October 19, 2020

Andrew Wheeler, Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460
Attention: Docket ID No. EPA–HQ– OAR–2018–0276

Re: Control of Air Pollution From Airplanes and Airplane Engines: GHG Emission Standards and Test Procedures

Dear Mr. Wheeler:

The Environmental Defense Fund (EDF) respectfully submits the following comments on EPA's proposed rule to control air pollution from airplanes and airplane engines.[1] Representing over 2.5 million members and supporters nationwide, EDF has been actively pursuing solutions to global climate change for over 30 years, including more than a decade of efforts to reduce emissions from the international aviation sector.

Our nation is in a climate crisis. To avoid catastrophic climate impacts, it is imperative that heat-trapping emissions go down. But as EPA's own analysis in the Notice of Proposed Rulemaking indicates, the proposed standard will not drive emissions down. It simply embodies what the industry has already baked in.[2] It is thus patently capricious and not in accordance with law - the Clean Air Act - for EPA, having found that greenhouse gas (GHG) emissions from aviation cause or contribute to air pollution that may be reasonably expected to endanger public health and welfare,[3] to propose a standard that achieves, in EPA's own words, "no benefit (no emission reduction)."[4]

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[1] Control of Air Pollution From Airplanes and Airplane Engines: GHG Emission Standards and Test Procedures, 85 Fed. Reg. 51556 (Aug. 20, 2020).

[2] Should the proposed standards be finalized, "all U.S. airplane models (in-production and in-development airplane models) should be in compliance with the proposed standards, by the time the standards would become applicable. Therefore, there would only be limited costs from the proposed annual reporting requirement and *no additional benefits from complying with these proposed standards* ..." Id. at 51588 (emphasis added).

[3] "Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare" (EPA 2016), text available at https://www.federalregister.gov/documents/2016/08/15/2016-18399/finding-that-greenhouse-gas-emissions-from-aircraft-cause-or-contribute-to-air-pollution-that-may (accessed October 16, 2020).

[4] Draft Airplane Greenhouse Gas Standards Technical Support Document (TSD) (EPA-420-D-20-004, July 2020), at pages 105-106 (emphasis added). Text available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ZN37.pdf (accessed October 16, 2020).

Moreover, fuel-related emissions at airports disproportionately affect local communities as well as workers within the airport envelope; these effects arise from the impact of aviation's fuel-related emissions on local air quality. In making its decision on level of stringency, EPA must weigh the health and environmental benefits, including the benefits of avoided climate damages as well as the co-benefits of improved local air quality; in fact, it would be arbitrary for EPA to fail to do so.[5]

It has been twenty-three years since nations of the world first directed the aviation industry to address its climate pollution. To date, ICAO has adopted only two global measures: The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which the industry succeeded in getting postponed for three years due to the COVID-19 crisis, and ICAO's CO_2 standard, which won't cut emissions below business-as-usual. EPA has the statutory authority and the statutory duty to adopt a much more stringent emissions standard. It is time for the industry's effective quarter-century of evading effective climate action requirements to end. Status quo operation of the aviation industry is incompatible with global efforts to avoid the worst impacts of climate change.

The Environmental Defense Fund submits these comments based on decades of expertise in the science, economics and law of aviation and climate change. EDF staff served as lead and contributing authors of the 1999 Intergovernmental Panel on Climate Change (IPCC) Special Report on Aviation and the Global Atmosphere.[6] EDF experts serve as nominated observers on Expert Working Groups in the Committee on Aviation Environmental Protection (CAEP) of the International Civil Aviation Organization (ICAO).[7] EDF staff have published extensively on aviation emissions, analyzing their contributions to global warming as well as advocating market-based solutions to stabilize such emissions,[8] and have participated as observers in meetings of the U.S.-EU Joint Committee under the U.S.-EU bilateral open skies agreement. EDF is an active participant in efforts in the United Nations Framework Convention on Climate Change (UNFCCC) and ICAO to reduce aviation pollution, and EDF staff have testified before the Committee on Commerce, Science, and Transportation of the United State Senate on

[5] EDF joins separately-submitted comments of the Institute for Policy Integrity detailing how EPA in preparing the instant proposal, has arbitrarily relied on problematic estimates of the social costs of carbon and nitrous oxide that fail to take account of the benefits that more stringent standards would provide.

[6] Aviation and the Global Atmosphere, J.E.Penner, D.H.Lister, D.J.Griggs, D.J.Dokken, M.McFarland (Eds.), Cambridge University Press 1999).

[7] EDF is a founding member of the International Coalition for Sustainable Aviation, which has observer status. EDF is also a founding member of the Clean Shipping Coalition, an organization established to reduce the global environmental effects of maritime transportation.

[8] *See, e.g.*, Allen Pei-Jan Tsai & Annie Petsonk, *Tracking the Skies: An Airline-based System for Limiting Greenhouse Gas Emissions from International Civil Aviation*, 6 ENVTL. LAW 763 (2000); Anu Vedantham & Michael Oppenheimer, *Long-term Scenarios for Aviation*: *Demand and Emissions of CO_2 and NOx*, 26 ENERGY POL'Y 625 (1998); Catherine C. Ivanovich, Ilissa B. Ocko, Pedro Piris-Cabezas & Annie Petsonk, *Climate Benefits of Proposed Carbon Dioxide Mitigation Strategies for International Shipping and Aviation*, 19 Atmos. Chem. & Phys. 14949 (2019).

matters related to aviation emissions.

EPA must act swiftly to control GHG pollution from airplane engines by setting emission standards and test procedures as required by section 231 of the Clean Air Act (CAA). We urge EPA to adopt a much more stringent standard to achieve real benefits and actually address the danger posed to public health and welfare by air pollution from aircraft engine emissions, including both CO_2 and non- CO_2 emissions that contribute to anthropogenic climate forcing.[9] We also request that the sources cited herein form part of EPA's Record of Decision.

I. EPA is authorized to promulgate standards more stringent than ICAO standards.

EPA is specifically authorized, and in fact required, to promulgate standards for aircraft engine emissions. Section 231 of the Clean Air Act (CAA) grants EPA the authority to "issue proposed emission standards applicable to the emission of any air pollutant from any class or classes of aircraft engines," which are determined by EPA to cause or contribute to "air pollution which may reasonably be anticipated to endanger public health or welfare."[10] Pursuant to EPA's 2016 "Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare" (2016 Findings), EPA is bound to issue standards under section 231. In the 2016 Findings, EPA found that aircraft engine emissions of six well-mixed GHGs contribute to air pollution as defined under CAA section 231 and "endanger the public health and welfare."[11] Consequently, EPA is now required by law to propose standards applicable to the emissions referenced in the 2016 Findings.

Additionally, as an ICAO Member State, the United States has committed to "adopt and put into operation the appropriate standard systems . . . which may be recommended or established [by ICAO] from time to time."[12] The United States is only able to fulfill its commitment if the administrator of EPA works with the Secretary of Transportation to issue emission standards and "prescribe regulations to insure compliance with all standards."[13]

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[9] D.S. Lee et al., *The Contribution of Global Aviation to Anthropogenic Climate Forcing for 2000 to 2018*, *Atmospheric Environment* (2020), https://www.sciencedirect.com/science/article/pii/S1352231020305689?via%3Dihub. This paper is attached in the Appendix to these comments.
[10] 42 U.S.C. § 7571(a)(2)(A).
[11] 81 Fed. Reg. 54422.
[12] ICAO, 2006: Convention on International Civil Aviation, 9th ed., Doc. 7300/9, Art. 28. Available at: https://www.icao.int/publications/Documents/7300_cons.pdf (last accessed Sept. 9, 2020).
[13] 42 U.S.C. §§ 7571(a)(2)(B)(i), 7572(a).

Moreover, the Chicago Convention on International Civil Aviation, to which the United States is a Party, specifically recognizes that Member States may adopt standards *more stringent* than those negotiated in ICAO. Article 33 of the Chicago Convention provides that ICAO Member States shall recognize certificates of airworthiness,[14] which, pursuant to several federal regulations, specifically include certification that the aircraft has met applicable exhaust emissions standards.[15] The Chicago Convention states, in Article 33, that Member States shall recognize airworthiness certificates of other Member States "provided that the requirements under which such certificates or licenses were issued or rendered valid are *equal to or above* the minimum standards which may be established from time to time."[16] Thus, the Convention expressly affirms that its Member States may adopt requirements more stringent than the minimum standards of ICAO. EPA is empowered and required by CAA to promulgate emission standards applicable to any air pollutant, emitted from aircraft engines, which contribute to "air pollution which may reasonably be anticipated to endanger public health or welfare."[17] While ICAO standards thus serve as a floor below which EPA cannot go, and the Chicago Convention authorizes its Member States to apply more stringent standards, EPA remains empowered to promulgate standards stricter than those adopted by ICAO.

II. EPA is required to promulgate standards effective to reduce pollutant emissions.

As mentioned above, section 231 of CAA expressly states,

> The Administrator [of EPA] 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.[18]

a. EPA is required to promulgate standards more stringent than the current proposed standards.

In its 2016 findings, EPA determined that six well-mixed GHGs—carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur

[14] Certificates of airworthiness are required for all aircraft flying between the United States and other countries. *See* Chicago Convention at Article 31: "Certificates of airworthiness. Every aircraft engaged in international navigation shall be provided with a certificate of airworthiness issued or rendered valid by the State in which it is registered." ICAO, 2006: Convention on International Civil Aviation, 9th ed., Doc. 7300/9, Art. 33. Available at: https://www.icao.int/publications/Documents/7300_cons.pdf (last accessed Sept. 9, 2020).
[15] *See* 14 CFR §§ 21.183(g), 34.21(d), 34.23(a), 34.3(o).
[16] ICAO, 2006: Convention on International Civil Aviation, 9th ed., Doc. 7300/9, Art. 33 (emphasis added). Available at: https://www.icao.int/publications/Documents/7300_cons.pdf (last accessed Sept. 9, 2020).
[17] 42 U.S.C. § 7571(a)(2)(A).
[18] *Id*.

hexafluoride—all emitted from aircraft engines, contribute to air pollution causing climate change, and thus endanger public health and welfare.[19] As such, EPA is required to promulgate standards that address and encourage the reduction of emissions of these six well-mixed GHGs, in order to effectuate the reduction or elimination of these pollutants. However, EPA's proposed standards simply are not stringent enough to make any meaningful impact. The standards EPA are proposing "lag[] existing aircraft technologies by more than 10 years," and are therefore "too weak" to encourage reduction of total pollutant emissions.[20] Though EPA would set a deadline of 2028 for compliance with the proposed standards, many new aircraft already satisfied or exceeded the standards initially adopted by ICAO in 2016, standards which EPA seeks to emulate.[21]

Moreover, while the Covid-19 pandemic has caused significant disruptions to the air traffic industry, current projections suggest that air traffic could return to pre-pandemic levels within the next four years.[22] In fact, even under the least optimistic projections, total air traffic is expected to increase beyond pre-pandemic levels by the end of the decade.[23] As air traffic returns to, and eventually exceeds pre-pandemic levels, stringent standards will be necessary to effectively address aircraft engine emissions. This is because total emissions will rise as air traffic increases. Thus, total emissions may easily rise in aggregate in the absence of standards sufficiently stringent to offset the increase in total number of flights. Consequently, to effectively address emissions of air pollutants from aircraft engines so as to achieve "the reduction or elimination . . . of pollutants produced or created at the source," EPA must promulgate stricter standards than the already outdated current proposed standards.

This is not to mention that EPA developed the current proposed standards based upon outdated and incomplete information. EPA's bases for promulgating the proposed standards were the conclusions drawn from the 2016 Findings.[24] However, by the time EPA began the process of developing the standards, new studies were well underway suggesting that the ICAO standards targeting carbon dioxide emissions were insufficient

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[19] 81 Fed. Reg. 54422.
[20] Marisa Garcia, *New EPA Aircraft Emission Standard 'Too Weak' To Encourage New Aircraft And Engine Technologies, ICCT Finds*, Forbes, July 22, 2020, *available at:* https://www.forbes.com/sites/marisagarcia/2020/07/22/new-epa-aircraft-emission-standard-too-weak-to-encourage-new-aircraft-and-engine-technologies-icct-finds/#10b357646867, (last visited Sept. 11, 2020).
[21] *Id.*
[22] Int'l Air Transp. Ass'n, *Traffic recovery slower than expected*, Airlines, July 29, 2020, *available at:* https://airlines.iata.org/analysis/traffic-recovery-slower-than-expected (last visited Sept. 23, 2020); Manfred Hader, Robert Thomson, & Holger Lipowsky, *How The Covid-19 Crisis Is Expected to Impact The Aerospace Industry*, Roland Berger, June 10, 2020, *available at:* https://www.rolandberger.com/en/Point-of-View/How-the-COVID-19-crisis-is-expected-to-impact-the-aerospace-industry.html (last visited Sept. 23, 2020).
[23] Hader, Thomson, & Lipowsky, *supra*.
[24] *See* 85 Fed. Reg. 51558.

to address the environmental problems posed by aircraft engine emissions. In particular, the definitive study published last month by the "A Team" of aviation-atmosphere researchers, including experts from the U.S. National Oceanic and Atmospheric Administration (NOAA) Chemical Sciences Laboratory, the U.S. National Center for Atmospheric Research (NCAR), and the Universities of Michigan and Colorado, found that noncarbon dioxide (non-CO_2) emissions, including water vapor, NO_X, and aerosol particles together contribute to roughly two-thirds of the environmental impact of aviation, while carbon dioxide emissions contribute to the remaining third.[25] These non-CO_2 emissions were omitted from the 2016 Findings[26] due in part to the fact that the "effective radiative forcing" (ERF) metric utilized by the new study not fully available when the 2016 Findings were being assembled. With more complete and accurate information now available, EPA should work to tailor its standards to address newly recognized areas of environmental concern. Moreover, it is essential to set stringent standards to drive new technologies to reduce total emissions and warming pollution, which the current proposed standards are too weak to do.

III. EPA has authority to implement tighter greenhouse gas emissions standards that both foster new technologies and provide flexibility.

As EPA asserts in the current proposed rule, EPA is authorized to consider a wide range of methods for achieving reductions in aircraft engine emissions.[27] Section 231 of CAA does not specify how standards promulgated by EPA must be formulated, nor does it specify that standards must apply only to the operation direct capabilities of engine technology.[28] Moreover, the lack of statutory specifics has in fact been interpreted to grant EPA significant discretion in how it chooses to promulgate standards.[29] Consequently, EPA is empowered to consider a variety of possible methods that may reduce "the emission of any air pollutant" which "in [the Administrator's] judgment causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare,"[30] even though the reductions may occur outside of the immediate class or classes of engines which emit those pollutants.

Section 231 requires EPA to promulgate standards that are applicable to aircraft engine emissions of air pollutants determined to cause or contribute to "air pollution which may reasonably be anticipated to endanger public health or welfare," such that the standards *result in the reduction or elimination of those pollutants*. However, EPA's proposed standard does not do so. In fact, it does not achieve any reductions in the pollutants. EPA

[25] Lee et al., *supra*.
[26] *See* 81 Fed. Reg. 54447.
[27] 85 Fed. Reg. 51562.
[28] *See id*; 42 U.S.C. § 7571.
[29] *Nat'l Ass'n of Clean Air Agencies*, 489 F.3d at 1230.
[30] 42 U.S.C. § 7571(a)(2)(A).

must consider and adopt options which would actually reduce the danger to public health; its failure to do so is arbitrary and capricious. As explained in EPA's "Draft Airplane Greenhouse Gas Standards Technical Support Document (TSD)," EPA considered only three Scenarios. As EPA admits in that document, "under both scenarios 1 and 2, there would be no cost *and no benefit (no emission reduction)* for the proposed GHG standards" and Scenario 3 would have only a minuscule impact on U.S. domestic emissions because it would necessitate improvements in only one aircraft, and none of the U.S. have that aircraft in their fleets.[31] . As stated in *Nat'l Ass'n of Clean Air Agencies v. EPA*, "Congress has delegated expansive authority to EPA to enact appropriate regulations applicable to the emission of air pollutants from aircraft engines."[32]

The statute does not specify that EPA must set these standards only by addressing emissions exclusively at the source. Rather, Section 231 affords EPA the latitude to consider approaches to reducing these pollutants that stimulate technology advancements for individual aircraft engines, spur innovation in airframe design, and provide flexibility to consider emission reductions that may be associated with particular aircraft-engine combinations but which occur outside the aircraft-engine envelope.

"[section] 231 requires rules promulgated thereunder to tighten emission standards," but does not necessarily require such standards to be technology-forcing.[33] Provided standards promulgated by EPA achieve the goal of addressing the endangerment, and that the EPA Administrator consult with the Administrator of the Federal Aviation Administration and avoid standards that would "significantly increase noise or adversely affect safety,"[34] EPA has broad latitude to craft a standard that will actually significantly protect public health from the climate change impacts of aviation, spur technology development for airplane engines and airframes, and provide flexibility, enabling industry to meet tighter emissions standards than are achievable with existing and reasonably foreseeable technology.[35]

Specifically, EPA could, within its statutory authority:

- set stringent emissions limits for engine/aircraft combinations that encourage and recognize the emission reduction effects of more aerodynamic aircraft designs, lightweight materials, and other innovative

[31] Draft Airplane Greenhouse Gas Standards Technical Support Document (TSD) (EPA-420-D-20-004, July 2020), at pages 105-106 (emphasis added). Text available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100ZN37.pdf (accessed October 16, 2020).
[32] 489 F.3d 1221, 1230 (D.C. Cir. 2007).
[33] *Id.*
[34] 42 U.S.C. § 7571(a)(2)(B)(ii).
[35] *See id*.

engineering;[36]

- set stringent emissions limits for aircraft engines that recognize the emission reductions actually achieved
    - by flight techniques that reduce total emissions per flight;[37]
    - through the use of Sustainable Aviation Fuels (SAF) that have been determined by EPA, working from the framework established by ICAO with the participation and approval of the United States, to meet rigorous sustainability criteria adopted by ICAO's Committee on Aviation Environmental Protection (CAEP), [38] provided that EPA has determined that the fuels emit at least 60% less GHGs than conventional jet fuels on a lifecycle basis, and these reductions are not double-counted or double-claimed; [39]
    - Emissions units that, in EPA's judgment, assure environmental integrity, including the avoidance of double-counting and double claiming, and that have been approved by ICAO with the participation of the United States.[40]

Such approaches would spur American innovation and could create jobs here in the United States producing the engines, aircraft, lightweighted materials, flight systems, emission reductions and fuels of the future. These approaches could foster co-benefits by encouraging technologies, flight patterns, and the uptake of SAFs that reduce local air pollution around airports, and thereby benefit the health of local communities and

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[36] *See* 49 U.S.C. §§ 44701(a)(1)-(2) ("The Administrator of [FAA] shall promote safe flight of civil aircraft in air commerce by prescribing minimum standards for the design, material, construction, quality of work, and performance of aircraft, aircraft engines, and propellers," and "regulations and minimum standards [for ensuring compliance]."). In consulting with FAA on aircraft engine emission standards, EPA may consider the reduction effects of particular designs and engineering techniques that FAA would then mandate to ensure compliance with EPA's standards.

[37] *See* 49 U.S.C. §§ 40103(b) ("The Administrator of [FAA] shall develop plans and policy for the use of the navigable airspace and assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace."). In consulting with FAA on aircraft engine emission standards, EPA may consider the reduction effects of particular flight techniques and flight paths that FAA would then mandate to ensure compliance with EPA's standards.

[38] *See* ICAO Doc 10126, CAEP/11 (2019), at 9A-8 (Table 1 – Sustainability Themes, Principles, Criteria and Guidance recommended by CAEP during its 2017 Steering Group Meeting). *See also* 49 U.S.C. §§ 44714(1)-(2) ("The Administrator of [FAA] shall prescribe standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive to control or eliminate aircraft emissions the Administrator of [EPA] decides under section 231 of the Clean Air Act endanger the public health or welfare; and regulations providing for carrying out and enforcing those standards."). In consulting with FAA on aircraft engine emission standards, EPA may consider the reduction effects of particular jet fuels that FAA would then require aircraft operators to utilize to ensure compliance with EPA's standards.

[39] *See* ICAO "Life Cycle Emissions of Sustainable Aviation Fuels," text available at https://www.icao.int/environmental-protection/pages/SAF_LifeCycle.aspx (accessed October 15, 2020).

[40] *See* ICAO, "CORSIA Eligible Emissions Units", https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Emissions-Units.aspx (accessed October 15, 2020). .

disadvantaged groups. EPA and FAA have in fact previously asserted the authority to consider "new air traffic systems and flight management techniques that can result in environmental benefits," when developing and implementing standards.[41] EPA can build on this authority in developing significantly more ambitious standards for aviation GHG emissions, and can work cooperatively with FAA to ensure these methods are enforceable by integrating the obligations directly into each aircraft's airworthiness certificate.

IV. Aviation is a Significant Source of Climate Pollution

The aviation industry is a significant source of CO_2 and other well-mixed gases that constitute the pollutant EPA has defined as GHGs[42]. In aggregate, as recently as 2011 aviation emissions accounted for nearly as much CO_2 as Germany, and, if treated as a country, would have ranked ninth in total emissions worldwide.[43]

Immediately prior to the disruption of the Covid-19 pandemic, the global aviation fleet was expected to grow dramatically in the coming years, from a current passenger fleet of approximately 20,800 civil aircraft globally to approximately 44,800 aircraft by 2038.[44] North American airlines alone were predicted to acquire over 3,500 new aircraft in that timeframe, as airlines replace some of the oldest fleets of aircraft in the world.[45] Demand for air travel services has remained strong, even in the face of major disruption such as the 9/11 attacks, and is predicted to rebound despite the temporary disruption of the Covid-19 pandemic.[46] That demand has stark environmental impacts, as aviation emissions from international flights have dramatically increased in recent years; approximately fifty percent of all global aviation emissions between 1940 and 2018 were emitted in the last twenty years. [47]

The U.S. is responsible for burning nearly half of all global aviation fuel, far more than any other single nation.[48] Prior to disruptions caused by the Covid-19 pandemic,

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[41] FAA and EPA, ''Agreement Between Federal Aviation Administration and Environmental Protection Agency Regarding Environmental Matters Relation to Aviation,'' signed on March 24, 1998 by FAA's Acting Assistant Administrator for Policy, Planning, and International Aviation, Louise Maillet, and EPA's Acting Assistant Administrator for Air and Radiation, Richard Wilson. A copy of this document can be found in EPA Docket OAR–2002– 0030.
[42] 40 C.F.R. § 86.1818-12(a); *see also* 80 Fed. Reg. 37773
[43] 80 Fed. Reg. 37788.
[44] Airbus, Global Market Forecast, 2019-2038, *available at* https://www.airbus.com/aircraft/market/global-market-forecast.html (last visited Sept. 9, 2020).
[45] *Id*.
[46] WSP, *Up in the Air: Resilience Amidst Uncertainty in the Aviation Sector*, *available at* https://www.wsp.com/en-GL/insights/ca-up-in-the-air (last visited Sept. 9, 2020). *See also* Int'l Air Transp. Ass'n; Hader, Thomson, & Lipowsky *supra*.
[47] Lee et al., *supra*.
[48] Jet Fuel Consumption – Country Rankings, https://www.theglobaleconomy.com/rankings/jet_fuel_consumption/ (last visited Sept. 9, 2020).

emissions from flights into and out of the United States were predicted to almost double by 2040 compared to 2019 levels.[49] Aircraft account for a significant portion – nine percent – of the U.S. transportation sector's GHG emissions,[50] as well as twelve percent of global CO_2 emissions,[51] and remain the largest unregulated sector of U.S. transportation emissions.[52] In the face of current demand and forecasts for air travel services, establishment of robust emissions standards is critically important, as experience shows that, even as airlines face increased fuel prices, emissions have not decreased, and cannot be expected to decrease, solely as a result of market trends.

V. Climate Change Causes Risks to the Safety of Aviation and Causes Emissions from Aviation to Increase

Climate change brings significant risks for the aviation industry. While a rulemaking for GHG emissions from aircraft should consider the full spectrum of the impacts of climate change, impacts to aviation itself have particular relevance under Section 231 of the Clean Air Act. In setting the standards for aircraft engines, EPA is required to consult with the Administrator of the Federal Aviation Administration ("FAA"),[53] whom Congress has mandated "shall promote safe flight of civil aircraft in air commerce."[54] The statute also prohibits changing "emission standards if such change would significantly increase noise and adversely affect safety."[55] Because aviation safety concerns are a central obligation of the FAA, climate-related threats to aviation safety deserve particular attention.

The climate risks to aviation are both significant and broad. Higher temperatures will reduce air density, reducing lift and contributing to flight cancellations or more restricted payloads, especially at high-altitude airports.[56] Intense heat can cause runways to buckle.[57] Increased precipitation and sea level rise can submerge runways, disrupting air travel or forcing temporary airport closures.[58] More intense tropical storms can

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[49] EDF calculation, based on FAA Aerospace Forecast: Fiscal Years 2020-2040 (FAA 2020), https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2020-40_FAA_Aerospace_Forecast.pdf.
[50] Office of Transp. & Air Quality, Envtl. Prot. Agency, Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions 1990-2018 (2020).
[51] Air Transport Action Group, Facts & Figures, https://www.atag.org/facts-figures.html (last visited Sept. 9, 2020).
[52] 80 Fed. Reg. 37762.
[53] *See* 42 U.S.C. § 7571(a)(2)(B)(i).
[54] 49 U.S.C. § 44701(a).
[55] 42 U.S.C. § 7571(a)(2)(B)(ii)..
[56] National Research Council, Potential Impacts of Climate Change on U.S. Transportation, 2008 at 88 ("NRC Impacts"); *see also* National Research Council, Adapting to the Impacts of Climate Change, 2011 at 48 ("NRC Adaptation").
[57] NRC Impacts at 88.
[58] NRC Impacts at 91-92; NRC Adaptation at 83.

damage or temporarily close airports.[59] Increased wildfires in drought-susceptible regions will reduce visibility and can close airports.[60] In far northern locations, such as Alaska, where air transport use is disproportionately high, warming temperatures will have a deleterious impact on airstrips built on permafrost, and may undermine runway foundations.[61] All of these risks create significant safety concerns for the aviation sector and its regulators.

Airlines are acutely aware of the risks they face from climate change. In a recent annual report, Delta Airlines warned investors that:

> [I]ncreases in the frequency, severity or duration of thunderstorms, hurricanes, typhoons or other severe weather events, including from changes in the global climate, could result in increases in delays and cancellations, turbulence-related injuries and fuel consumption to avoid such weather, any of which could result in loss of revenue and higher costs.[62]

These impacts create a vicious circle: increased fuel consumption due to climate impacts further increases aviation's contribution to climate change and the impacts of emissions from aviation on human health.

Climate change has made, and will continue to make, hurricanes more intense.[63] Combined with higher sea levels, such storms may cause damage over larger areas. The most recent National Climate Assessment (NCA) notes that sea level rise and storm surge pose a serious threat to coastal airports,[64] and the previous NCA specified that 13 of the nation's 47 busiest airports – one in four of these airports – have at least one runway that is low enough to be inundated by a moderate-to-high storm surge.[65] These risks have already been realized - Hurricane Sandy caused over 20,000 flight cancellations at eight US airports over six days,[66] or about half the flights that were scheduled to have been operated at those airports over those six days. Some estimates placed the cost to the airline industry at $190 million.[67]

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[59] NRC Impacts at 92.
[60] *Id*. at Annex 3-1.
[61] NRC Impacts at 88; NRC Adaptation at 99.
[62] Delta Air Lines. Form 10-K (Annual Report), February 12, 2020, at 15. https://www.annualreports.com/HostedData/AnnualReports/PDF/NYSE_DAL_2019.pdf.
[63] *See, e.g.*, 80 Fed. Reg. 37774.
[64] U.S. Global Climate Change Research Program, Fourth National Climate Assessment, 486 (2018).
[65] U.S. Global Climate Change Research Program, National Climate Assessment, 134 (2014).
[66] Flight Cancellations: Superstorm Sandy Cancels Thousands of Flights, Closes Airports (Updates), HuffPost (Nov. 3, 2012, 10:48 AM), https://www.huffpost.com/entry/flight-cancellations-superstorm-sandy_n_2044102.
[67] Terry Maxon, *Analyst Puts Hurricane Sandy Losses at Close to $200 Million for Airlines*, Dallas Morning News, Nov. 2, 2012, *available at*

A single storm can easily cripple multiple airports. Hurricane Sandy almost completely shut down airports at Newark, LaGuardia, JFK, Philadelphia, and Washington, DC for two days, and severely reduced their capacity for another four days.[68] A storm surge that causes flight cancellations at Oakland International may also cause cancellations at San Francisco International, and storm activity in or near the coast of southern Florida could impact airports in Miami, Tampa Bay, Fort Lauderdale, and San Juan simultaneously. Such incidents could strand hundreds to thousands of passengers, with significant costs to airlines, airports, and the travelling public.

Hurricane Sandy was not the first storm to cause such damages, nor was it the last. In 2005, Hurricane Katrina significantly damaged Louis Armstrong New Orleans International Airport ($15.2 million in damages, 17 days of closure) and Gulfport-Biloxi International Airport ($44 million in damages, 12 days of closure); some smaller airports were closed for over a month. In 2017, Hurricanes Harvey and Irma each caused over 12,000 flight cancellations,[69] and the disruptions from hurricane Harvey alone were predicted to cost affected airlines over $350 million.[70] While many factors contribute to these costs, they provide one indicator of the scale of the risks posed to the aviation sector.

Strong winds can also cause airport closures as happened in Philadelphia during Hurricane Sandy.[71] As a result, it is not just low-lying, flood-prone airports that are vulnerable.

Climate change poses other types of risks to aviation. The IPCC cautions against the impact on aviation of a warmer climate, saying that, "Hotter air is less dense. In summer months, especially at airports located at high altitudes, this may result in limitations for freight capacity, safety, and weather-related delays, unless runways are lengthened."[72]

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https://www.dallasnews.com/business/airlines/2012/11/02/analyst-puts-hurricane-sandy-losses-at-close-to-200-million-for-airlines/ (last visited Sept. 11, 2020).

[68] EDF analysis of flight data from FAA Air Traffic Activity System (ATADS). ATADS can be access at http://aspm.faa.gov/opsnet/sys/Main.asp.

[69] Hugo Martin, *Harvey Causes Airlines to Delay or Cancel More Than 12,000 Flights*, L.A. Times, Aug 28, 2017, a*vailable at*: https://www.latimes.com/business/la-fi-harvey-flights-canceled-20170828-story.html (last visited Sept. 9, 2020); Ben Mutzbaugh, *Hurricane Irma: Flight Cancellations top 12,500; Even More Expected*, USA Today, Sept. 10, 2017, a*vailable at:* https://www.usatoday.com/story/travel/flights/todayinthesky/2017/09/10/hurricane-irma-airlines-cancellations-pile-up-florida-ahead-landfall/650592001/ (last visited Sept. 11, 2020).

[70] Benjamin Zhang, *Hurricane Harvey Could Cost United Airlines More Than $265 Million*, Business Insider, Aug. 30, 2017, *available at:* https://www.businessinsider.com/hurricane-harvey-cost-united-airlines-265-million-2017-8. (last visited Sept. 11, 2020).

[71] AON Benfield. Hurricane Sandy Event Recap Report: Impact Forecasting, 2013. http://thoughtleadership.aonbenfield.com/Documents/20130514_if_hurricane_sandy_event_recap.pdf.

[72] Douglas Arent , Richard S.J. Tol, Eberhard Faust, Joseph P. Hella, Surender Kumar, Kenneth M.

The IPCC described these problems further:

> Increased storminess at airports, particularly those located in coastal regions, may increase the number of weather related delays and cancellations and increase maintenance and repair costs. Clear-air turbulence will increase in the Atlantic corridor leading to longer and bumpier trips. The impact of climate change on airport pavement is very similar to paved roads. The effect of temperature and increased precipitation intensity on airports imposes a risk to the entire facility if pavements are not adapted to these increases.[73]

Increasing carbon dioxide concentrations in the atmosphere are expected to increase the frequency and intensity of turbulence, which is already responsible for costing airlines tens of millions of dollars and injuring (occasionally fatally) hundreds of passengers each year.[74] Increased temperatures, flooding and extreme weather events arising from climate change threaten the health of airport and airline workers, damage airport runways and other critical air traffic control equipment, overwhelm storm water systems, impair airplane performance, increase the risk of vehicle crashes, and, as a result, disrupt traffic, restrict public transportation, and threaten human lives and local economies.[75]

VI. EPA Must Set Stringent Standards In Order to Drive Development of Long-Lived Capital Stock

Aircraft, like power plants, have a lifecycle measured in decades. Immediately prior to the disruption of the Covid-19 pandemic, U.S. airlines were expected to invest in over 9,000 new aircraft, and globally airlines were expected to invest in over 44,000 new aircraft in the coming years.[76] Rapid action to set stringent standards for these long-lived investments is critical. The resources required to design a new jet engine are considerable – historically, up to a decade and investments in the billions have been needed.[77] As EPA

Strzepek, Ferenc L. Toth, et al. "Chapter 10: Key Economic Sectors and Services." In IPCC Working Group II Assessment Report 5, 2013, p.18 http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap10_FGDall.pdf.

[73] *Id.* (internal citations removed).

[74] Paul D. Williams and Manoj M. Joshi, "Intensification of Winter Transatlantic Aviation Turbulence in Response to Climate Change," 7 *Nature Climate Change* , 644 (2013).

[75] Transportation Research Board of the National Academies, *Airport Climate Adaptation and Resilience: A Synthesis of Airport Practice* (Washington, D.C.: Transportation Research Board, 2012), *available at http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_033.pdf* at 1; U.S. Department of Transportation, *U.S. Department of Transportation Climate Adaptation Plan 2014: Ensuring Transportation Infrastructure and System Resilience*, 2014, *available at https://www.transportation.gov/sites/dot.gov/files/docs/2014- DOT-Climate-Adaptation-Plan.pdf* at 7.

[76] Boeing, Commercial Market Outlook, 2019-2038, *available at https://www.boeing.com/commercial/market/commercial-market-outlook/#/interactive-forecast* (last visited Sept. 11, 2020).

[77] *See* 80 Fed. Reg. 37792, n.211.

proceeds with its rulemaking, it is essential to set stringent standards to drive new technologies to reduce GHG emissions and drive new technologies in an industry characterized by long-lived capital stock.

VII. Conclusion

EPA is not only empowered, but also required under the law to promulgate standards to address the polluting effects of aircraft engine emissions. EPA must ensure that its standards are based on accurate information; are sufficiently stringent to avert aviation's contribution to dangerous climate change, taking into account the high costs of inaction; incentivize necessary technological innovation; and catalyze emissions reductions demanded by science and the interests of equity. EPA must act swiftly to control GHG pollution from airplane engines by setting emission standards and test procedures as required by section 231 of the Clean Air Act (CAA). However, we urge EPA to consider the risks to the aviation sector and to the American people posed by climate change, and to work with FAA to strengthen the proposed rule so as to effectively address the danger posed to public health and welfare by air pollution from aircraft engine emissions. Particularly in this time of crisis, the United States aviation industry and the country as a whole need stringent standards that will actually address the climate crisis. Meeting this challenge, and utilizing the flexibility designed into the Clean Air Act, will enable EPA to meet its statutory requirements and spur the creation of many good jobs in the process.

Sincerely,

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APPENDIX

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The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018

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