

**READY FOR TAKEOFF: EMBARKING ON A JOURNEY TO
REGULATE AIRCRAFT GREENHOUSE GAS EMISSIONS
AT HOME AND ABROAD**

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INTRODUCTION

Air travel is among the fastest growing modes of transportation in the world.¹ It is not only quick, but also increasingly affordable.² Businesspeople, students, and tourists alike can travel by plane across the United States or across the world in a matter of hours. However, this growing popularity in air transportation is also increasing global greenhouse gas (GHG) emissions.³ To put the level of GHG emissions from aviation into perspective, “[s]omeone flying from London to New York and back generates roughly the same level of emissions as the average person in the [European Union] does by heating their home for a whole year.”⁴ Not surprisingly, aircraft emissions are among the fastest growing types of GHG emissions worldwide.⁵ Some predict that international aviation GHG emissions will increase by approximately 70% between 2005 and 2020.⁶ Indeed, for many people, air transportation is one of the largest portions of

1. Suzana Kahn Ribeiro et al., *Transport and Its Infrastructure*, in CLIMATE CHANGE 2007: MITIGATION 323, 334 (B. Metz et al. eds., 2007), <https://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter5.pdf>.

2. Derek Thompson, *How Airline Ticket Prices Fell 50% in 30 Years (and Why Nobody Noticed)*, ATLANTIC (Feb. 28, 2013), <http://www.theatlantic.com/business/archive/2013/02/how-airline-ticket-prices-fell-50-in-30-years-and-why-nobody-noticed/273506/>.

3. *EPA Ruling on Aircraft Emissions Paves Way for New Regulations*, GUARDIAN (July 26, 2016, 8:15 AM), <https://www.theguardian.com/environment/2016/jul/26/epa-ruling-on-aircraft-emissions-paves-way-for-new-regulations>.

4. *Reducing Emissions from Aviation*, EUROPEAN COMM’N CLIMATE ACTION [hereinafter *Reducing Emissions from Aviation*], https://ec.europa.eu/clima/policies/transport/aviation_en (last visited May 3, 2018).

5. *Id.*

6. *Id.*

their carbon footprints.⁷ Historically, these emissions have been left to the industry and individual countries to regulate.⁸ However, this autonomy is fading.

Two major recent events indicate that regulating aircraft GHG emissions is on the horizon. First, the International Civil Aviation Organization (ICAO), the United Nations specialized body on international aircraft regulation, issued two important measures as part of its goal to obtain carbon-neutral growth in aircraft GHG emissions from 2020 onward.⁹ Among these measures are the first-ever global standards for aircraft carbon-dioxide emissions.¹⁰ Second, the U.S. Environmental Protection Agency (EPA or Agency) issued an endangerment finding under section 231(a)(2)(A) of the Clean Air Act (CAA) for the combination of six GHG emissions from certain aircraft.¹¹ With the endangerment finding, the EPA is now positioned to regulate aircraft emissions in the United States, implementing ICAO's new standards for international aviation, and either using those same standards or creating its own for domestic aviation.¹² These developments are essential to mitigating climate change and attaining the global goal of keeping temperature rise below 1.5°C or 2°C.¹³

7. See COOLCLIMATE NETWORK, <http://coolclimate.berkeley.edu/calculator> (last visited May 3, 2018) (enabling visitors to calculate their carbon footprint).

8. See Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,424 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068) (“In 2014, aircraft remained the single largest GHG-emitting transportation source not yet subject to any GHG standards . . . [while] accounting for 12 percent of all U.S. transportation GHG emissions . . .”).

9. Miranda Jensen, *Global Aviation CO2 Emissions Cap Almost Clear for Takeoff*, SUBSTANTIAL & SUSTAINED (Oct. 10, 2016), <http://vlscop.vermontlaw.edu/2016/10/10/global-aviation-co2-emissions-cap-almost-clear-for-takeoff/>; see also Int'l Civil Aviation Org. [ICAO], ENVIRONMENTAL REPORT 2016: AVIATION AND CLIMATE CHANGE, at 97 (2016) [hereinafter ICAO ENVIRONMENTAL REPORT 2016], <https://www.icao.int/environmental-protection/Documents/ICAO%20Environmental%20Report%202016.pdf> (defining carbon-neutral growth from 2020 as “stabilizing the [international aviation] sectors’ global CO₂ emissions at 2020 levels”).

10. *New ICAO Aircraft CO2 Standard One Step Closer to Final Adoption*, ICAO (Feb. 8, 2016) [hereinafter *One Step Closer*], <http://www.icao.int/Newsroom/Pages/New-ICAO-Aircraft-CO2-Standard-One-Step-Closer-To-Final-Adoption.aspx>; see also *ICAO Council Adopts New CO2 Emissions Standards for Aircraft*, ICAO (Mar. 6, 2017), <http://www.icao.int/Newsroom/Pages/ICAO-Council-adopts-new-CO2-emissions-standard-for-aircraft.aspx> (announcing that ICAO has finalized its CO₂ standards).

11. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,422.

12. *Id.* at 54,426–28.

13. See Paris Agreement art. 2, Dec. 12, 2015, http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (striving to keep the world’s temperature below

This Note will provide background information on GHG-emissions regulation in the aviation sector. It will also lay out some of the essential elements of a future rule that the United States should incorporate when adopting these regulations domestically. Part I will offer an overview of some of the problems associated with global warming and the need to reduce GHGs. This Part will also briefly discuss international climate change treaties, including the goals of the Paris Agreement and the United States' nationally determined contribution. Part II will fly through the history of aircraft-emissions regulations—both in the United States and in the European Union (EU). It will also discuss the ways the aviation sector has voluntarily worked to reduce its carbon footprint and explore ICAO's initiatives in greater detail. Part III will examine the framework for regulating GHGs from domestic aviation, including the recent EPA endangerment finding under section 231 of the CAA. Part IV will discuss the next steps for the United States in terms of adopting regulations for aircraft GHG emissions and effective implementation. This Part will also detail the most important characteristics of an effective EPA rule regulating GHG emissions from domestic aircraft. Finally, this Note will conclude by summarizing the shortfalls of this regulatory scheme and offer recommendations for policymakers going forward.

2°C above pre-industrial levels, while trying to limit that increase to 1.5°C). While the Trump Administration has suggested that it may withdraw the United States from the Paris Agreement, it is unclear whether the Administration will actually do so. See Robinson Meyer, *Trump and the Paris Agreement: What Just Happened?*, ATLANTIC (Aug. 4, 2017), <https://www.theatlantic.com/science/archive/2017/08/trump-and-the-paris-agreement-what-just-happened/536040/> (noting that the Administration says it intends to withdraw, but will continue to send a delegation for three years until the official withdrawal date allowed by the Agreement). In any event, any withdrawal would not become effective until November 2020 at the earliest. *Id.* Under Article 28 of the Agreement, no party may withdraw from the Agreement until November 2019, three years after the Agreement entered into force. Paris Agreement, *supra*, art. 28. At that time, parties may submit a written notice to the U.N. Depository, and the withdrawal would become effective no sooner than one year from that date. *Id.* The United States could remove itself from the Paris Agreement much sooner by withdrawing from the UNFCCC treaty. United Nations Framework Convention on Climate Change [UNFCCC], art. 25, May 9, 1992, 1771 U.N.T.S. 107. However, the White House has not suggested that it will pursue that option. See Meyer, *supra* (stating that the U.S. plans to continue participating in UNFCCC negotiations). Therefore, this Note will assume that the United States will remain a party to the Paris Agreement until the White House issues a clearer statement on withdrawal.

I. BACKGROUND: CLIMATE CHANGE IN CONTEXT

GHGs, which trap heat, are accumulating in the atmosphere and causing the Earth's temperature to rise.¹⁴ There is near-universal consensus in the scientific community that anthropogenic activity is greatly accelerating climate change.¹⁵ This warming results in numerous adverse effects globally. For example, melting polar ice contributes to rising sea levels, which threaten the existence of many of the world's most populous cities.¹⁶ Additionally, rising ocean temperatures and ocean acidification threaten coral reefs and other ocean ecosystems since oceans absorb much of the world's carbon dioxide.¹⁷ Scientists have also linked climate change to increasing frequency and severity of weather events, including increased precipitation in some parts of the world and droughts in others.¹⁸ These events are merely samples of the countless damaging and potentially irreversible effects precipitated by climate change.¹⁹ Extreme climate events have already resulted in resource scarcity and displaced coastal populations.²⁰ These problems are likely to worsen as the climate changes, and lead to global instability.²¹ For instance, many scientists believe drought was a major contributing factor to the current Syrian crisis.²² Thus, climate change can ultimately produce situations that lead to interstate and intrastate conflicts.²³

In light of these catastrophic events, countries around the world have recognized the need to reduce anthropogenic GHG emissions. Some

14. *Overview of Climate Change Science*, EPA, https://19january2017snapshot.epa.gov/climate-change-science/overview-climate-change-science_.html (last updated Jan. 19, 2017).

15. See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], FIFTH ASSESSMENT REPORT: CLIMATE CHANGE 2014 SYNTHESIS REPORT SUMMARY FOR POLICYMAKERS 4 (2014), http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf (noting that anthropogenic greenhouse gas emissions are almost certainly the main cause of global warming and that emission rates have been accelerating).

16. *Id.* at 4, 13–16.

17. *Id.* at 4, 13.

18. *Id.* at 7–8.

19. *Id.* at 13–16.

20. SÉGOLÈNE ROYAL: PRÉSIDENTE DE LA COP21, RAPPORT: SÉCURITÉ ET CLIMAT [REPORT: SECURITY AND CLIMATE] 1, 3, 5, 6, 8 (Nov. 2016), http://www.developpement-durable.gouv.fr/sites/default/files/16220-FR_rapport-securite-climat_36p_A4_DEF_BD_Page%20%C3%A0%20page.pdf.

21. *Id.*

22. *Id.* at 11.

23. *Id.* at 3.

countries have made more progress on this front than others.²⁴ Nevertheless, because GHG emissions are a transboundary problem, it is essential that countries cooperate to mitigate the effects of climate change. No matter how laudable their efforts, individual countries, on their own, cannot prevent the adverse effects of climate change. The United Nations Framework Convention on Climate Change (UNFCCC) laid the foundation for such cooperation by producing the Kyoto Protocol and, more recently, the Paris Agreement.²⁵

Adopted in 1997, the Kyoto Protocol attempted to reduce GHG emissions by requiring developed countries party to the Protocol to cut their emissions.²⁶ However, the Protocol did not govern international “aviation and marine bunker fuels”; instead, it required the parties to use ICAO and the International Maritime Organization, respectively, to regulate those fuels.²⁷ Once again, the aviation and maritime industries fell through the cracks with the adoption of the Paris Agreement in 2015.²⁸

The primary goal under the Paris Agreement is to limit the increase in global temperature by keeping it “well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”²⁹ Parties based the global temperature cap on the findings by the Intergovernmental Panel on Climate Change (IPCC) in its 2014 report on climate change outlook.³⁰ As part of the Agreement, parties must submit nationally determined contributions (NDCs) to collectively work toward this temperature cap.³¹ The parties must then review and strengthen their NDCs every five years.³² The United States’ initial NDC

24. *Rating Countries*, CLIMATE ACTION TRACKER [hereinafter *Rating Countries*], <http://climateactiontracker.org/countries.html> (last visited May 3, 2018).

25. *Five Steps to a Safer Future: Introducing the United Nations Framework Convention on Climate Change*, UNITED NATIONS, http://unfccc.int/essential_background/convention/items/6036.php (last visited May 3, 2018); *Kyoto Protocol*, UNITED NATIONS [hereinafter *Kyoto Protocol*], http://unfccc.int/kyoto_protocol/items/2830.php (last visited May 3, 2018); *The Paris Agreement*, UNFCCC, http://unfccc.int/paris_agreement/items/9485.php (last visited May 3, 2018).

26. *Kyoto Protocol*, *supra* note 25.

27. Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 2.2, *opened for signature* Dec. 11, 1997, 2303 U.N.T.S. A-30822 (entered into force Feb. 16, 2005) [hereinafter *Kyoto Protocol*], <https://treaties.un.org/doc/Publication/UNTS/Volume%202303/v2303.pdf>.

28. Paris Agreement, *supra* note 13, art. 7.8.

29. *Id.* art. 2.1(a).

30. See IPCC, *supra* note 15, at 20–24 (discussing scenarios for keeping the global temperature increase below 2°C from pre-industrial levels).

31. Paris Agreement, *supra* note 13, art. 3.

32. *Id.* art. 4.9.

(INDC) is “to achieve an economy-wide target of reducing its greenhouse gas emissions by 26-28[%] below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%.”³³ This is a moderately ambitious INDC,³⁴ and will require emissions cuts across multiple sectors and industries.³⁵ Regulating domestic aviation GHGs would help the United States reach its INDC under the Paris Agreement, and perhaps even go further.

II. INTERNATIONAL AIRCRAFT GHG-EMISSIONS REGULATIONS

While neither the Kyoto Protocol nor the Paris Agreement covers international aircraft (or maritime) emissions, ICAO has stepped up to reduce GHG emissions from aircraft in the international arena.³⁶ Among other things, aircraft emissions include two types of GHGs: carbon dioxide and nitrous oxide.³⁷ These emissions contribute to rising global temperatures and exacerbate climate change.³⁸ As a result, addressing

33. U.N. Conference on Intended Nationally Determined Contributions (INDC), *U.S. Cover Note, INDC and Accompanying Information*, (Mar. 3, 2015), <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf>.

34. See *Tracking INDCs: USA*, CLIMATE ACTION TRACKER, <http://climateactiontracker.org/countries/usa/2016.html> (last updated Nov. 2, 2016) (giving the United States a “medium” rating).

35. See *Rating Countries*, *supra* note 24 (finding that India, the Philippines, and Costa Rica (among others) have “2°C Compatible” INDCs, while countries like the United States, South Korea, Australia, and Russia (among others) have “insufficient” INDCs, and Morocco and the Gambia have “1.5°C Paris Agreement Compatible” INDCs). Under the Trump Administration, the United States’ contribution has become “critically insufficient,” but the country could nevertheless maximize its contribution by regulating domestic aviation GHGs. *Id.*

36. See Kyoto Protocol, *supra* note 27, 2303 U.N.T.S. A-30822 (noting that parties “shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively”). ICAO began to address GHG emissions in 2007 following the Kyoto Protocol. See Int’l Civil Aviation Org., Assembly Res. A36-22, at 96–97 (Sept. 28, 2007), Int’l Civil Aviation Org. Doc. 9902 (Sept. 2007) (directing the ICAO Council to take various actions addressing aviation’s impact on the climate). However, the Paris Agreement reinforces the fact that international aircraft GHG emissions do not fall under the UNFCCC treaties. See Paris Agreement, *supra* note 13, art 7.8 (stating in reference to adaptation measures that “United Nations specialized organizations and agencies are encouraged to support the efforts of Parties to implement [adaptation] actions”).

37. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,424 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

38. *Id.* Not all GHGs are created equal: nitrous oxide is 298 times more potent than carbon dioxide, meaning it has a much greater warming effect. *CO2 Equivalents*, CLIMATE CHANGE

aircraft emissions is important when working to mitigate the effects of climate change.

Even without international or United States regulations in place, the aviation sector has taken several actions that reduce GHG emissions. For example, aircraft manufacturers have improved the fuel efficiency of airplanes by using more efficient designs and lighter materials.³⁹ In fact, aviation is 80% more fuel efficient today than it was 50 years ago.⁴⁰ While increasing fuel efficiency may be motivated by business and economic goals, these technological improvements have the added benefit of reducing GHG emissions.⁴¹ Some airlines have also attempted to reduce their environmental impacts by allowing passengers to purchase carbon offsets when booking flights.⁴² In these situations, airlines may partner with nonprofits to fund offsets that often involve protecting forests, which act as carbon sinks⁴³ for the carbon dioxide that the passenger's travel creates.⁴⁴

To meet its targets under the Kyoto Protocol, the EU created its own Emissions Trading System (ETS) in 2005, which cuts across multiple industries (including aviation) to curb EU carbon dioxide emissions.⁴⁵ This cap-and-trade scheme covers approximately 45% of GHG emissions in the

CONNECTION [hereinafter *CO2 Equivalents*], <http://climatechangeconnection.org/emissions/co2-equivalents/> (last updated Apr. 27, 2016).

39. *How Are Aviation Emissions Regulated?*, AVIATION ONLINE MAG. [hereinafter *How Are Aviation Emissions Regulated?*], http://avstop.com/aviation_emissions/How_are_aviation_emissions_regulated.htm (last visited May 3, 2018).

40. ON BOARD: A SUSTAINABLE FUTURE, INT'L CIV. AVIATION ORG. (2016) [hereinafter ON BOARD], <https://www.icao.int/environmental-protection/Documents/ICAO%20Environmental%20Report%202016.pdf>.

41. *How Are Aviation Emissions Regulated?*, *supra* note 39.

42. See, e.g., *A Greener Way to Fly: Learn More About the Carbon Impact of Your Trip*, DELTA AIRLINES, https://www.delta.com/content/www/en_US/about-delta/corporate-responsibility/carbon-emissions-calculator.html (last visited May 3, 2018) (allowing passengers to calculate emissions by searching travel confirmation numbers). Even passengers who are not able to calculate their carbon emissions on the airline's website may do so directly through various nonprofit agencies. COOLCLIMATE NETWORK, *supra* note 7.

43. Carbon sinks are ecosystems like oceans and forests that help mitigate the effects of global warming by absorbing carbon dioxide out of the atmosphere. *Carbon sink*, DICTIONARY.COM, <http://www.dictionary.com/browse/carbon-sink> (last visited May 3, 2018).

44. See *Where Does My Money Go?*, DELTA AIRLINES [hereinafter *Where Does My Money Go?*], https://www.delta.com/content/www/en_US/about-delta/corporate-responsibility/carbon-emissions-calculator.html#money (last visited May 3, 2018) (explaining Delta's partnership with The Nature Conservancy and the projects that passengers may help fund when they purchase offsets).

45. *The EU Emissions Trading System (EU ETS)*, EUROPEAN COMM'N CLIMATE ACTION [hereinafter *EU ETS*], http://ec.europa.eu/clima/policies/ets_en (last visited May 3, 2018).

EU.⁴⁶ In the context of aviation, the ETS requires airlines managing flights departing from or arriving in an EU member state to pay for their flight's carbon emissions.⁴⁷ Despite its efforts to curb EU GHG emissions, some countries outside the EU refused to comply with this regulation, most notably the United States and China.⁴⁸ As a result, the EU temporarily suspended its application of the ETS program to foreign aircraft, and now only requires planes flying between countries within the European Economic Area to participate.⁴⁹ In return for the suspension, ICAO established global emissions regulations in 2016.⁵⁰

In the aviation sector, 65% of carbon dioxide emissions are from international aviation.⁵¹ To address international aircraft GHG emissions, ICAO has been developing a “basket of measures” since 2010.⁵² This basket includes four components: technology improvements, operational improvements, alternative fuels, and market-based measures.⁵³ Together, these components will help international aviation reach carbon-neutral growth from 2020⁵⁴ and fuel-efficiency improvements of 2% per year through 2050 (based on the fleet of international, in-service civil aircraft).⁵⁵

The first measure in ICAO's basket involves technology improvements. In February 2016, ICAO's Committee on Aviation Environmental Protection (CAEP)⁵⁶ laid the groundwork for the first-ever

46. *Id.*

47. Valerie Volcovici, *Obama Shields U.S. Airlines from EU Carbon Fees*, REUTERS (Nov. 27, 2012, 4:48 PM), <http://www.reuters.com/article/us-usa-airlines-emissions-idUSBRE8AQ1AR20121127>.

48. *Id.*

49. *EU ETS*, *supra* note 45.

50. *Reducing Emissions from Aviation*, *supra* note 4.

51. ICAO ENVIRONMENTAL REPORT 2016, *supra* note 9, at 16.

52. ON BOARD, *supra* note 40.

53. *Id.*

54. *Carbon neutrality from 2020* refers to ICAO's “aspirational goal of keeping the global net CO₂ emissions from international aviation from 2020 at the same level” going forward. ICAO ENVIRONMENTAL REPORT 2016, *supra* note 9, at 141.

55. *Id.* at 97, 141; Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,429 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

56. It is worth noting that ICAO was developed in 1944 under the Convention on International Civil Aviation (also known as the Chicago Convention) to promote peace and cooperation in the development of the civil aviation sector. Int'l Civil Aviation Org. [ICAO], Convention on International Civil Aviation, arts. 43–44, 61 Stat. 1180 (Dec. 7, 1944), <https://www.loc.gov/law/help/us-treaties/bevans/m-ust000003-0944.pdf>. As a result, ICAO addresses a wide variety of issues in addition to environmental protection. CAEP, an ICAO technical committee, was established in 1983 to assist ICAO with its environmental matters. *Committee on Aviation Environmental Protection (CAEP)*, INT'L

global carbon-dioxide-missions standards for international aviation at its tenth meeting.⁵⁷ ICAO's 39th Assembly then adopted these standards in October, and they became the first carbon-dioxide-emissions technology standards for an entire sector at the international level.⁵⁸ Aircraft designs have already made substantial progress over the past 50 years, but the new emissions standards will keep this progress moving forward by requiring new aircraft to use fuel-efficient technology.⁵⁹ In fact, ICAO chose one of the more stringent options it was considering, resulting in a 33% emissions reduction.⁶⁰ Starting in 2020, the standards will apply to new aircraft designs.⁶¹ For aircraft designs already in production, the standards will take effect in 2023, with a production cutoff date in 2028 for non-complying designs.⁶²

Aircraft manufacturers have generally been supportive of ICAO's carbon-dioxide-emissions standards. For example, Boeing issued a statement praising ICAO for its new standards and acknowledging the importance of reducing aircraft emissions.⁶³ Part of the reason for this approval may be because Airbus and Boeing, the world's two largest aircraft manufacturers, already manufacture some models that comply with ICAO's standards.⁶⁴ For example, Airbus's A320neo family, in addition to its wide-body A330neo and A350 already clears the strict standards that

CIV. AVIATION ORG., <https://www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx> (last visited May 3, 2018).

57. *One Step Closer*, *supra* note 10; ICAO ENVIRONMENTAL REPORT 2016, *supra* note 9, at 97.

58. *ICAO Assembly Achieves Historic Consensus on Sustainable Future for Global Civil Aviation*, INT'L CIV. AVIATION ORG. (Oct. 6, 2016), <https://www.icao.int/Newsroom/Pages/ICAO-Assembly-achieves-historic-consensus-on-sustainable-future-for-global-civil-aviation.aspx>.

59. ON BOARD, *supra* note 40.

60. Allison Lampert & Tim Hopher, *Factbox: What Deal on CO2 Standards Means for Airbus, Boeing Jets*, REUTERS (Feb. 8, 2016, 5:48 PM), <http://www.reuters.com/article/us-climatechange-aviation-options-factbo-idUSKCN0VH252?mod=related&channelName=globalEnergyNews>.

61. ON BOARD, *supra* note 40.

62. *Id.*

63. Jessica Kowal, *Boeing Supports ICAO Aircraft CO2 Emissions Standard: Real Progress to Reduce Aviation CO2 Emissions*, PR NEWswire (Feb. 08, 2016, 7:19 PM), <http://www.prnewswire.com/news-releases/boeing-supports-icao-aircraft-co2-emissions-standard-300217001.html>.

64. Allison Lampert & Valerie Volcovici, *U.N. Group Agrees to Aircraft Standards to Cut CO2 Emissions*, REUTERS (Feb. 8, 2016, 3:25 PM), <https://www.reuters.com/article/us-climatechange-aviation/u-n-group-agrees-to-aircraft-standards-to-cut-co2-emissions-idUSKCN0VH1XA>.

ICAO passed.⁶⁵ Likewise, Boeing 777-9X and 787 models are in compliance.⁶⁶

Operational improvements are another important component of ICAO's basket of measures. These measures apply to activities carried out during air travel, both on the ground and in the sky.⁶⁷ For example, operational activities include fueling aircraft, pushing back from the gate, taxiing to the runway, taking off, cruising during flight, and landing.⁶⁸ By making these processes more efficient, the aviation sector can reduce fuel consumption.⁶⁹ This fuel reduction is significant because "[f]or every tonne of fuel reduced, an equivalent amount of 3.16 tonnes of CO₂ are saved."⁷⁰ ICAO created the Global Air Navigation Plan (GANP), which will help it carry out this measure.⁷¹ As part of the GANP, ICAO, countries, and private actors are analyzing current air navigation processes through ICAO's Aviation System Bloc Updates (ASBU).⁷² This measure, developed in 2012, is an analysis intended to address a wide variety of issues associated with increased air traffic—including environmental effects.⁷³

The third element in ICAO's basket of measures is developing sustainable alternative fuels that will produce lower levels of carbon dioxide emissions.⁷⁴ There is serious potential to reduce carbon-dioxide emissions through this path, particularly with alternative fuels that would not require any changes to current aircraft design.⁷⁵ These fuels would be especially valuable because they would allow the aviation sector to reduce implementation costs.⁷⁶ In 2009, ICAO developed the Global Framework for Aviation Alternative Fuels (GFAAF) to track various innovations and news reports on alternative aircraft fuels.⁷⁷ The GFAAF allows countries to see what others are doing and to share alternative aviation-fuel information

65. Lampert & Hepher, *supra* note 60.

66. *Id.*

67. ON BOARD, *supra* note 40.

68. *Id.*

69. *Id.*

70. ICAO ENVIRONMENTAL REPORT 2016, *supra* note 9, at 98.

71. *Id.* at 97–98.

72. *Id.* at 120.

73. *Id.*

74. ON BOARD, *supra* note 40.

75. *Id.*

76. *Id.*

77. ICAO ENVIRONMENTAL REPORT 2016, *supra* note 9, at 153.

with one another.⁷⁸ Some of the sustainably produced alternative aviation fuels include those sourced from animal fats, used cooking oils, various crops, and other agricultural products.⁷⁹ Alternative fuels have already been used to power live aircraft.⁸⁰ ICAO predicted that, by the end of 2016, sustainable fuels would have powered more than 5,500 commercial flights.⁸¹

Finally, ICAO developed a market-based mechanism to fill the gaps in the above set of measures.⁸² Market-based mechanisms (also known as “market-based instruments”) use financial incentives to drive policy objectives in environmental law.⁸³ To this end, ICAO adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) at its 39th session in October 2016.⁸⁴ ICAO boasts CORSIA as the “first global market-based measure to address CO₂ emissions from any industry sector”⁸⁵ Using 2020 as a base year, this scheme will require offsets for carbon emissions that exceed 2020 levels based on both individual operators’ emissions growth and aviation sector growth.⁸⁶ CORSIA will be implemented in three phases: the pilot phase from 2021–23, the first phase from 2024–26, and the second phase from 2027–35.⁸⁷ The pilot phase and the first phase are voluntary, while the second phase is mandatory.⁸⁸ More

78. *Id.*

79. ON BOARD, *supra* note 40.

80. *Live Feed of Flights Operating with Alternative Fuels*, INT’L CIV. AVIATION ORG., <https://planefinder.net/custom/icao-fuel.php> (last visited May 3, 2018).

81. ON BOARD, *supra* note 40.

82. See Int’l Civ. Aviation Org., *The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, YOUTUBE (Nov. 24, 2016) [hereinafter *CORSIA*], <https://www.youtube.com/watch?v=OUfhLkMhc8w> (explaining the reasoning and elements of the CORSIA program).

83. *Market-Based Instruments*, GREENFACTS, <http://www.greenfacts.org/glossary/mno/market-based-instruments.htm> (last visited May 3, 2018). These mechanisms can take many forms, but a common example includes cap-and-trade programs, like the EU ETS, which commonly address pollution in sectors outside of aviation. See *supra* notes 45–47 and accompanying text (discussing the EU ETS); see also *How Cap and Trade Works*, ENVTL. DEF. FUND, <https://www.edf.org/climate/how-cap-and-trade-works> (last visited May 3, 2018) (discussing cap-and-trade programs generally and noting that California, China, and the EU have been experimenting with cap-and-trade programs to cut emissions).

84. *ICAO Council President Inspires COP22 with Positive Updates on International Aviation Emissions*, INT’L CIV. AVIATION ORG. (Nov. 9, 2016), <http://www.icao.int/Newsroom/Pages/ICAO-Council-President-inspires-COP22-with-positive-updates-on-international-aviation-emissions.aspx>.

85. *Id.*

86. ON BOARD, *supra* note 40.

87. *Id.*

88. *Id.*

than 70 countries, including the United States, have already pledged to participate in the voluntary stages,⁸⁹ indicating widespread support for GHG-emissions reductions.

There are, however, exemptions to mandatory participation in CORSIA. Least Developed Countries (LDCs), Small Island Developing States (SIDS), and Landlocked Developing Countries (LLDCs) are never required to participate in the scheme, but they are welcome to voluntarily participate.⁹⁰ Likewise, certain operators are exempt, including those that emit very small quantities of carbon dioxide, those that are new to the market, and those that perform specialized functions (like search and rescue).⁹¹ Given these country exemptions and the voluntary phases of implementation, CORSIA-emissions offsets will only apply to a route if both countries are participating in the scheme.⁹² These exemptions are reasonable because without them, CORSIA would negatively and disproportionately impact these parties' economies. Moreover, despite the exemptions, ICAO claims that, by 2027, CORSIA will cover 90% or more of international flights.⁹³

Because CORSIA is so new, much remains uncertain about its implementation. However, it seems clear that ICAO will proceed in a transparent fashion, similar to the way the Paris Agreement will be implemented.⁹⁴ Article 13 of the Paris Agreement requires the parties to create transparency mechanisms to disclose mitigation and adaptation actions and support.⁹⁵ CORSIA will also require transparency in order to be successful.⁹⁶ ICAO is currently developing a “[m]onitoring, reporting and verification system”; “[c]riteria for emissions units to be purchased by aircraft operators”; and “[r]egistries” for CORSIA.⁹⁷ The ICAO Council working on the system aims to adopt it by 2018 so countries can begin to

89. *Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*, INT’L CIV. AVIATION ORG., <http://www.icao.int/environmental-protection/Pages/market-based-measures.aspx> (last visited May 3, 2018).

90. ON BOARD, *supra* note 40.

91. *Id.*

92. *Id.*

93. *Id.*

94. Miranda Jensen, *Reporting on COP: Backbone of the Paris Agreement Has Undertones in ICAO’s CORSIA Scheme*, VT. J. ENVTL. L.: ECOPERSPECTIVES BLOG (Nov. 17, 2016), <http://vjel.vermontlaw.edu/reporting-cop-backbone-paris-agreement-undertones-icaos-corsia-scheme/>.

95. Paris Agreement, *supra* note 13, art. 13.

96. Jensen, *supra* note 94.

97. ON BOARD, *supra* note 40.

implement it in January 2019.⁹⁸ When ICAO finishes developing these processes, it will become clearer how the CORSIA scheme will function in reality. Additionally, ICAO will review CORSIA every three years starting in 2022.⁹⁹ Hopefully this review process will look similar to the global stocktake provision under Article 14 of the Paris Agreement, and involve ICAO strengthening CORSIA so as to complement the Paris Agreement's efforts to keep the global temperature increase below 1.5°C or 2°C.¹⁰⁰ While aviation GHG emissions are excluded from the Paris Agreement, ICAO can use CORSIA and the rest of its basket of measures to curb GHG emissions and help the world achieve its ambitious 1.5°C goal and prevent some of the damaging effects of climate change.

In addition to these aviation GHG-emissions developments, countries have also submitted their own state action plans to ICAO.¹⁰¹ As of January 2018, over 100 countries have submitted state action plans.¹⁰² These plans detail the actions countries are taking domestically to address international aircraft carbon-dioxide emissions.¹⁰³ The United States submitted its state action plan in June 2015.¹⁰⁴ Included in the document is the United States' plan to address each component of ICAO's basket of measures, such as technology improvements, operational improvements, alternative fuels, and policy.¹⁰⁵ The United States' plan also strives to achieve carbon-neutral growth for its commercial aviation by 2020; however, the United States sets its baseline at 2005, making it more ambitious than ICAO's 2020-levels baseline.¹⁰⁶ The United States also stated that it would review its state action plan every three years, meaning an update will be due in 2018.¹⁰⁷

98. *What Are the Mechanisms for the CORSIA Implementation? How Will ICAO Support States to Implement the CORSIA?*, INT'L CIV. AVIATION ORG., https://www.icao.int/environmental-protection/Pages/A39_CORSIA_FAQ4.aspx (last visited May 3, 2018).

99. Jensen, *supra* note 94.

100. *Id.*

101. ON BOARD, *supra* note 40.

102. *Climate Change: State Action Plans and Assistance*, INT'L CIV. AVIATION ORG., https://www.icao.int/environmental-protection/Pages/ClimateChange_ActionPlan.aspx (last visited May 3, 2018).

103. ON BOARD, *supra* note 40.

104. UNITED STATES: AVIATION GREENHOUSE GAS EMISSIONS REDUCTION PLAN 1 (2015) [hereinafter 2015 US GHG REDUCTION PLAN], https://www.icao.int/environmental-protection/Lists/ActionPlan/Attachments/30/UnitedStates_Action_Plan-2015.pdf.

105. *Id.* at 2–3.

106. *Id.* at 9.

107. *Id.* at 42.

III. REGULATING AIRCRAFT GHG EMISSIONS DOMESTICALLY

The state action plan the United States submitted to ICAO addresses international and domestic aviation emissions.¹⁰⁸ However, the most significant development for aircraft GHG emissions at the domestic level in the United States is the EPA's endangerment finding under section 231(a)(2)(A) of the CAA.¹⁰⁹ This section requires the EPA Administrator to issue emissions standards for "any air pollutant from any class or classes of aircraft engines which in his [or her] judgment causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare."¹¹⁰

The EPA Administrator took the first step toward regulation on August 15, 2016, when the Agency issued a finding under section 231(a)(2)(A) that high levels of "six well-mixed GHGs constitute air pollution that may reasonably be anticipated to endanger both the public health and welfare of current and future generations."¹¹¹ This definition mirrors that in the EPA's 2009 endangerment finding for the same mixture of GHGs from motor vehicles under section 202(a) of the CAA.¹¹² However, because section 202(a) does not cover aircraft, this finding under section 231(a)(2)(A) is an essential prerequisite to regulating aviation GHG emissions.¹¹³

While the section 231(a)(2)(A) endangerment finding defines the pollutant as a mixture of six GHGs, aircraft engines emit only two of them: carbon dioxide and nitrous oxide.¹¹⁴ The fact that aircraft do not emit all six

108. *Id.* at 4.

109. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,440 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068); Eric B. Rothenberg et al., *Regulating Aircraft GHG Emissions: EPA's Initial Steps*, LAW360 (July 27, 2016, 4:27 PM), <https://www.law360.com/articles/821783>.

110. Clean Air Act § 231(a)(2), 42 U.S.C. § 7571(a)(2)(A) (2012).

111. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,440. These six gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. *Id.* Many of these gases are more potent (and thus trap more heat) than carbon dioxide itself. *CO2 Equivalents*, *supra* note 38.

112. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,424–26.

113. *Id.* at 54,424.

114. *Id.*

does not bar their regulation; instead, the situation is analogous to the section 202(a) endangerment finding, where the EPA determined that it could regulate pollutants from motor vehicles emitting only four of the six chemicals.¹¹⁵ Similarly here, the EPA’s finding concluded that the emissions from aircraft covered by the rule “cause or contribute” to this pollution.¹¹⁶ The “[c]overed aircraft” include “[s]ubsonic jet aircraft with a maximum takeoff mass (MTOM) greater than 5,700 kilograms and subsonic propeller-driven (*e.g.*, turboprop) aircraft with a MTOM greater than 8,618 kilograms.”¹¹⁷ These are the same classes of aircraft covered under ICAO’s standards, and they cover 89% of domestic aircraft GHG emissions.¹¹⁸

Notable exclusions from both ICAO and EPA regulations include helicopters and military aircraft,¹¹⁹ which some commenters argue the EPA should have brought within the scope of its endangerment finding.¹²⁰ The EPA, however, declined to depart from ICAO’s existing classification scheme.¹²¹ While ICAO cannot stretch its standards beyond international civil aviation, the EPA is not so limited under the CAA.¹²² As a result, the EPA could have included these additional classifications of aircraft in its endangerment finding, but chose not to.

In response to commenters who urged the EPA to broaden the scope of its endangerment finding, the EPA stated that following ICAO’s classification scheme is “a reasonable approach for this first finding regarding the contribution of aircraft GHG emissions to the endangering air pollution”¹²³ It added that section 231(a)(2)(A) of the CAA “gives the EPA discretion to determine which class or classes of aircraft engines to

115. *Id.* at 54,426.

116. *Id.* at 54,459.

117. *Id.* at 54,423.

118. *Id.* at 54,469.

119. *Id.* at 54,465.

120. *Id.* at 54,469.

121. *Id.*

122. See *infra* notes 180–83 and accompanying text (discussing gaps in the EPA’s rule); *Clean Air Act (CAA) and Federal Facilities*, EPA, <https://www.epa.gov/enforcement/clean-air-act-cao-and-federal-facilities> (last updated Jan. 29, 2018) (stating that unless the President exempts military equipment, it is subject to “all federal, state, local and tribal CAA requirements”).

123. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,469 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

evaluate in making a cause or contribute finding”¹²⁴ While the EPA indicated that it would consider commenters’ requests to initiate an endangerment finding regarding “non-covered U.S. aircraft,” the Agency also noted that it was under a time crunch to issue this rule before ICAO finalized its standards.¹²⁵ The EPA issued this endangerment finding in preparation for the United States’ adoption of these new standards, and the EPA is currently unwilling to issue regulations that stretch beyond what the Chicago Convention will require parties to adopt.¹²⁶

In its 2016 endangerment finding, the EPA followed the same framework as its 2009 endangerment finding of GHGs under section 202(a).¹²⁷ The EPA’s endangerment finding in 2009 came as a result of the United States Supreme Court’s holding in *Massachusetts v. EPA*.¹²⁸ In that case, the EPA failed to regulate GHGs under section 202(a) in response to a rulemaking petition, claiming that the CAA did not authorize the Agency to issue “regulations to address global climate change”¹²⁹ However the Court disagreed, concluding that the EPA has the authority to regulate GHGs under section 202(a).¹³⁰ It therefore held that the Agency’s determination was arbitrary and capricious, so the EPA would need to find a better reason for its refusal to pursue an endangerment finding.¹³¹

The Court did not decide whether the EPA needed to actually make an endangerment finding.¹³² However, the EPA would have had a difficult time justifying a decision not to do so given the overwhelming scientific evidence supporting the dangers of GHGs and their link to global warming. Additionally, the Court noted that, because it has responded to a petition for rulemaking, the only way the “EPA can avoid taking further action [is] if it determines that greenhouse gases do not contribute to climate change or if it

124. *Id.*

125. *Id.*

126. *Id.*

127. 42 U.S.C. § 7521(a)(1) (2012); Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,425–26.

128. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,425–26.

129. *Massachusetts v. EPA*, 549 U.S. 497, 511 (2007).

130. *Id.* at 532.

131. *Id.* at 534–35.

132. *Id.*

provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do.”¹³³ With its hands tied, the EPA issued an endangerment finding two years later, concluding that the combination of six GHGs (methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) “endanger the public health and welfare of current and future generations” and that motor vehicle emissions contribute to this air pollution.¹³⁴

A few months after the Court decided *Massachusetts v. EPA* in 2007, a group of environmental nonprofit organizations, including Earthjustice, Friends of the Earth, Center for Biological Diversity, and Oceana, submitted a rulemaking petition to the EPA asking the Agency to conduct a finding under section 231 as well, which would require the EPA to regulate aircraft emissions.¹³⁵ Perhaps overwhelmed by its new responsibility, the EPA responded to *Massachusetts v. EPA* by soliciting comments through an advanced notice of proposed rulemaking (ANPR).¹³⁶ This ANPR sought out comments addressing GHG emissions from various sources, including aircraft.¹³⁷

However, the group of environmental nonprofit petitioners filed suit in 2010 when the EPA dragged its feet in responding to their petition regarding aircraft GHG emissions.¹³⁸ In its ruling on the merits, the United States District Court for the District of Columbia found in favor of the EPA, concluding that there was no unreasonable delay.¹³⁹ In August 2016, the EPA finally released an endangerment finding under section 231(a)(2)(A).¹⁴⁰ In doing so, the EPA noted that the science supporting the danger of these GHGs is even stronger now than it was in 2009.¹⁴¹ While an endangerment finding itself does not create any new

133. *Id.* at 533 (citing 42 U.S.C. § 7521(a)(1) (2012)).

134. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,425–26 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

135. *Id.* at 54,427.

136. *Id.*

137. *Id.*

138. *Id.*

139. *Id.*; Ctr. for Biological Diversity v. EPA, No. 1:10-cv-985, 2012 U.S. Dist. LEXIS 37870, at *3 (D.D.C. Mar. 20, 2012).

140. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,422 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

141. *Id.* at 54,440.

requirements for the regulated community, this finding means that the EPA must issue future rules to regulate aircraft GHG emissions from the aircraft covered by the endangerment finding.¹⁴² As a result, it is a necessary and positive first step toward regulation.

While the EPA must now regulate these GHG emissions from covered aircraft, it has not set a timeline to do so.¹⁴³ Because the EPA issued the endangerment finding partly to prepare for ICAO's new carbon dioxide emissions standards¹⁴⁴ (and given the change of administration in the United States), the EPA is not likely to begin creating GHG emissions regulations until it is forced to implement the ICAO standards as a party to the Chicago Convention. However, if the EPA fails to regulate these GHGs after issuing an endangerment finding, the CAA allows citizens to bring suits against the Agency to force it to perform its nondiscretionary duties.¹⁴⁵ Under a less environmentally focused administration, this provision of the CAA may be a helpful tool for those who want to push the EPA to promulgate aircraft GHG-emissions regulations. The drawback, however, is that if the Agency is pushed to adopt a rule under an administration that does not want to impose these regulations on the industry, the final rule may be weaker than it would be under a more environmentally friendly administration. Judicial review is available to challenge the substance of the EPA's final rule,¹⁴⁶ but courts have traditionally deferred to an agency's determination so long as the administrative record supports such a conclusion.¹⁴⁷

142. *Id.* at 54,433–34.

143. *Id.*

144. *Id.* at 54,424.

145. 42 U.S.C. § 7604(a)(2) (2012); *see also* Massachusetts v. EPA, 549 U.S. 497, 533 (2007) (noting that the CAA *requires* agencies to regulate emissions upon issuing an endangerment finding). Because § 202(a) and § 231(a)(2)(A) are analogous, this conclusion holds true for both provisions, therefore making regulation of aircraft GHG emissions a nondiscretionary activity subject to citizen enforcement. *See id.* (making it a nondiscretionary activity to regulate following an endangerment finding).

146. 42 U.S.C. § 7607(b) (generally allowing judicial review of agency rules under the CAA within 60 days of publishing the challenged rule).

147. *See* Chevron U.S.A., Inc. v. Nat. Res. Def. Council, Inc., 467 U.S. 837, 842–44, 866 (1984) (finding that Congress did not clearly define “source” in the CAA Amendments of 1977, and since the EPA’s interpretation of that term “is a permissible construction of the statute,” the Court upheld it). Likewise, CAA § 231(a)(2)(A) does not define the standards the EPA should use to address pollutants from aircraft emissions, so a reviewing court would defer to the EPA’s interpretation so long as it “is a permissible construction of the statute.” *Id.*

In addition to supporting the substance of its rule, the EPA must also follow specific procedures. The Administrative Procedure Act (APA) requires administrative agencies to follow certain procedures before regulations can become law, and CAA section 307(d) builds on those procedures for most rules adopted under the CAA.¹⁴⁸ For example, the APA and CAA both require that proposed regulations undergo a notice and comment period.¹⁴⁹ Among other things, this requires that the Agency publish notice of the proposed rule in the Federal Register and allow interested parties sufficient time to comment on the Agency's action.¹⁵⁰ Additionally, the APA and CAA require that agencies issue a "statement of their basis and purpose" with a final rule and address concerns raised in the comments they receive.¹⁵¹

The CAA also imposes additional procedures beyond what the APA requires. For example, the EPA must open a docket for the action and include all materials pertaining to the rule, including the data and information it relied on when creating the rule, the comments it received during the comment period, and much more.¹⁵² Section 307(d)(5) also requires that the EPA allow interested parties to present oral statements in addition to written comments.¹⁵³ Section 231 adds to this procedural requirement for aircraft emissions standards: it requires the EPA to "hold public hearings . . . [that] to the extent practicable, be held in air quality control regions which are most seriously affected by aircraft emissions."¹⁵⁴ According to section 307(d), after the conclusion of these proceedings, the EPA must allow 30 days for additional comments and rebuttals.¹⁵⁵ Moreover, the EPA must promulgate modified regulations under section 231 "[w]ithin 90 days after the issuance of such proposed regulations"¹⁵⁶ In issuing regulations under section 231, the EPA must

148. William F. Pedersen, *Rule Making and Judicial Review Under the Clean Air Act*, in CLEAN AIR ACT HANDBOOK 637, 637–38 (Robert J. Martineau, Jr. & David P. Novello eds., 2d ed. 2004).

149. Administrative Procedure Act, 5 U.S.C. § 553 (2012); 42 U.S.C. § 7607(d)(3) (2012).

150. 5 U.S.C. § 553(b)–(c); *see also* 42 U.S.C. § 7607 (detailing "[a]dministrative proceedings and judicial review" under the CAA).

151. 5 U.S.C. § 553(c); 42 U.S.C. § 7607(d)(3).

152. 42 U.S.C. § 7607(d).

153. *Id.* § 7607(d)(5).

154. *Id.* § 7571(a)(3).

155. *Id.* § 7607(d)(5).

156. *Id.* § 7571(a)(3).

also consult with both the Administrator of the Federal Aviation Administration (FAA) as well as the Secretary of Transportation.¹⁵⁷

As a result of all of these technical requirements, the rulemaking process can span a significant length of time, and, given the EPA's limited resources and the current political climate, it could be many years before the United States sees an actual regulation for these GHGs from the covered aircraft.¹⁵⁸ However, given the recent approval of ICAO's carbon dioxide standards and the United States' duty to carry out these standards as a member to the Chicago Convention,¹⁵⁹ the EPA will need to move fast enough to comply with ICAO's timeline. Regardless of what happens with ICAO, regulation in the United States is certain; therefore, it can be useful to begin considering the elements that should be present in a final EPA rule. The next section of this Note will lay out the most essential requirements of an EPA rule addressing GHG emissions from aircraft in response to the EPA's endangerment finding.

IV. REGULATING AIRCRAFT GHG EMISSIONS IN THE UNITED STATES: ESSENTIAL ELEMENTS

In the past few years, ICAO and the EPA have made significant progress toward mitigating climate change through regulating GHG emissions from aircraft. ICAO is already finalizing its basket of technology improvements, operational improvements, alternative fuel developments, and market-based measures,¹⁶⁰ and the EPA is in the infancy stage of regulating GHG emissions from aircraft. The components in ICAO's basket of measures are designed to work together to help international aviation reach carbon-neutral growth from 2020 onward and achieve fuel-efficiency improvements of 2% per year through 2050.¹⁶¹ However, this basket of measures only applies to carbon-dioxide emissions from international

157. *Id.* §§ 7571(a)(2)(B)(i), 7571(b).

158. *Cf.* WILLIAM F. FUNK ET AL., ADMINISTRATIVE PROCEDURE AND PRACTICE: PROBLEMS AND CASES 137 (5th ed. 2014) (outlining a sample informal rulemaking according to the Administrative Procedure Act for a significant rule that is also subject to review by the Office of Information and Regulatory Affairs).

159. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,424 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

160. ON BOARD, *supra* note 40.

161. *Id.*

flights.¹⁶² As a party to ICAO under the Chicago Convention, the United States will need to implement these developments for its international flights to other participating countries.¹⁶³ The United States must impose standards at least as strict as ICAO's, and, if it goes beyond the ICAO standards, it is required to notify ICAO to prevent placing a burden on international commerce.¹⁶⁴

Thanks to the EPA's endangerment finding, the United States is in a position to regulate aircraft GHG emissions.¹⁶⁵ However, the EPA's finding will not limit the Agency to regulating international flights; it will require the EPA to regulate domestic flights as well.¹⁶⁶ Because ICAO does not extend to the domestic aviation sector, the EPA has discretion as to how to regulate domestic aircraft GHG emissions. The EPA also has discretion over how to regulate nitrous oxide, since only carbon dioxide is covered by the new ICAO standards.¹⁶⁷ However, because the EPA's endangerment finding covers six GHGs, it must issue standards for both the carbon dioxide and nitrous oxide that aircraft engines emit.¹⁶⁸ Despite this difference in the EPA and ICAO rules, the regulations for both may be similar since ICAO's measures target limiting emissions generally, which would effectually reduce both carbon dioxide and nitrous oxide. As a result, the domestic-flight GHG-emissions regulations could look comparable (or identical) to ICAO's basket of measures, but the EPA could also develop its own standards. Given the EPA's participation in developing ICAO's standards and its history of following ICAO's footsteps,¹⁶⁹ it seems likely

162. *Id.*

163. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,427; *see also* ON BOARD, *supra* note 40 (noting that CORSIA will be mandatory by 2027 for parties who do not meet one of the narrow exceptions).

164. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,428.

165. *Id.* at 54,433–34.

166. *Id.*

167. *See id.* at 54,424 (listing the six GHGs that constitute an air pollutant under CAA § 231); ON BOARD, *supra* note 40 (stating objectives that specifically target carbon dioxide as opposed to other GHGs).

168. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,424; ON BOARD, *supra* note 40 (stating objectives that specifically target carbon dioxide as opposed to other GHGs).

169. *See, e.g.*, Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,430 (stating that the EPA has followed ICAO's emissions requirements for NO[X] emissions); *id.* at

that the EPA will adopt relatively the same standards as ICAO. In this section, this Note will lay out the most important components for an EPA rule regulating domestic aircraft GHG emissions.

Regulations are most effective when they contain all five of the “Principles of Good Regulation”: they should be proportionate, accountable, consistent, transparent, and targeted.¹⁷⁰ To be proportionate, the regulation balances the benefits, risks, and costs.¹⁷¹ Additionally, the basis for the regulations must be clear and justifiable in order to meet the accountability principle.¹⁷² For consistency, the regulations must be fair.¹⁷³ Transparency requires that regulations consider the regulated community and be easy to understand.¹⁷⁴ Finally, to be targeted, the regulation must “be focused on the problem, and minimise side effects.”¹⁷⁵ For effective regulation, it is important to weave these principles into the structure and substance of future EPA aircraft GHG-emissions regulations. The rulemaking procedures required by the APA and CAA address several of these principles, especially accountability and transparency. However, these characteristics are useful to the substance of a regulation as well as its adoption procedures. Consequently, it will be helpful to keep these principles in mind throughout the following discussion on the essential elements of an effective EPA GHG-emissions rule for aircraft.

There are countless mechanisms the EPA could use to regulate aircraft GHG emissions. However, like ICAO, the EPA should take a holistic approach to regulating the aviation sector, focusing on both aircraft manufacturers and airline operators. While the EPA is limited to regulating air pollutants from aircraft engines, the statute provides little guidance on

54,465 (noting that the EPA adopted the same classification scheme for aircraft covered and exempted under the endangerment finding as ICAO used for its carbon dioxide emissions standards); Alec C. Zaccaroli, *Regulation of Mobile Sources: Motor Vehicles, Nonroad Engines and Aircraft*, in *CLEAN AIR ACT HANDBOOK 406* (Julie R. Domike & Alec C. Zaccaroli eds., 4th ed. 2016) (“EPA emission standards generally track standards adopted by [ICAO’s CAEP].”).

170. BETTER REGULATION TASK FORCE, PRINCIPLES OF GOOD REGULATION 1 (2003), <http://webarchive.nationalarchives.gov.uk/20100407162704/http://archive.cabinetoffice.gov.uk/brc/upload/assets/www.brc.gov.uk/principlesleaflet.pdf>.

171. *Id.* at 4.

172. *Id.*

173. *Id.* at 5.

174. *Id.*

175. *Id.* at 6.

what these EPA regulations should look like.¹⁷⁶ The D.C. Circuit has consequently given the Agency broad discretion to regulate under section 231.¹⁷⁷ The EPA's endangerment finding calls out aircraft engine manufacturers as being interested parties, suggesting that the EPA intends to focus its regulations on the manufacturers alone; however, the EPA also notes that others not specifically mentioned "could also be interested and potentially affected by subsequent actions . . ."¹⁷⁸ Therefore, it does not foreclose a well-rounded approach, so long as the regulations address emissions from aircraft engines. Such an approach allows the burden to be spread evenhandedly over the entire sector instead of targeting a particular facet. It also creates an opportunity for more substantial GHG-emissions reductions.

From a structural standpoint, the EPA should implement new regulations in phases that grow more stringent over time.¹⁷⁹ The long-term goal should be reasonable, but also ambitious. As noted, the United States has already developed a goal to reach carbon-neutral growth by 2020 for commercial aviation.¹⁸⁰ It may want to set a secondary goal aimed at *reducing* carbon dioxide and nitrous oxide emissions. Additionally, the United States may want to expand the scope of its goal by including military and other non-commercial aviation in carbon-neutral growth. This effort could result in even more significant reductions. According to one article, the United States had approximately 13,000 military aircraft in

176. See Daniel H. Conrad, Note, *Into the Wild Green Yonder: Applying the Clean Air Act to Regulate Emissions of Greenhouse Gases from Aircraft*, 34 N.C. J. INT'L L. & COM. REG. 919, 928–29, 934–35 (2009) (discussing the EPA's authority under § 231 of the CAA and its legislative history); 42 U.S.C. § 7571 (2012) (providing little guidance on regulation).

177. See Nat'l Ass'n of Clean Air Agencies v. EPA, 489 F.3d 1221, 1230 (D.C. Cir. 2007) (holding that the EPA's interpretation of § 231 for the regulation of NO[X] emissions was a reasonable interpretation of the statute).

178. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. 54,422, 54,423 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068).

179. In 2009, the EPA's endangerment finding led to regulations on motor vehicles that were implemented in multiple stages, which became more stringent over time. *Id.* at 54,426. In 2010, the first phase went into effect for 2012–16 models of "light-duty vehicles," followed in 2011 by the first phase for 2014–18 models of "heavy-duty engines and vehicles." *Id.* The second phase for light-duty vehicles became effective in 2012. *Id.* President Obama strengthened these regulations in 2014 for implementation in 2016. *Id.*

180. 2015 US GHG REDUCTION PLAN, *supra* note 104, at 4.

2015.¹⁸¹ For comparison, there were approximately 7,000 commercial aircraft in the United States fleet in 2015.¹⁸² However, according to the EPA, the aircraft covered under its endangerment finding are responsible for 89% of aviation GHG emissions.¹⁸³ While the military aircraft article does not differentiate between the different types of aircraft, nor does it account for the level of GHGs they emit annually, it nevertheless represents a substantial number of aircraft that will escape future GHG-emissions regulation.

In addition, the EPA should design the GHG-emissions regulations to ensure continued progress. To do this (and thus prevent backsliding), the EPA should strengthen its standards over time as technology advances.¹⁸⁴ The EPA may use a technology-forcing method like it did when eliminating lead from motor-vehicle emissions,¹⁸⁵ or it may use a technology-following (also known as technology-based) approach like it does to regulate water-pollution discharges under the Clean Water Act.¹⁸⁶ The CAA does not require the EPA to use a specific method when creating aircraft emissions standards, so long as the standards do not “significantly increase noise and adversely affect safety,”¹⁸⁷ and the EPA allows for enough time, considering costs, for the regulated community to come into compliance.¹⁸⁸ Nevertheless, each approach has its pros and cons. Technology-forcing regulations are usually less popular among members of the regulated industry since the means of achieving the goal is not yet possible, but this

181. Jeremy Bender, *This Map Shows How Many More Military Aircraft the US Has Than Every Other Country on Earth*, BUSINESS INSIDER (Jan. 28, 2015, 2:26 PM), <http://www.businessinsider.com/military-aircraft-strength-of-every-country-2015-1>.

182. *U.S. Commercial Aircraft Fleet 2016*, AEROWEB, <http://www.fi-aeroweb.com/US-Commercial-Aircraft-Fleet.html> (last visited May 4, 2018).

183. Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,465.

184. *See id.* at 54,430 (stating that previous aircraft emissions regulations for NO[X] have been “anti-backsliding” and “technology-following”); *see also* 42 U.S.C. § 7571(a)(2)–(3) (2012) (permitting the EPA to periodically revise its standards).

185. Zygmunt J.B. Plater et al., *From Harm Based Standards to Tech-Based Standards: The Clean Air Act*, in ENVIRONMENTAL LAW AND POLICY: NATURE, LAW, AND SOCIETY 465, 516–17 (4th ed. 2010) [hereinafter *From Harm Based Standards to Tech-Based Standards: The Clean Air Act*].

186. Zygmunt J.B. Plater et al., *Technology-Based Standard Setting: The Clean Water Act*, in ENVIRONMENTAL LAW AND POLICY: NATURE, LAW, AND SOCIETY 523, 523–24 (4th ed. 2010); *see also* Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare, 81 Fed. Reg. at 54,430 (stating that previous aircraft emissions regulations for NO[X] have been “technology-following”).

187. 42 U.S.C. § 7571(a)(2)(B)(ii).

188. *Id.* § 7571(b).

method has the potential to spur rapid technological advancement to meet more ambitious pollution-reduction goals.¹⁸⁹ On the other hand, technology-following standards may be more favorable to the regulated community. These standards can also be based on the best available technology, and strengthened regularly so as to maintain rigorous goals.¹⁹⁰

With aircraft GHG emissions, it may make the most sense for the EPA to adopt a technology-following approach for aircraft manufacturers. As noted above, ICAO is already requiring new and in-production aircraft to meet certain standards to reduce carbon dioxide emissions.¹⁹¹ By creating lighter aircraft, the planes need less fuel to fly, and consequently, they emit lower levels of GHGs like carbon dioxide and nitrous oxide.¹⁹² Fuel efficiency is thus both good for business and good for the environment. Should the EPA depart from ICAO's standards and impose its own novel standards for domestic aircraft, the United States may pose an unnecessary burden on the global aircraft manufacturing industry. For this reason, as well as to maintain consistency between aircraft flown domestically and internationally, the best approach may be for the EPA to adopt the same technology standards that ICAO adopted in March 2017. Regardless, to increase long-term ambition and prevent backsliding, it is important that the EPA and ICAO revisit these technology standards regularly, perhaps every six years.¹⁹³ This way, the organizations can ensure that the standards are effectively reducing GHG emissions. The EPA and ICAO should also tighten the standards over time to maximize the reduction of GHG emissions as newer and better technology becomes available.

Like ICAO, the EPA's regulations should also address airline operations, both in the air and on the ground. The EPA's authority to address airline operations is somewhat less clear than its authority to

189. Plater et al., *From Harm Based Standards to Tech-Based Standards: The Clean Air Act*, *supra* note 185, at 516–17.

190. *Id.* at 516.

191. *One Step Closer*, *supra* note 10.

192. Wendy Koch, *5 Technologies That Could Help Curb Airplane Emissions*, NAT'L GEOGRAPHIC (June 10, 2015), <https://news.nationalgeographic.com/energy/2015/06/150610-technologies-could-reduce-airplane-emissions/>.

193. As the technical committee charged with environmental protection, CAEP would likely be responsible for determining the effectiveness of these standards. *See supra* note 56 and accompanying text (discussing CAEP). Changes, however, would need to be approved by the ICAO Assembly, ICAO's principal organ, which is only required to meet once every three years. *Assembly*, INT'L CIV. AVIATION ORG., <https://www.icao.int/about-icao/assembly/Pages/default.aspx> (last visited May 4, 2018). Therefore, six years seems like an appropriate interval for revisiting these emissions regulations.

regulate aircraft engine manufacturers.¹⁹⁴ The CAA indicates that the FAA would enforce emissions standards when certifying and inspecting aircraft engines for airworthiness.¹⁹⁵ These inspections and certifications occur before the airline purchases the aircraft, so enforcement of airline operational measures presents a potential challenge.¹⁹⁶ However, the FAA is also allowed to “modif[y], suspen[d], or revo[ke]” these certificates,¹⁹⁷ so it could potentially use these post-certification actions to enforce operational measures through subsequent inspections.

Operational measures the EPA may impose in a section 231 regulation include a variety of GHG-emissions-reducing procedures. For example, the EPA should require airlines to fly the most efficient path possible—except when conditions otherwise prohibit—to reduce fuel consumption and, consequently, engine GHG emissions.¹⁹⁸ It should also limit the number of non-revenue ferry flights that an airline can schedule to prevent unnecessary GHG emissions.¹⁹⁹ On the ground, EPA regulations should require airline ground crews to plug aircraft into a ground power unit or turn the airplane off altogether when it is parked at the gate for more than one hour. This practice would prevent needless engine idling—reducing GHG emissions and saving airlines money on fuel costs. To further reduce engine GHG emissions in ground operations, the EPA rule could require aircraft to taxi into the gate using only one engine. Many pilots already use this technique, so requiring airlines to do so would conform to a growing practice.²⁰⁰

The EPA may also employ a technology-following, or a technology-forcing, approach to regulate the fuel airlines use in their aircraft engines. The regulation may require airlines to fuel their planes using the best available fuel technology that the particular aircraft engine is capable of

194. See Conrad, *supra* note 176, at 933–34 (arguing that, due to a lack of clarity in the statute, the EPA should address operational measures under § 108 of the CAA and “reserv[e] the use of Section 231 solely for the engine efficiency emission[s] standards”).

195. 42 U.S.C. § 7572(a) (2012).

196. Conrad, *supra* note 176, at 934.

197. 42 U.S.C. § 7572(a).

198. See ON BOARD, *supra* note 40 (noting fuel-efficient flight paths as one of the operational improvements ICAO has proposed).

199. See *id.* (noting that minimizing non-revenue flights could reduce fuel consumption).

200. Chi. Dep’t of Aviation, *Iberia Airlines Taxiing Program to Reduce Emissions at ORD*, AVIATIONPROS (Dec. 6, 2011), <http://www.aviationpros.com/article/10467486/single-engine-taxi-program-will-reduce-emissions-and-save-fuel>.

using. Because section 231 gives the EPA the authority to regulate air pollutants from aircraft engines, alternative fuel opponents may challenge such a rule as not falling within the scope of the statute.²⁰¹ Nevertheless, the D.C. Circuit gives the EPA significant discretion when interpreting how to regulate aircraft engine emissions.²⁰² Because engines running on alternative fuels would emit lower levels of carbon dioxide and nitrous oxide, the EPA could make a persuasive argument that a rule requiring alternative fuel use falls within the Agency's authority under the CAA.

The fuel composition itself, however, would require the EPA and the FAA to work together, since the Federal Aviation Act grants the FAA the power to "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 the Environmental Protection Agency decides [endanger public health or welfare] under section 231 of the Clean Air Act," as well as the power to issue regulations to enforce the EPA's standards.²⁰³ Again, it would be important for the FAA and EPA to revisit these regulations on a regular basis to be sure that aircraft are truly running on the best available fuels as new alternative fuels become available. It would also be important to monitor the fuel's complete lifecycle to be sure the net result is overall positive for the environment.²⁰⁴

Finally, the EPA should incorporate a market-based mechanism within its regulatory scheme, since it may be difficult to achieve adequate engine-emissions reductions through technological changes alone.²⁰⁵ The EPA may want to create its own version of ICAO's CORSIA offsetting approach to curb carbon-dioxide and nitrous-oxide emissions in the short-term until technology reaches a sufficient level to meet long-term reduction goals. The money from the offsets should go toward protecting or expanding forests, ocean habitats, and other carbon sinks, similar to the offsets passengers can

201. See Conrad, *supra* note 176, at 928 ("[F]uel conservation efforts appear much more controversial [than technology-based regulations] for the EPA to implement under Section 231 and more prone to challenge by industry if implemented.").

202. Nat'l Ass'n of Clean Air Agencies v. EPA, 489 F.3d 1221, 1230 (D.C. Cir. 2007) ("Congress has delegated expansive authority to EPA to enact appropriate regulations applicable to the emission of air pollutants from aircraft engines.").

203. Conrad, *supra* note 176, at 932 (quoting 49 U.S.C. § 44714 (2007)).

204. E-mail from Martin Cames, Head of Energy & Climate Div., Öko-Institut, to Miranda Jensen, Vermont Law School Student (Jan. 16, 2017, 8:46 AM) (on file with author).

205. *Id.*

already purchase through some airlines.²⁰⁶ In protecting these ecosystems, the EPA can ensure that a sufficient number of plants are available to absorb GHGs and cancel out some of the GHG emissions aircraft produce.

Alternatively, the EPA may use a different market-based mechanism, such as a cap-and-trade program for current aircraft GHG emissions (like the EU ETS).²⁰⁷ This could be implemented either based on each airline's overall fleet emissions or based on each type of aircraft. Those who emit lower levels than their predetermined cap would then be able to sell the remainder of their emissions credits to aircraft manufacturers or airlines (depending on the way the scheme is set up) who emit higher levels than the cap allows. However, ICAO carbon dioxide standards are aircraft specific, so it is likely that the EPA will follow this same approach.²⁰⁸ As with the previous approaches, the EPA would need to revisit and revise the cap-and-trade or offsetting program in order to continuously reduce aircraft GHG emissions.

While the EPA endangerment finding and ICAO basket of measures provide a positive first step toward aircraft GHG-emissions reductions, they could still be improved. As noted above, there are a substantial number of aircraft left out of these actions.²⁰⁹ The endangerment finding does not take a stance either way on these classes of uncovered aircraft, but instead leaves them out of its analysis altogether.²¹⁰ ICAO, as the International Civil Aviation Organization, cannot impose standards on military aircraft,²¹¹ but the EPA could fill in this gap in the United States by bringing these classes

206. See, e.g., *Where Does My Money Go?*, *supra* note 44 (explaining The Nature Conservancy projects that Delta Airlines passengers may help fund when they voluntarily purchase offsets for their flights).

207. See *EU ETS*, *supra* note 45 (explaining the cap-and-trade program the EU adopted to reduce carbon dioxide emissions).

208. The EPA has traditionally mirrored ICAO's emissions-reductions actions. See *Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare*, 81 Fed. Reg. 54,422, 54,430 (Aug. 15, 2016) (codified at 40 C.F.R. pts. 87, 1068) (stating that the EPA has followed ICAO's emissions requirements for NO[X] emissions); *id.* at 54,465 (noting that the EPA adopted the same classification scheme for aircraft covered and exempted under the endangerment finding as ICAO used for its carbon dioxide emissions standards).

209. See *supra* notes 117–24 and accompanying text (discussing the gaps in ICAO's new GHG-emissions standards and the EPA's adherence to the same classification scheme).

210. *Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution that May Reasonably Be Anticipated to Endanger Public Health and Welfare*, 81 Fed. Reg. at 54,424.

211. See *id.* at 54,465 n.228 (“ICAO regulations only apply to civil aviation (aircraft and aircraft engines); consequently, ICAO regulations do not apply to military aircraft.”).

of aircraft within the scope of the section 231(a)(1)(A) endangerment finding.

Another problem with the current ICAO regulations (and likely future EPA regulations) is that the carbon dioxide emissions standards do not address existing aircraft. The EPA could perhaps require airlines operating within the United States to phase out aircraft that do not meet minimum technology standards by a specific date in order to prevent a repeat of the coal industry.²¹² Aircraft have long lives (though shorter than coal plants), so, naturally, it could take decades to phase out these existing non-compliant aircraft.²¹³

CONCLUSION

Without serious regulation of GHG emissions and proper enforcement, climate change will continue to threaten the existence of ecosystems and developments all over the world. Every corner of the earth will feel its effects, if it has not already. If the world works together, however, as many countries have agreed to under the Paris Agreement, it can minimize the damage of climate change. One remaining source of unregulated GHGs comes from the aviation sector. With air travel on the rise, it will be essential to control aviation GHG emissions and encourage sustainable sectoral growth to mitigate climate change. Both at the international level under ICAO and the domestic level under the EPA, effective regulation will require a multifaceted approach that targets both aircraft manufacturers and operators.

ICAO and the EPA have taken important steps toward this goal. The EPA's endangerment finding has positioned the United States to adopt ICAO's new carbon dioxide emissions standards as well as the EPA's own

212. See Juliet Eilperin & Steven Mufson, *Everything You Need to Know About the EPA's Proposed Rule on Coal Plants*, WASH. POST (June 2, 2014), https://www.washingtonpost.com/national/health-science/epa-will-propose-a-rule-to-cut-emissions-from-existing-coal-plants-by-up-to-30-percent/2014/06/02/f37f0a10-e81d-11e3-afc6-a1dd9407abcf_story.html?utm_term=.fb05c58dcc51 (explaining that more than half of existing coal-fired power plants in the U.S. have been around for over 40 years, and are therefore less efficient than new coal plants; consequently, the article states, old plants are responsible for a large portion of the nation's carbon dioxide emissions).

213. For a graph of the average age of U.S. carriers' aircraft fleets broken down by airline, see *Age of Selected Airlines' Aircraft Fleets As of April 2014 (In Years)*, STATISTA, <https://www.statista.com/statistics/273993/age-of-the-aircraft-fleets-of-selected-airlines/> (last visited May 4, 2018).

domestic aviation GHG-emissions regulations. With a new administration in the White House, it is difficult to predict the timeline for these United States developments. Nevertheless, the United States will need to act at least in accordance with the implementation deadlines for ICAO's standards for international aircraft, or it will violate its international obligations under the Chicago Convention.

When the time comes, the above principles will help the EPA effectively regulate aircraft GHG emissions. The EPA has discretion as to how to regulate domestic aviation GHG emissions, but, no matter the approach it chooses, it will be crucial for the Agency to revisit and strengthen its standards in the future. Additionally, the EPA, and to a lesser extent, ICAO will need to address some of the gaping holes in the aircraft they cover. To maximize the United States' contribution under the Paris Agreement and genuinely make its best efforts toward the Paris Agreement's aspirational goal of limiting global temperature rise to 1.5°C, the EPA will need to expand the scope of the GHG-emissions regulations to include all domestic aircraft without categorical exemptions. The world is changing quickly, and humans are running out of time to change its course. Only by working together—across international borders and across industry sectors—can the world protect its oceans, wilderness, and developments from the disastrous effects of climate change.

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