stimulate innovation. In a prior rulemaking, the U.S. EPA correctly noted that U.S. law does not require it to "demonstrate that a technology [selected for inclusion in a standard] is currently available universally or over a broad range of aircraft."[82]

In other words, technology still on the drawing board may be selected as part of the emission standard. Basing an emission standard on technology 10 to 12 years behind existing technology standards at the time of implementation, as ICAO contemplates, is directly contrary to the technology-forcing nature of the U.S. Clean Air Act.

If, as appears likely, ICAO's final standard does not meet U.S. legal requirements, the U.S. EPA will be required to set a more stringent U.S. domestic standard. Such a standard, in turn, would likely serve as a catalyst leading to international adoption.

D. Why Focusing On Market-Based Mechanisms Is The Wrong Approach

The airline industry avows a voluntary emissions goal of carbon-neutral growth after 2020 to be achieved through "market-based measures" consisting of emissions-offset purchases. The efficacy of offsets in reducing carbon emissions, however, is questionable. It is difficult, for example, to ascertain whether actions intended to preserve carbon sinks have in fact done so, or whether those sinks would have remained intact in any event; and numerous other problems are inherent in identifying, monitoring and verifying offsets.

Offsets make sense only after stringent energy efficiency standards have been applied first so that emissions are *avoided and prevented* in the first place – rather than "offset" by uncertain methods.

E. Aviation efficiency can be improved significantly

That the airline industry can make enormous fuel-efficiency improvements is unquestionable. For example, according to a recent ICCT report, some airline carriers, British Airways among them, are up to *51 percent less fuel efficient* than their competitors, such as Norwegian Air.[83]

Implementing standards that raise the performance of the least fuel-efficient carriers to what is presently achieved by their competitors makes common sense, as it prevents rather than merely offsets carbon pollution. Offsets may have a role once efficiency has been maximized through cost-effective technological and operational measures, but they should not take their place.

Smarter investment in technology and changes in operations could transform a carrier like British Airways to one like Norwegian. Yet the history of airline investments shows that absent mandatory standards, airlines will significantly underinvest in currently available efficiency improvements. A prior ICCT study of air carrier fuel efficiency noted that improved fuel efficiency could have brought about savings of $2.26 billion or more for the airlines in 2010 alone.[84]

Airlines can sustain the cost of improved technology requirements and would likely benefit significantly from the associated reduction in fuel expenses. Last year, American, Delta, Southwest, and United Continental earned $2.88 billion,[85] $659 million,[86] $1.13 billion,[87] and $1.14 billion[88] in net income, respectively.

Investing earnings in efficiency improvements for new and existing planes and operations generally pays for itself in the form of lowered fuel expenses, sometimes many times over. For example, one viable aircraft technology under development by Boeing as part of the U.S. Federal Aviation Administration's Continuous Lower Energy, Emissions, and Noise (CLEEN) program could save 340 million gallons of fuel a year — an estimated $1.2 billion in savings for the industry if used fleet-wide in the U.S.[89]

F. U.S. EPA is not required to follow ICAO's standards

The U.S. EPA acknowledges its authority to implement regulations that are more stringent than ICAO's international standards. In the EPA's first rulemaking under Clean Air Act section 231 (curtailing NO_x emissions from aircraft), the agency noted its "discretion to adopt more stringent NO_x standards . . . if the international consensus standards ultimately prove[d] insufficient to protect U.S. air quality."[90] Similarly, in the greenhouse gas ANPR, the EPA stated that it would adopt the "international aircraft CO_2 standard [if] consistent with CAA section 231 and . . . appropriate for domestic needs in the United States."[91]

If whatever final standards ICAO adopts will not affect, much less reduce, U.S. domestic emissions for decades, the U.S. EPA must step forward. The U.S.' exceptional and vastly disproportionate position as by far the greatest emitter of global aircraft greenhouse gases underscores its unique responsibility to reduce those emissions through enforceable domestic regulations. Once it does so, meaningful international standards will follow.

NEXT STEPS

Climate science, as well as the United States' international climate commitments, dictate that greenhouse gases, including those from aircraft, must be *reduced*; merely bending the upward curve slightly or even holding it level is insufficient. Every year of unnecessary delay in reducing greenhouse gas emissions from aircraft in the face of steeply rising, persistent and irreversible costs and harms from climate change, including the acknowledged possibility that mitigation will be too late altogether,[92] is unreasonable and unjustifiable.

The ICCT report, which found a 51 percent gap between the best and the worst performing transatlantic flight carriers, has demonstrated that airlines are capable of achieving much greater fuel-efficiency today.[93] Standards can be developed to greatly improve new aircraft based on currently existing technology as well as technology on the drawing board. Before the aviation industry looks to offsets that are difficult to trace, verify, and monitor, ICAO must mandate stringent emission standards for all aircraft. Failing that, the U.S. EPA should establish standards as mandated under U.S. law. The United States acknowledges that it must be a "world leader" in the "global movement to produce and consume energy in a better, more sustainable way."[94]

CONCLUSION

UNFCCC cannot continue to ignore airplane pollution in the international negotiations and must include aviation in the Paris agreement, obligating aviation to contribute its fair share to meeting the target of holding temperatures below 2º C. Oversight by the Conference of the Parties will help ensure that ICAO follows through on its responsibility to reduce aviation's emissions. Barring that, the U.S. EPA will have to do so.

Combined greenhouse gas emissions from U.S. aircraft are *about 7 times higher* than aircraft greenhouse gas emissions from China, which itself is ranked *second* in the world for aircraft emissions.

Cover photograph courtesy of D Sleeter2000/Flickr.

SOURCES

[1] Proposed Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare and Advance Notice of Proposed Rulemaking, 80 Fed. Reg. 37,758 at 37,788-89, *available at* https://www.federalregister.gov/articles/2015/07/01/2015-15192/proposed-finding-that-greenhouse-gas-emissions-from-aircraft-cause-or-contribute-to-air-pollution (hereinafter "Endangerment Finding and ANPR").

[2] The International Council on Clean Transportation, *U.S. Domestic Airline Fuel Efficiency Ranking, 2011-2012* at 1 (Apr. 2014), *available at* http://www.theicct.org/sites/default/files/publications/ICCT_airline-efficiency-ranking_2011-2012.pdf (hereinafter "ICCT, *U.S. Domestic Ranking* 2011").

[3] IPCC, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Summary for Policymakers* at 27 (2013), *available at* http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf ("Limiting the warming caused by anthropogenic CO_2 emissions alone with a probability of >33%, >50%, and >66% to less than 2°C since the period 1861–1880, will require cumulative CO_2 emissions from all anthropogenic sources to stay between 0 and about 1570 GtC (5760 $GtCO_2$), 0 and about 1210 GtC (4440 $GtCO_2$), and 0 and about 1000 GtC (3670 $GtCO_2$) since that period, respectively. These upper amounts are reduced to about 900 GtC (3300 $GtCO_2$), 820 GtC (3010 $GtCO_2$), and 790 GtC (2900 $GtCO_2$), respectively, when accounting for non-CO_2 forcings as in RCP2.6. An amount of 515 [445 to 585] GtC (1890 [1630 to 2150] $GtCO_2$), was already emitted by 2011.") (hereinafter "IPCC Working Group I *Summary for Policymakers*"); United Nations Environment Programme, *The Emissions Gap Report* at 13-22 (2013), *available at* http://www.unep.org/pdf/UNEPEmissionsGapReport2013.pdf (describing emissions "pathways" consistent with meeting 2°C and 1.5°C targets) (hereinafter "UNEP *The Emissions Gap Report* 2013").

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[10] *About ICAO*, *supra* note 9; Kyoto Protocol, *supra* note 9, at 2; Transport & Environment, *Grounded*, *supra* note 9, at 9-11.

[11] Endangerment Finding and ANPR, *supra* note 1, at 37,788 (emphasis added). In total, greenhouse gas emissions from U.S. "covered" aircraft are "about 6 times" more than corresponding emissions from China. *Id.*

[12] Calculations derived from ICCT, *Model*, *supra* note 8.

[13] Endangerment Finding and ANPR, *supra* note 1, at 37,763.

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[15] The White House, *Cost of Delaying Action to Stem Climate Change* at 4 (Jul. 29, 2014), *available at* https://www.whitehouse.gov/sites/default/files/docs/the_cost_of_delaying_action_to_stem_climate_change.pdf (hereinafter "The White House, *Cost of Delaying*").

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[17] ICCT, *U.S. Domestic Ranking* 2011, *supra* note 2, at 1.

[18]Environment Branch, International Civil Aviation Organization, *ICAO ENVIRONMENTAL REPORT 2013: AVIATION AND CLIMATE CHANGE* at 18 (2013), *available at* http://www.icao.int/environmental-protection/Pages/EnvReport13.aspx (hereinafter "ICAO Report 2013").

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[31] Endangerment Finding and ANPR, *supra* note 1, at 37,788 (emphasis added). In total, greenhouse gas emissions from U.S. "covered" aircraft are "about 6 times" more than corresponding emissions from China. *Id.*

[32] U.S. Energy Information Administration, *How Much of U.S. Carbon Dioxide Emissions are Associated with Electricity Generation?*, *available at* http://www.eia.gov/tools/faqs/faq.cfm?id=77&t=11 (last visited Oct. 24, 2015).

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[62] ICAO is considering an implementation date of either 2020 or 2023 for new aircraft types, and 2023 or later for new in-production aircraft. Endangerment Finding and ANPR, *supra* note 1, at 37,804.

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