PETITION FOR RULEMAKING

UNDER 5 U.S.C. § 553(e) AND CLEAN AIR ACT (CAA) § 231

REGARDING:
AVIATION AEROSOL EMISSIONS, AVIATION-INDUCED CLOUDINESS (AIC) AND THE ENDANGERMENT OF PUBLIC HEALTH AND WELFARE

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Petitioners reserve the right to supplement the list of co-petitioners and supporting parties as this matter proceeds.

Via Electronic and Certified Mail

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ACRONYMS

ACCRI — Aviation Climate Change Research Initiative

ADS-B — Automatic Dependent Surveillance–Broadcast

AIC — Aviation-Induced Cloudiness

APA — Administrative Procedure Act

ASTM — American Society for Testing and Materials

ATom — Atmospheric Tomography Mission (NOAA-NASA)

BC — Black Carbon

BDC — Brewer-Dobson Circulation

CAA — Clean Air Act

CCN — Cloud Condensation Nuclei

CO_2 — Carbon Dioxide

CSP — Concentrated Solar Power

DOT — Department of Transportation

EPA — U.S. Environmental Protection Agency

FAA — Federal Aviation Administration

GAIA — Global Aviation Emissions Inventory Based on ADS-B

GHG — Greenhouse Gas

GIS — Geographic Information System

ICAO — International Civil Aviation Organization

IISc — Indian Institute of Science

INPs — Ice Nucleating Particles

ISSR — Ice-Supersaturated Regions

LAX — Los Angeles International Airport

LMS — Lowermost Stratosphere

LTO — Landing and Takeoff

NASA — National Aeronautics and Space Administration

NH — Northern Hemisphere

nm — nanometer (10^{-9} meters)

NOAA — National Oceanic and Atmospheric Administration

nvPM — Non-volatile Particulate Matter

PAHs — Polycyclic Aromatic Hydrocarbons

$PM_{2.5}$ — Particulate Matter (≤2.5 microns)

PN — Particle Number

PNAS — Proceedings of the National Academy of Sciences

ppm — Parts Per Million

SAI — Stratospheric Aerosol Injection

SO_2 — Sulfur Dioxide

SOx — Sulfur Oxides

SH — Southern Hemisphere

UFP — Ultrafine Particles (sub-100 nm)

UTLS — Upper Troposphere and Lower Stratosphere

I. STATEMENT OF PURPOSE AND STATUTORY AUTHORITY

GenSeven and ClimateViewer News, LLC (the "Lead Petitioners"), together with a coalition of public health professionals, environmental health advocates, and legal oversight organizations (collectively, the "Petitioners"), respectfully submit this Petition to the U.S. Environmental Protection Agency (EPA) pursuant to the Administrative Procedure Act (APA), 5 U.S.C. § 553(e),[1] and in light of Section 231 of the Clean Air Act (CAA), 42 U.S.C. § 7571 (hereinafter 'Section 231').[2] Petitioners request that EPA:

1. Make a formal endangerment finding pursuant to CAA § 231(a)(2)(A)[3] for non-CO_2 emissions from civil aircraft engines, including sulfur oxides (SO_x), black carbon (BC, commonly known as soot), metallic aerosols, ultrafine particulates (UFP), and Aviation-Induced Cloudiness (AIC) and
2. Following that finding, propose and promulgate emission and fuel-composition standards under CAA § 231[4] necessary to protect public health and welfare, including children's health and the integrity of the nation's energy, agricultural, and scientific infrastructure.
3. Ensure, consistent with CAA § 232[5] and applicable aviation authorities,[6] that the Federal Aviation Administration (FAA) and the Secretary of Transportation coordinate to implement and enforce compliance with those standards, including operational measures within FAA's statutory authority.

This Petition does not rely on speculative or future harms, but on documented emissions and observed impacts already occurring within the United States. The CAA does not require scientific certainty before the Administrator acts; it requires action where emissions "may reasonably be anticipated to endanger public health or welfare." 42 U.S.C. § 7571(a)(2)(A).[7] Courts have made clear that this standard is precautionary in nature and is satisfied where credible evidence indicates a risk of harm, even in the presence of scientific uncertainty. Accordingly, the existence of remaining uncertainty does not relieve the Agency of its statutory obligation to act; it underscores that obligation.

Section 302(h) of the CAA, 42 U.S.C. § 7602(h) (hereinafter 'Section 302(h)') defines "effects on welfare" as: "includes, but is not limited to, effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, **weather, visibility, and climate**, damage to and deterioration of property, and hazards to transportation, as well as effects on **economic values** and on **personal comfort and well-being**, whether caused by transformation, conversion, or combination with other air pollutants."[Emphasis added][8]

Congress independently codified the national goal of preventing anthropogenic visibility

[1] 5 U.S.C. § 553(e) (2018).
[2] 42 U.S.C. § 7571 (2018).
[3] 42 U.S.C. § 7571(a)(2)(A) (2018)
[4] 42 U.S.C. § 7571 (2018); 42 U.S.C. § 7602(h) (2018).
[5] 42 U.S.C. § 7572 (2018).
[6] 49 U.S.C. § 40101 et seq. (2018); 49 U.S.C. § 44714 (2018).
[7] 42 U.S.C. § 7571(a)(2)(A) (2018); *Massachusetts v. EPA*, 549 U.S. 497, 534 (2007). https://supreme.justia.com/cases/federal/us/542/431/ (holding that the CAA endangerment standard is precautionary in nature and does not require scientific certainty before the Administrator is obligated to act).
[8] 42 U.S.C. § 7602(h) (2018).

impairment in CAA § 169A, 42 U.S.C. § 7491,[9] establishing natural conditions as the regulatory baseline — a provision that operates independently of and in addition to § 302(h).

The effects described in this Petition fall squarely within this statutory definition, particularly with respect to visibility impairment, atmospheric alteration, impacts to human health, agricultural, environment, and energy systems.

Petitioners further request that EPA initiate formal interagency coordination with the FAA to evaluate and implement operational measures — such as contrail-avoidance procedures — within FAA's statutory authority, while maintaining aviation safety.

Petitioners respectfully request that the FAA, consistent with EPA action under CAA § 231[10] and Department of Transportation's (DOT) obligations under CAA § 232,[11] initiate complementary rulemaking within its statutory authority[12] to address aviation operational practices that materially affect non-CO_2 emissions, AIC, and atmospheric visibility within U.S. airspace.

This Petition is submitted at a time of increasing legislative activity concerning atmospheric modification. As evidenced by the February 2026 introduction of H.R. 7452,[13] alongside 37 state-level geoengineering bans,[14] there is urgent, bipartisan recognition that the national airspace is being physically altered without oversight. By failing to regulate these emissions, EPA and FAA are not merely exposing the aviation industry to liability, but also exposing the land, food, water, air, and public to pollutants that may reasonably be anticipated to endanger health and welfare. This regulatory gap raises serious questions regarding EPA's obligation to evaluate whether these emissions may reasonably be anticipated to endanger public health or welfare under CAA § 231.

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[9] 42 U.S.C. § 7491 (2018).
[10] 42 U.S.C. § 7571 (2018), *supra* note 2.
[11] 42 U.S.C. § 7572 (2018)
[12] 49 U.S.C. § 40101 et seq. (2018); 49 U.S.C. § 44714 (2018).
[13] Air Quality Act, H.R. 7452, 119th Cong. (2026). https://steube.house.gov/wp-content/uploads/2026/02/Air-Quality-Act.pdf
[14] Segall, C. *Misguided Proposals to Ban Geoengineering in US States Lose Steam.* SRM360. (2026). https://srm360.org/perspective/proposals-to-ban-geoengineering-us-states-lose-steam/

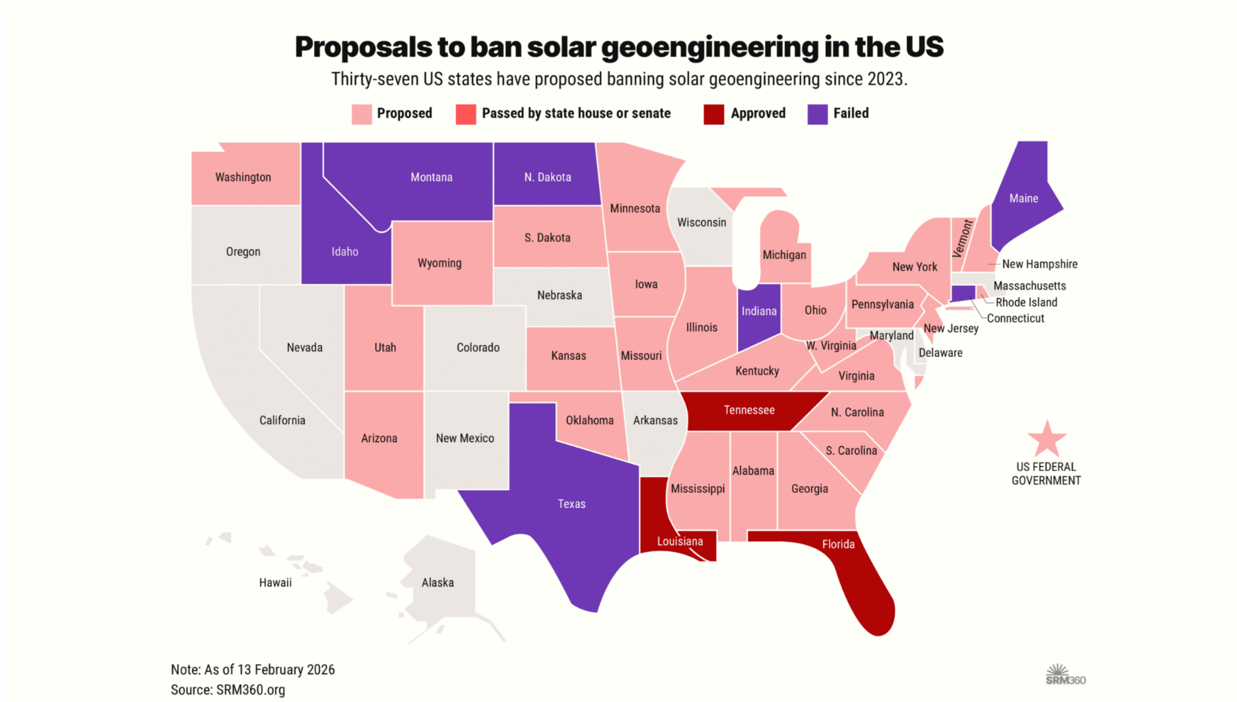

Figure 1. The Fragmented Airspace: State-Level Geoengineering Prohibitions. **Source:** Segall, Craig. Misguided Proposals to Ban Geoengineering in US States Lose Steam, SRM360 (Feb. 13, 2026), https://srm360.org/perspective/proposals-to-ban-geoengineering-us-states-lose-steam/. **Legal Significance:** This map illustrates the emergence of state-level legislative responses to atmospheric modification in the absence of comprehensive federal standards. This patchwork of state-level measures creates a fragmented regulatory landscape in which commercial aviation operations may face increasing legal exposure under state law, including potential liability for emissions-related activities, underscoring the need for a uniform federal regulatory framework.

II. PETITIONERS AND AUTHORITY TO PETITION

A. Authority to Petition

This Petition is submitted pursuant to the APA, 5 U.S.C. § 553(e).[15]

EPA has jurisdiction under Section 231,[16] to promulgate standards for aircraft engine emissions that "cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare." Once EPA makes such a finding, Section 231(a)(2)(A) requires the Administrator to propose emissions standards.[17] Under Section 232 of the CAA, 42 U.S.C. § 7572,[18] the Secretary of Transportation "shall prescribe regulations to insure compliance" with EPA standards.

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[15] 5 U.S.C. § 553(e) (2018).
[16] 42 U.S.C. § 7571 (2018), *supra* note 2.
[17] 42 U.S.C. § 7571(a)(2)(A), *supra* note 3.
[18] 42 U.S.C. § 7572 (2018), *supra* note 5.

The FAA has jurisdiction to regulate air traffic under 49 U.S.C. § 40101 et seq.;[19] and set standards for aircraft fuel in accordance with EPA decisions 49 U.S.C. § 44714.[20]

B. Petitioners

GenSeven and ClimateViewer News, LLC (the "Lead Petitioners") submit this Petition on their own behalf.

> **GenSeven**, a 501(c)(3) non-profit public benefit corporation, is dedicated to the Seventh Generation Principle, an Indigenous philosophy which mandates that decisions made today must result in a thriving and healthy world seven generations into the future. One of GenSeven's missions centers on the "Save Our Skies" initiative, advocating for the restoration of atmospheric purity and the protection of "Healthy Skies" as a fundamental right for current and future populations. GenSeven and the communities and individuals it serves and represents are directly harmed by EPA's failure to regulate aviation-induced atmospheric modification, which threatens the biological integrity of the environment, the cognitive health of children, and the intergenerational stability of the nation's natural resources.
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> **ClimateViewer News, LLC** is a public-interest media and research organization that investigates and reports on atmospheric pollution, climate engineering, and related public-health risks. ClimateViewer News and its subscribers are harmed by EPA's failure to control non-CO_2 aviation emissions that contribute to degraded air quality, altered cloudiness, and associated health and welfare impacts.
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> **Health Freedom Defense Fund** is a 501(c)(3) non-profit which seeks to protect and advance health freedom, educating Americans on informed consent, advocating for human rights and bodily autonomy for all people, and legally challenging unethical mandates, laws, and policies when necessary. Health freedom does not just mean the ability to choose what medical interventions we use, it also means the freedom to breathe clean air, drink clean water, and eat food free of toxins raining down on us from the air. Health Freedom Defense Fund and its members across the nation are adversely affected by EPA's failure to address atmospheric changes associated with aviation, a situation that threatens ecological balance, the neurological health of all Americans, and the enduring viability of national natural resources.
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> **MO Clean Skies**, is a grass-roots 501(c)4 non-profit organization dedicated to protecting our skies from the harmful effects of geoengineering and weather modification as well as other toxic atmospheric pollutants that poison our air, water and soil. A clean environment is essential for life. MCS is taking a stand for citizens who deserve transparency and accountability.
>
> **Stand for Health Freedom** is a 501(c)(4) non-profit organization dedicated to protecting informed consent in health decision-making and the constitutional structure that safeguards those freedoms. SHF has empowered over 1 million individuals to directly contact elected officials and key decision-makers, generating more than 7.7 million civic

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[19] 49 U.S.C. § 40101 et seq., *supra* note 6.
[20] 49 U.S.C. § 44714, *supra* note 6.

actions and 173 policy wins through its specialized engagement portal. Central to SHF's mission is the protection of the environmental foundations of human health, including the safety of the land, water, and ecosystems on which all Americans depend. SHF and its members around the country have been harmed by lack of informed consent and ability to mitigate or avoid safety hazards associated with substances EPA and FAA knew or should have known would be unsafe for humans and the environment.

Global Wellness Forum is a 501(c)(3) nonprofit organization dedicated to advancing health, transparency, and individual sovereignty through research, public education, and policy reform. Working alongside its affiliated advocacy organization, **Global Wellness Action** (GWA), a 501(c)(4) social welfare organization, GWF brings together experts across science, medicine, law, and public policy to address critical issues impacting human and environmental health. Together, the organizations support evidence-based solutions, legislative engagement, and public awareness to promote accountability and protect the foundations of public well-being.

Petitioners and their members experience direct, concrete harms associated with aviation emissions and aviation-induced atmospheric effects, including degraded visibility, reduced solar exposure affecting energy production and agricultural productivity, and increased exposure to ultrafine particulate matter. These harms are locally experienced within the communities where Petitioners reside, work, and conduct organizational activities, and are traceable to ongoing aviation operations and emissions within U.S. airspace.

The Petitioners have consistently maintained that the Agency's prior exclusive focus on greenhouse gases (GHG) obscured the more immediate physical dangers of aviation emissions. On August 11, 2015, Co-Petitioner James Franklin Lee Jr. provided formal testimony at the EPA's Hearing on Commercial Aircraft Emissions.[21] At that time, Mr. Lee argued that the Agency's reliance on the GHG Endangerment Finding was misplaced and that Carbon Dioxide (CO_2) should not be the primary focus of aviation regulation under the CAA — a legal position finally rectified eleven years later by the Administrator's February 12, 2026 revocation order.[22]

Crucially, Mr. Lee's 2015 testimony explicitly warned that the true threat to public health was not CO_2, but the unregulated release of Ultrafine Particles (UFP) and the generation of Aviation-Induced Cloudiness (AIC, refers to the total increase in cirrus cloud cover caused by aviation operations, specifically through the creation of persistent contrails and their subsequent spreading into larger cloud fields). The Agency's failure to heed this warning has resulted in a lost decade of regulation, during which hazardous particulates and solar-dimming haze were allowed to proliferate unchecked. With the GHG distraction now removed, the Agency must fulfill the other half of Mr. Lee's 2015 demand: the immediate monitoring and reduction of these physical pollutants.

[21.] Lee, J. F. (2015). *My speech to the EPA about flight pollution.* ClimateViewer News. https://climateviewer.com/2015/08/09/my-speech-to-the-epa-about-flight-pollution (testimony of James Franklin Lee Jr. before the U.S. Envtl. Prot. Agency Hearing on Commercial Aircraft Emissions, Aug. 11, 2015, calling for specific regulation of UFP and contrail cirrus independent of CO_2).
[22] Rescission of the greenhouse gas endangerment finding and motor vehicle greenhouse gas emission standards under the CAA. 91 Fed. Reg. 7686 (February 18, 2026) [hereinafter "EPA GHG Rescission"].

In 2023, EPA issued an endangerment finding for lead from piston-engine aircraft.[23] In 2024, EPA finalized non-volatile particulate matter (nvPM) standards for certain large turbofan engines.[24] Having acknowledged that aviation fuel constituents and particulate emissions can endanger public health and welfare,[25] EPA may not reasonably treat the remaining non-CO_2 emissions — sulfur-driven aerosols, BC, AIC, and metallic ultrafine particles — as categorically beyond the endangerment framework without confronting the scientific record that establishes their harm.

C. Reservation of Rights

Petitioners reserve the right to supplement this Petition with additional co-petitioners. Petitioners and their members are directly and adversely affected by EPA's failure to regulate non-CO_2 aviation emissions under the CAA.

This Petition is directed to the Office of the Administrator of EPA and shall be construed as addressed to whoever holds that office at the time of receipt, review, or response, including any Acting Administrator or successor. Petitioners respectfully request that this Petition be logged, docketed, and processed regardless of any change in Agency leadership, and that no change in personnel shall be construed to moot, delay, or otherwise affect the Agency's obligation to respond pursuant to 5 U.S.C. § 553(e).

Scientific uncertainty does not preclude regulatory action under the CAA. The statutory standard — whether emissions may reasonably be anticipated to endanger public health or welfare — explicitly allows EPA to act in the face of uncertainty where credible evidence of risk exists. The record presented here satisfies that standard.

III. SUMMARY OF REQUESTED ACTIONS UNDER THE CAA

Section 231 of the CAA provides that the Administrator "*shall*" issue emission standards for any aircraft engine pollutant that may reasonably be anticipated to endanger public health or welfare. As demonstrated herein, that endangerment threshold has been met across multiple independent domains, including public health, localized acute toxicity, and welfare impacts.

Accordingly, Petitioners respectfully request that the Administrators initiate rulemaking and related actions to address air pollution arising from aircraft emissions.

A. Endangerment Finding

[23] Finding That Lead Emissions From Aircraft Engines That Operate on Leaded Fuel Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare. 88 Fed. Reg. 72,372 (Oct. 20, 2023) [hereinafter "EPA Lead Finding"].

[24] Control of Non-Volatile Particulate Matter From Aircraft Engines: Emission Standards and Test Procedures. 89 Fed. Reg. 92,787 (Apr. 24, 2024) [hereinafter "EPA nvPM Finding"].

[25] *Integrated Science Assessment (ISA) for Oxides of Nitrogen, Oxides of Sulfur and Particulate Matter Ecological Criteria (Final Report).* U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-20/278, 2020. https://www.epa.gov/isa/integrated-science-assessment-final-reports

Under 42 U.S.C. § 7571(a)(2)(A),[26] issue a formal finding that AIC, Sulfur Oxides (SO_x), Black Carbon (BC, also known as soot), Metallic Aerosols, and Ultrafine Particles (UFP) from aviation may reasonably be anticipated to endanger public health or welfare.

1. Definition of Regulated Air Pollution

Define aircraft-related air pollution under Section 231 to include both primary emissions and their reasonably foreseeable atmospheric transformations, including but not limited to particulate matter, sulfur compounds, black carbon, and Aviation-Induced Cloudiness (AIC),[27] where such effects result from emissions released into the ambient air.

B. Regulatory Actions Requested

1. Reduce Jet Fuel Sulfur Emissions

Establish standards under 42 U.S.C. § 7571(b) to limit sulfur content in aviation turbine fuel to 15 parts per million (ppm) within a reasonable compliance period.[28] Reduction of fuel sulfur content has been shown to reduce contrail persistence and associated atmospheric effects.[29]

2. Mandatory Contrail Avoidance

Pursuant to 42 U.S.C. § 7571,[30] and in coordination with applicable authorities under 42 U.S.C. § 7572[31] and 49 U.S.C. § 44714,[32] promulgate standards or requirements to reduce the formation of persistent contrails and AIC associated with aircraft emissions, including through measures addressing emissions characteristics, fuel composition, and operational conditions that contribute to their formation — such measures to include binding Ice-Supersaturated Regions (ISSR) and persistent-contrail-forming region diversion; requirements, including coordination with the FAA as necessary, for the installation of onboard humidity sensors on commercial aircraft to enable real-time ISSR detection and avoidance; a narrowly tailored safety exemption; and limitations on operational practices that intentionally promote contrail formation for atmospheric or radiative effects — all consistent with aviation safety requirements.

Current satellite-based ISSR prediction carries a 50–80% error rate compared to *in situ* measurements, rendering voluntary avoidance protocols without onboard sensing operationally unreliable.[33]

3. National Aerosol Registry

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[26] 42 U.S.C. § 7571(a)(2)(A) (2018), *supra* note 3.
[27] 42 U.S.C. § 7571 (2018), *supra* note 2.
[28] 42 U.S.C. § 7571(b) (2018).
[29] Dischl, R., Märkl, R., Sauer, D., Voigt, C., Harlaß, T., Scheibe, M., ... & Le Clercq, P. (2025). *Fuel sulfur content can modulate contrail ice crystal numbers.* Communications Earth & Environment, 6(1), 902. https://doi.org/10.1038/s43247-025-02951-5
[30] 42 U.S.C. § 7571 (2018), *supra* note 2.
[31] 42 U.S.C. § 7572 (2018), *supra* note 5.
[32] 49 U.S.C. § 44714 (2018), *supra* note 6.
[33] International Air Transport Association (IATA). (2024). Aviation contrails and their climate effect, at 13. https://www.iata.org/contentassets/726b8a2559ad48fe9decb6f2534549a6/aviation-contrails-climate-impact-report.pdf

Pursuant to CAA §§ 103 and 114[34] establish a phased national monitoring and public data registry to characterize aviation-related particulate emissions. Phase 1 shall include monitoring at major hub airports, including Hartsfield–Jackson Atlanta International Airport (ATL), Los Angeles International Airport (LAX), O'Hare International Airport (ORD), Dallas/Fort Worth International Airport (DFW), and Denver International Airport (DEN). Phase 2 shall expand monitoring to the top 25 U.S. airports by traffic volume. Phase 3 shall implement a nationwide Geographic Information System (GIS)-based public dashboard integrating emissions data, including particle number (PN) concentration, and Fushimi's nanostructure.[35] An initial PN baseline audit shall be completed within 180 days.[36]

IV. THE REGULATORY VACUUM IN THE NATIONAL AIRSPACE

The prominent geoengineering scientist Dr. David Keith observed: "You can't write legislation that says you can't put sulfur in the stratosphere since every commercial flight does that."[37]

The absence of clear federal regulatory standards has contributed to a rapid expansion of legislative activity addressing atmospheric modification. As of early 2026, 37 states have introduced or enacted legislation targeting "atmospheric modification."[38] H.R. 7452 seeks to criminalize "weather modification" nationally.[39]

The root cause: EPA's longstanding regulatory approach has not distinguished between deliberate geoengineering and incidental atmospheric modification from commercial aviation. The consequences of that conflation are now threatening the commercial aviation industry itself. State statutes written to prohibit "intentional injection of chemicals into the sky" are broad enough, on their face, to encompass aviation emissions that release metallic aerosols, sulfur compounds, and BC into the atmosphere on a continuous, large-scale basis. Federal law (H.R. 7452) moves in the same direction.

Without clear EPA standards under CAA § 231 that define aviation emissions as a distinct, regulated category of non-CO_2 air pollution, the industry faces escalating legal exposure that cannot be resolved through policy discretion alone, as the available scientific evidence consistently indicates that these emissions contribute to conditions that may reasonably be anticipated to endanger public health and welfare.

On April 15, 2025, Administrator Zeldin condemned Make Sunsets — a startup launching balloons filled with sulfur dioxide (SO_2) to conduct geoengineering Stratospheric Aerosol

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[34] 42 U.S.C. § 7403 (2018); 42 U.S.C. § 7414 (2018).

[35] Fushimi, A., Fujitani, Y., Durdina, L., Anet, J. G., Spirig, C., Edebeli, J., ... & Takegawa, N. (2025). *Unique Microphysical Structures of Ultrafine Particles Emitted from Turbofan Jet Engines.* ACS Es&t Air, 2(5), 847-856. https://doi.org/10.1021/acsestair.4c00309

[36] Stacey, B., Harrison, R. M., & Pope, F. D. (2023). *Emissions of ultrafine particles from civil aircraft: dependence upon aircraft type and passenger load.* npj Climate and Atmospheric Science, 6, 161. https://doi.org/10.1038/s41612-023-00477-1

[37] Garrison, C. (2023, March 27). *How two weather balloons led Mexico to ban solar geoengineering.* Reuters. https://www.reuters.com/business/environment/how-two-weather-balloons-led-mexico-ban-solar-geoengineering-2023-03-27/

[38] Segall, C. (2025, June 24). *Misguided Proposals to Ban Geoengineering in US States Lose Steam.* SRM360. https://srm360.org/perspective/proposals-to-ban-geoengineering-us-states-lose-steam/

[39] Air Quality Act, H.R. 7452, 119th Cong. (2026). https://steube.house.gov/wp-content/uploads/2026/02/Air-Quality-Act.pdf

Injection (SAI) to cool the planet — stating that "individuals, supported by venture capitalists, are putting criteria air pollutants into the air to sell cooling credits."[40] EPA's response to the actions of Make Sunsets was to create two webpages for public edification: one for geoengineering and one for contrails.[41]

> "As of May 2025, Make Sunsets reported releasing about 220 pounds (0.1 tons) of SO_2 into the stratosphere. Even though that amounts to an extraordinarily low amount of SO_2, EPA is conducting an internal review of any current authorities that can be utilized to halt this activity, especially if it significantly scales up."[42]

Commercial aviation injected 747 million pounds (373,500 tons) of sulfur into the UTLS in 2024; however, Administrator Zeldin has not expressed any concern (See **Figure 2** below).

UTLS stands for the Upper Troposphere/Lower Stratosphere, referring to the atmospheric region surrounding the tropopause where the upper troposphere and lower stratosphere overlap and interact, typically spanning roughly 5–25 km altitude depending on latitude and season.

In *Motor Vehicle Manufacturers Ass'n v. State Farm*[43] (1983), the Supreme Court held that an agency's rescission of a regulation (the National Highway Traffic Safety Administration's revocation of a passive-restraint/airbag requirement) is subject to the same "arbitrary and capricious" standard of review under the APA as the decision to enact it, meaning the agency must provide a reasoned explanation supported by the record and cannot simply fail to consider obvious alternatives. This ruling is widely understood to reflect the 'hard look' doctrine, requiring agencies to thoroughly examine all relevant data and provide a satisfactory explanation for their policy shifts to ensure they are not merely political or unsupported by the facts.

EPA's decision to regulate fuel sulfur content in motor vehicle fuel (diesel fuel) and not aviation turbine fuel raises questions under the arbitrary and capricious standard articulated in *State Farm*.

EPA-FAA *Interagency Contrail Fact Sheet* (2025) claims "jet fuel does not contain metal-based compounds."[44] That claim is refuted by the Agency for Toxic Substances and Disease Registry Profile No. 121,[45] and by direct measurements.

> The detected metallic compounds were all internally mixed with the soot particles. The most abundant metals in the exhaust were Chromium (Cr), Iron (Fe), Molybdenum (Mo),

[40] EPA Press Office. *EPA Demands Answers from Unregulated Geoengineering Start-Up Launching Sulfur Dioxide into the Air.* U.S. Envtl. Prot. Agency. (2025). https://www.epa.gov/newsreleases/epa-demands-answers-unregulated-geoengineering-start-launching-sulfur-dioxide-air

[41] *About Geoengineering.* U.S. Envtl. Prot. Agency. (2025). https://www.epa.gov/geoengineering/about-geoengineering; *Information on Contrails from Aircraft.* U.S. Envtl. Prot. Agency. (2025). https://www.epa.gov/regulations-emissions-vehicles-and-engines/Contrails

[42] *Government Action: What are EPA's statutory authorities regarding solar geoengineering?* U.S. Envtl. Prot. Agency. (2025). https://www.epa.gov/geoengineering/government-action

[43] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29 (1983).

[44] U.S. Envtl. Prot. Agency & Fed. Aviation Admin. (2025). *Interagency Contrails Fact Sheet.* https://www.epa.gov/system/files/documents/2025-07/epa-faa-contrails-factsheet-2025-0718.pdf

[45] Agency for Toxic Substances and Disease Registry (ATSDR). (2017). *Toxicological profile for jet fuels JP-5, JP-8, and Jet A (Profile No. 121).* https://www.atsdr.cdc.gov/ToxProfiles/tp121.pdf

> Sodium (Na), Calcium (Ca) and Aluminum (Al); Vanadium (V), Barium (Ba), Cobalt (Co), Copper (Cu), Nickel (Ni), Lead (Pb), Magnesium (Mg), Manganese (Mn), Silicon (Si), Titanium (Ti) and Zirconium (Zr) were also detected. These metals were derived from jet fuel, lubricants, and engine component erosion.[46]

The same Fact Sheet admits SO_x contributes to AIC and contrail persistence — acknowledging the mechanism it refuses to regulate.

There are more commercial flights than ever before, increasing the toxic load, AIC, and haze with every flight. Americans want their clean, blue, healthy skies back, and it is the duty of the regulatory agencies named to ensure this happens. The commercial aviation industry needs to make changes to their jet fuel to reverse decades of damage and keep Americans and our environment safe. This Petition is the regulatory intervention that makes rational resolution possible.

V. THE EVIDENTIARY RECORD: SCIENTIFIC BASIS AND LEGAL TRIGGERS FOR RULEMAKING

This record is direct, peer-reviewed, and climate-model-independent — measurements taken by independent bodies across four decades. It proceeds from the top of the atmosphere downward. Each subsection is a self-contained trigger for rulemaking.

Section 231(a)(2)(A) provides that the Administrator "*shall*" issue emission standards upon endangerment.[47] Under *Loper Bright*,[48] courts must enforce plain meaning. Section 302(h) defines welfare broadly.[49] The GHG revocation has no effect on these non-GHG pollutants.[50] The CAA regulates *physical results*, not intent.

A. Stratospheric Aerosol Injection (SAI) by Jet Emissions

Aviation-generated BC has been measured at nearly three times surface concentrations between 8-12 kilometers,[51] and at concentrations of 10,000 BC particles per cubic centimeter at altitudes up to 18 kilometers,[52] well above the commercial flight ceiling in the stratosphere. The Indian Institute of Science (IISc) and the Indian Space Research Organisation (ISRO) confirmed this

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[46] Abegglen, M., Brem, B. T., Ellenrieder, M., Durdina, L., Rindlisbacher, T., Wang, J., Lohmann, U., & Sierau, B. (2016). *Chemical characterization of freshly emitted particulate matter from aircraft exhaust using single particle mass spectrometry.* Atmospheric Environment, 134, 181–197. https://doi.org/10.1016/j.atmosenv.2016.03.051

[47] 42 U.S.C. § 7571(a)(2)(A), *supra* note 3.

[48] *Loper Bright Enterprises v. Raimondo*, 603 U.S. 369 (2024).

[49] 42 U.S.C. § 7602(h), *supra* note 4.

[50] *EPA GHG Rescission*, 91 Fed. Reg. at 7686.

[51] Sunilkumar, K., Ajay, A., Anand, N., Dharmesh, T., Stalin, P. G., Kapardhi, B. V. N., ... & Satheesh, S. K. (2025). *Persistent elevated black carbon aerosol layers in the upper troposphere and its linkage to aircraft emissions.* Geophysical Research Letters, 52(11), e2024GL113363. https://doi.org/10.1029/2024GL113363

[52] Govardhan, G., Satheesh, S. K., Nanjundiah, R., Moorthy, K. K., & Babu, S. S. (2017). *Possible climatic implications of high-altitude black carbon emissions.* Atmospheric Chemistry and Physics, 17(15), 9623-9644. https://doi.org/10.5194/acp-17-9623-2017;

mechanism directly: "This is the first time that any group in the world has shown that BC from aircraft can go to the stratosphere and affect the ozone layer."[53]

At these altitudes, BC provides catalytic surfaces for heterogeneous chemical reactions that destroy stratospheric ozone by the same mechanism documented in the Montreal Protocol context. Aviation BC provides catalytic surfaces for ozone-depleting reactions — the Montreal Protocol pathway. The Hunga Tonga volcanic eruption provided an independent natural experiment: rapid injection of SO_2 and water vapor into the stratosphere produced measurable ozone depletion within weeks, validating the heterogeneous chemistry mechanism at scale.[54]

EPA projects 443 million skin cancers and 2.3 million cancer deaths prevented through 2165 by full implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer and its amendments.[55] Permitting aviation BC to catalyze the same chemistry is arbitrary and capricious under *State Farm*.[56]

1. The Sulfur Audit: 747 Million Pounds Injected Annually

BC (soot) particles contain trace metals from jet exhaust,[57] which subsequently get coated in sulfur in the exhaust plume.[58]

In 2024, aviation injected 747 million pounds (0.34 Tg) of sulfur into the UTLS (See **Figure 2** below), based on an industry average of 650 ppm in aviation turbine fuel. EPA's Tier 3 diesel standard caps fuel at 15 ppm[59] — a 200-fold difference from the current American Society for Testing and Materials (ASTM) standard of 3,000 ppm.[60] Under *State Farm*, this disparity is arbitrary and capricious.[61] Transition of aviation turbine fuel to 15 ppm (as requested in Section III.B.) reduces the stratospheric sulfur load by over 99%.

[53] Koshy, Jacob. (2017). *Aeroplanes may be affecting ozone layer.* The Hindu Digital. https://web.archive.org/web/20190727224321/https://www.thehindu.com/sci-tech/energy-and-environment/aeroplanes-may-be-affecting-ozone-monsoon/article19498497.ece

[54] Evan, S., Brioude, J., Rosenlof, K. H., Gao, R. S., Portmann, R. W., Zhu, Y., ... & Read, W. G. (2023). *Rapid ozone depletion after humidification of the stratosphere by the Hunga Tonga Eruption.* Science, 382(6668), eadg2551. https://doi.org/10.1126/science.adg2551.

[55] U.S. EPA. (2026, Mar. 4). *Health and environmental effects of ozone layer depletion.* https://www.epa.gov/ozone-layer-protection/health-and-environmental-effects-ozone-layer-depletion; U.S. EPA. (2026, Jan. 13). *International Actions - The Montreal Protocol on Substances that Deplete the Ozone Layer.* https://www.epa.gov/ozone-layer-protection/international-actions-montreal-protocol-substances-deplete-ozone-layer

[56] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, *supra* note 43, at 43.

[57] Abegglen et al., *supra* note 46, at 181.

[58] Jacobson, M. Z. (2001) *Strong radiative heating due to the mixing state of black carbon in atmospheric aerosols.* Nature, 409, 695–697. https://doi.org/10.1038/35055518

[59] *Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards.* 79 Fed. Reg. 23,414 (2014). https://www.federalregister.gov/d/2014-06954

[60] ASTM D1655-25a. *Standard Specification for Aviation Turbine Fuels. American Society for Testing and Materials.* (2025). https://store.astm.org/d1655-25a.html

[61] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, *supra* note 43, at 43.

Jet Fuel Sulfur Content (FSC) and Emissions

	JET FUEL CONSUMPTION (1)		~650ppm Industry Average	
Year	Million barrels per day	Billion barrels per year	Total SO2	UTLS SO2
2015	6.06	2.21	0.37 Tg (816 million lbs)	0.26 Tg (576 million lbs)
2018	7.04	2.57	0.43 Tg (948 million lbs)	0.30 Tg (669 million lbs)
2024	7.8	2.85	0.48 Tg (1.06 billion lbs)	0.34 Tg (747 million lbs)

	3000ppm ASTM Standard		15ppm Proposed Regulation	
Year	Total SO2 (2)	UTLS SO2 (3)	Total SO2	UTLS SO2
2015	1.69 Tg (3.73 billion lbs)	1.19 Tg (2.63 billion lbs)	8.46 Gg (18.6 million lbs)	5.97 Gg (13.2 million lbs)
2018	1.97 Tg (4.34 billion lbs)	1.39 Tg (3.06 billion lbs)	9.84 Gg (21.7 million lbs)	6.95 Gg (15.3 million lbs)
2024	2.18 Tg (4.81 billion lbs)	1.54 Tg (3.40 billion lbs)	10.9 Gg (24.1 million lbs)	7.71 Gg (17.0 million lbs)

Figure 2. The Sulfur Injection Audit: Global Jet Fuel Sulfur Content and Emissions. **Source:** Lee, J. L. (2026). Jet Fuel Sulfur Content (FSC) and Emissions in the UTLS. ClimateViewer News. **Legal Significance:** This data table serves as the "Forensic Accounting" of the regulatory vacuum. It establishes that in 2024, the aviation sector injected approximately 0.34 Teragrams (747 million pounds) of SO_2 directly into the sensitive UTLS. This contrasts sharply with the "15 ppm Proposed Regulation" column (green), which demonstrates that mandating ultra-low sulfur fuel would reduce this stratospheric load by over 99%, to a mere 7.71 Gigagrams. **Methodology:** Jet fuel consumption derived from Energy Institute 2025.[62] SO_2 derived from Lee et al. study in 2021.[63] Flights in UTLS fraction: 72.5% of total emissions occurring above 8 km from 2013 study applied to all years.[64]

2. The Bifurcated Stratosphere

National Aeronautics and Space Administration's (NASA) Atmospheric Tomography Mission (ATom) mission found the Northern Hemisphere's (NH) stratosphere chemically distinct from the Southern Hemisphere (SH), with aviation as the cause. Williamson et al. documented in 2021 that sub-12 nanometers (nm) aerosols exist in the lowermost stratosphere (LMS) in all four seasons.[65]

> "We also observe elevated SO_2, an important precursor for new particle formation (NPF) and growth, in the NH LMS."

This bifurcation is maintained by the Brewer-Dobson Circulation (BDC), a large-scale atmospheric pattern where air rises from the tropics into the stratosphere, moves poleward, and then sinks back into the troposphere at middle and high latitudes.[66] ATom confirms: the NH–SH asymmetry is consistent with one anthropogenic source — commercial aviation.[67]

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[62] Ersoy, E., Schaffer M. E. (2025). *Statistical Review of World Energy 2025*. Energy Inst. https://www.energyinst.org/data/assets /pdf_file/0007/1658077/Statistical-Review-of-World-Energy.pdf

[63] Lee, D. S., Fahey, D. W., Skowron, A., Allen, M. R., Burkhardt, U., Chen, Q., ... & Wilcox, L. J. (2021). *The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018.* Atmospheric environment, 244, 117834. https://doi.org /10.1016/j.atmosenv.2020.117834

[64] Simone, N. W. (2013). *Development of a rapid global aircraft emissions estimation tool with uncertainty quantification.* Doctoral dissertation, Massachusetts Institute of Technology. https://dspace.mit.edu/handle/1721.1/79335

[65] Williamson, C. J., Kupc, A., Rollins, A., Kazil, J., Froyd, K. D., Ray, E. A., ... & Brock, C. A. (2021). *Large hemispheric difference in nucleation mode aerosol concentrations in the lowermost stratosphere at mid-and high latitudes.* Atmospheric Chemistry and Physics, 21(11), 9065-9088. https://doi.org/10.5194/acp-21 -9065-2021

[66] Butchart, N. (2014). *The Brewer-Dobson circulation.* Reviews of Geophysics, 52, 157–184. https://doi.org/10.1002/20 13RG000448

[67] Thompson, C. R., Wofsy, S. C., Prather, M. J., Newman, P. A., Hanisco, T. F., Ryerson, T. B., ... & Zeng, L. (2022). *The NASA atmospheric tomography (ATom) mission: Imaging the chemistry of the global atmosphere.* Bulletin of the American Meteorological Society, 103(3), E761-E790. https://doi.org/10.1175/BAMS-D-20-0315.1.

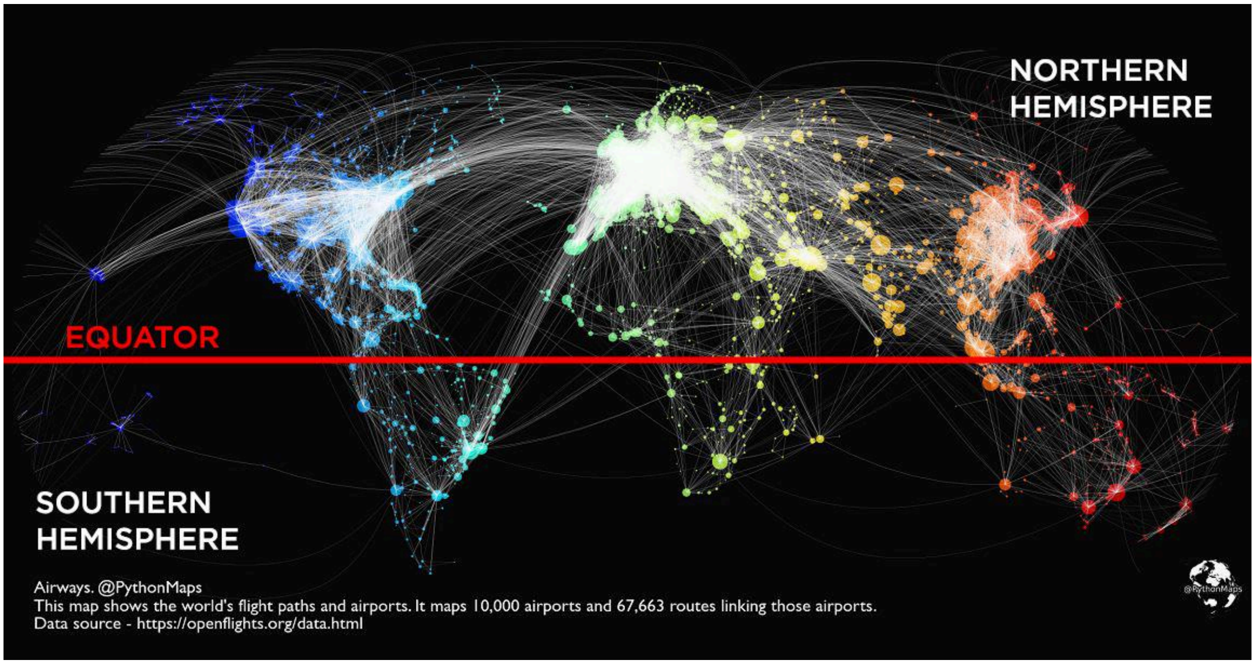

Figure 3: While exact figures depend on how you measure (number of flights, passenger-kilometers, etc.) and vary by year, a reasonable estimate is that somewhere around **80–90% of all flight activity occurs in the Northern Hemisphere.** Some industry analysts have put it even higher for certain metrics. The Southern Hemisphere's share, by contrast, is disproportionately small relative to its geographic area. The densest corridors — the North Atlantic, trans-Pacific, and Europe–Far East routes — all run through the Northern Hemisphere. A large share (39%) of air traffic in terms of passenger-km occurs within just three northern regions: North America (19%), Europe (13%), and China (7%).

3. Metallic Fingerprints

Research in the Proceedings of the National Academy of Sciences (PNAS) shows metallic particles (Al, Cu) embedded in ~10% of stratospheric aerosols.[68] PNAS attributes these stratospheric metallic aerosols to spacecraft reentry; however Abegglen et al. confirmed 15 metallic species in aircraft exhaust in 2016,[69] and Govardhan et al. (2017) confirmed that stratospheric accumulation of aviation soot is more likely the cause of metallic aerosol accumulation.[70] Under *Loper Bright*,[71] EPA-FAA *Interagency Contrail Fact Sheet*'s false claim that "Jet fuel does not contain metal-based compounds" are entitled to no deference.[72]

4. The nvPM Inventory

NvPM refers to solid particles emitted from combustion processes — most notably aircraft engines — that remain in a solid state and do not vaporize when heated to a temperature of 350°C. Primarily composed of carbonaceous soot and trace metal aerosols, these particles are

[68] Murphy, D. M., Abou-Ghanem, M., Cziczo, D. J., Froyd, K. D., Jacquot, J., Lawler, M. J., ... & Shen, X. (2023). *Metals from spacecraft reentry in stratospheric aerosol particles.* Proceedings of the National Academy of Sciences, 120(43), e2313374120. https://doi.org/10.1073/pnas.2313374120.

[69] Abegglen et al., *supra* note 46, at 181.

[70] Govardhan et al., *supra* note 52, at 9623.

[71] *Loper Bright Enterprises v. Raimondo*, *supra* note 48.

[72] EPA & FAA, *Interagency Contrails Fact Sheet, supra* note 44.

measured directly at the engine exhaust nozzle and are crucial in aircraft emission certification standards.

The Global Aviation Emissions Inventory (GAIA) Based on Automatic Dependent Surveillance–Broadcast (ADS-B) documents 21.4 Gg nvPM (2.8×10^{26} particles) annually.[73] GAIA maps contamination corridors with 4D resolution. These particles do not dissipate on timescales relevant to human exposure. They persist in the UTLS as a continuous atmospheric load, providing condensation nuclei for ice crystal formation, catalytic surfaces for ozone chemistry, and a persistent aerosol scattering layer. Aviation-derived BC particles carry a distinctive onion-like nanostructure — a forensic fingerprint that distinguishes them unambiguously from ground-source combustion particles in stratospheric measurements.[74] Rates certified by the International Civil Aviation Organization (ICAO) undercount actual particle number emissions by 10–24×, excluding the volatile and condensable particles that dominate real-world exhaust plumes.[75]

B. The Troposphere: AIC Direct Welfare Harms

Cirrus Homogenitus and Cirrus Homomutatus, collectively referred to as AIC herein, are the most visible and concerning pollution from aviation that remains completely unregulated.[76] The federal response is inconsistent with the scientific record, the roadmaps,[77] and the welfare mandate of Section 302(h).[78]

1. The Expansion of Aviation-Induced Cloudiness (1990–2025)

Over the past three decades, the continuous deposition of aircraft exhaust into ISSR has driven a highly quantifiable increase in artificial high-altitude cloud cover. As initial persistent contrails (cirrus homogenitus) spread outward, they evolve into vast, enduring cirrus shields (cirrus homomutatus). Satellite data from International Satellite Cloud Climatology Project (ISCCP) and Moderate Resolution Imaging Spectroradiometer (MODIS), alongside surface observations, confirm that high-cloud frequency in heavily trafficked air corridors — specifically over North America, Europe, and the North Atlantic — has increased disproportionately by 1% to 3% per decade compared to low-traffic regions.[79] In peak flight zones, this localized AIC has increased regional cirrus coverage by up to 5% since the early 1990s.[80] Consequently, regions with high

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[73] Teoh, R., Engberg, Z., Shapiro, M., Dray, L., & Stettler, M. E. (2024). *The high-resolution Global Aviation emissions Inventory based on ADS-B (GAIA) for 2019–2021.* Atmospheric Chemistry and Physics, 24(1), 725-744. https://doi.org/10.5194/acp-24-725-2024.

[74] Fushimi et al., *supra* note 35, at 847.

[75] Stacey et al., *supra* note 36, at 161.

[76] World Meteorological Organization. (2017). *International cloud atlas: Explanatory remarks and special clouds.* https://cloudatlas.wmo.int/en/explanatory-remarks-and-special-clouds-cirrus.html

[77] *Contrails Research Roadmap.* Federal Aviation Administration, National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration. (2025). https://ascent.aero/documents/2025/01/contrails-research-roadmap-january-2025.pdf/; IATA, *supra* note 33, at 13.

[78] 42 U.S.C. § 7602(h), *supra* note 4.

[79] Minnis, P., Ayers, J. K., Palikonda, R., & Phan, D. (2004). *Contrails, cirrus trends, and climate.* Journal of Climate, 17(8), 1671–1685. https://doi.org/10.1175/1520-0442(2004)017<1671:CCTAC>2.0.CO;2; Stordal, F., Myhre, G., Stordal, E. J. G., Rossow, W. B., Lee, D. S., Arlander, D. W., & Svendby, T. (2005). *Is there a trend in cirrus cloud cover due to aircraft traffic?* Atmospheric Chemistry and Physics, 5(8), 2155–2162. https://doi.org/10.5194/acp-5-2155-2005

[80] Zerefos, C. S., Eleftheratos, K., Balis, D. S., Zanis, P., Tselioudis, G., & Meleti, C. (2003). *Evidence of impact of aviation on cirrus cloud formation.* Atmospheric Chemistry and Physics, 3(5), 1633–1644. https://doi.org/10.5194/acp-3-1633-2003

flight volumes have experienced a measurable physical transition, wherein structurally clear skies are converted into persistent artificial cirrus layers.[81]

This artificial cloud proliferation is directly proportional to the immense expansion of commercial aviation; from 1990 to 2025, global passenger air traffic more than tripled, with the worldwide commercial aircraft fleet doubling in the last quarter-century alone.[82] Consequently, the most recent atmospheric assessments indicate a severe escalation in the frequency of both initial cirrus homogenitus and the sprawling cirrus homomutatus canopies they become. While pre-2000 estimates capped regional aviation-induced cirrus coverage at approximately 5%, contemporary analyses reveal that in high-density flight corridors — such as the eastern United States and Europe — cirrus homomutatus now routinely covers up to 10% of the total sky area.[83]

Furthermore, recently published satellite and lidar studies have unveiled that the true extent of these anthropogenic clouds is significantly larger than what 1990s methodologies could quantify. For instance, Tesche et al. in their 2025 study demonstrated that **"hidden" cirrus homogenitus embedded within preexisting natural cirrus layers — which were entirely unaccounted for in pre-2000 optical satellite estimates** — contribute an additional 10% to the overall net radiative warming effect of line-shaped contrails.[84] Peer-reviewed projections now confirm that contrail cirrus radiative forcing could triple by 2050 as air traffic grows.[85]

This highlights the need for addressing the drastic information gap in quantifying how much of our sky is covered in artificial clouds. Based on the lack of sufficient ground-based observational networks, especially when reliance on satellite data has failed to track the majority of contrail evolution into cirrus clouds, there is zero accountability or accuracy when determining the extent of the AIC problem. With the growth projections of the aviation industry and the documented record of unregulated atmospheric emissions, it is time for EPA to directly address the AIC issue.

AIC and ice haze cover six harms that the Section 302(h) welfare mandate directly addresses: weather modification, altered climate, impaired visibility, economic loss, personal comfort, and well-being.[86]

2. Weather Modification

Based on decades of satellite climatology and cloud microphysics research, the literature demonstrates that the exponential growth of global air traffic has structurally transformed

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[81] Penner, J. E., Lister, D., Griggs, D. J., Dokken, D. J., & McFarland, M. (1999). *Aviation and the global atmosphere: a special report of the Intergovernmental Panel on Climate Change.* Cambridge University Press. Google Books
[82] Boeing. (2025). *Commercial market outlook 2025–2044.* The Boeing Company. https://www.boeing.com/commercial/market/commercial-market-outlook; Global Aerospace. (2026, January 9). *Balancing in-air advancements with on-the-ground realities.* Jetstream. https://www.global-aero.com/wp-content/uploads/2026/01/Jetstream2026.pdf
[83] International Civil Aviation Organization. (2025, September 19). *Report on operational opportunities to reduce climate effects of contrails and other non-CO2 emissions.* ICAO. https://www.icao.int/sites/default/files/environmental-protection/Documents/CAEP%20WG2/Report-on-Operational-Opportunities-to-Reduce-Contrails-and-Non-Co2-1.pdf
[84] Seelig, T., Wolf, K., Bellouin, N., & Tesche, M. (2025). *Quantification of the radiative forcing of contrails embedded in cirrus clouds.* Nature Communications, 16(1), 10703. https://doi.org/10.1038/s41467-025-66231-8
[85] Singh, D. K., Sanyal, S., & Wuebbles, D. J. (2024). *Understanding the role of contrails and contrail cirrus in climate change: A global perspective.* Atmospheric Chemistry and Physics, 24(16), 9219–9262. https://doi.org/10.5194/acp-24-9219-2024; Bock, L., & Burkhardt, U. (2019). *Contrail cirrus radiative forcing for future air traffic.* Atmospheric Chemistry and Physics, 19(12), 8163–8174. https://doi.org/10.5194/acp-19-8163-2019
[86] 42 U.S.C. § 7602(h), *supra* note 4.

regional atmospheric moisture profiles, directly causing quantifiable increases in high-altitude cloud cover (AIC) and subsequently altering regional precipitation mechanisms.

> "It appears likely that inadvertent cloud seeding by jet aircraft may be of the same order of magnitude as that attained in commercial cloud seeding operations." Wallace Murcray, 1970.[87]

Microphysical Alteration of Regional Precipitation: This volumetric expansion of artificial cirrus is not merely a visual or aesthetic shift; it fundamentally alters the vertical profile of atmospheric ice water content, thereby disturbing the regional hydrological cycle independent of radiative forcing. AIC alters regional precipitation predominantly by introducing an immense density of unusually small, non-coalescing ice crystals into the upper troposphere, disrupting natural precipitation via two opposing mechanisms:

Suppression and Redistribution (Over-seeding): The massive influx of artificial ice nucleating particles (INPs) and cloud condensation nuclei (CCN) — specifically aviation exhaust-associated nvPM such as BC, and metallic aerosols — creates an aggressive upper-tropospheric moisture sink.[88] This persistent influx "over-seeds" the atmosphere, forcing numerous small ice crystals within AIC and cirrus homomutatus (contrail-induced cirrus) to compete for available ambient moisture.[89] Because these highly concentrated, artificial crystals remain too small and lightweight to sediment (fall), they interrupt the Wegener-Bergeron-Findeisen process, the natural mechanism of atmospheric droplet coalescence.[90] This microphysical disruption stabilizes atmospheric moisture layers, heavily suppressing light, natural regional rainfall and redistributing the locked moisture further downwind to precipitate in altered geographic locations.[91]

Enhancement and Streamers (The Seeder-Feeder Mechanism): Conversely, as AIC evolves and cirrus homomutatus matures and heavily saturates, the immense concentration of aviation exhaust-associated nvPM — specifically BC (soot) and metallic aerosols acting as INPs and

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[87] Murcray, W. B. (1970). *On the possibility of weather modification by aircraft contrails.* Monthly Weather Review, 98(10), 745-748. https://doi.org/10.1175/1520-0493(1970)098%3C0745:OTPOWM%3E2.3.CO;2

[88] Cziczo, D. J., Froyd, K. D., Hoose, C., Jensen, E. J., Diao, M., Zondlo, M. A., Smith, J. B., Twohy, C. H., & Murphy, D. M. (2013). *Clarifying the dominant sources and mechanisms of cirrus cloud formation.* Science, 340(6138), 1320–1324. https://doi.org/10.1126/science.1234145 (This foundational study utilizing aircraft sampling demonstrates that aviation-associated emissions, specifically metallic aerosols and black carbon, are the dominant nvPM acting as ice nucleating particles (INPs) in cirrus clouds.); Kärcher, B. (2018). *Formation and radiative forcing of contrail cirrus.* Nature Communications, 9(1), 1824. https://doi.org/10.1038/s41467-018-04068-0 (A comprehensive review isolating the physical mechanisms of contrail-induced cirrus (cirrus homomutatus) and how jet exhaust aerosols trigger massive upper-tropospheric ice nucleation.)

[89] Hendricks, J., Kärcher, B., & Lohmann, U. (2011). *Effects of ice nuclei on cirrus clouds in a global climate model.* Journal of Geophysical Research: Atmospheres, 116(D12). https://doi.org/10.1029/2010JD015302 (Analyzes how black carbon and soot from aircraft exhaust supply immense numbers of INPs, modifying cirrus ice crystal concentrations and driving microphysical competition for moisture.)

[90] Schumann, U., Penner, J. E., Chen, Y., Zhou, C., & Graf, K. (2015). *Dehydration effects from contrails in a coupled contrail–climate model.* Atmospheric Chemistry and Physics, 15(19), 11179–11199. https://doi.org/10.5194/acp-15-11179-2015 (Explicitly models the "moisture sink" effect of contrails, proving that AIC aggressively dehydrates flight levels and redistributes atmospheric moisture downwind, disrupting the Wegener-Bergeron-Findeisen process and regional hydrological cycles.)

[91] Dietlicher, R., Lohmann, U., & Roesch, A. (2022). *Cirrus cloud thinning using a more physically based ice microphysics* scheme in the ECHAM-HAM general circulation model. Atmospheric Chemistry and Physics, 22(17), 11475–11505. https://doi.org/10.5194/acp-22-11475-2022 (Details the microphysics of cirrus cloud "over-seeding" and how immense concentrations of small ice crystals stabilize moisture layers and interrupt the Wegener-Bergeron-Findeisen precipitation process.); Schumann et al., *supra* note 90.

CCN — can generate massive, aggregated ice structures.[92] These dense artificial formations act as a "seeder" layer over lower, moisture-rich altostratus clouds. Heavy ice masses, nucleated by these localized aviation emissions, descend from flight altitudes as "precipitation streamers."[93] As these falling artificial ice crystals penetrate lower cloud layers, they initiate the seeder-feeder mechanism, introducing exogenous INPs that accelerate water droplet coalescence and secondary ice formation in the feeder clouds below.[94] This microphysical interaction triggers sporadic, highly concentrated regional precipitation anomalies and fundamentally alters spatial rainfall geometry.

Ultimately, the literature synthesizes into a clear structural reality: the persistent evolution of contrails into cirrus homomutatus acts as a microphysical catalyst that directly and mechanically alters the timing, spatial distribution, and volume of regional surface precipitation.

3. Solar Dimming

In 2015, National Oceanic and Atmospheric Administration (NOAA) scientist Dr. Charles Long suggested that a high-altitude ice haze, created by water and other emissions from aircraft, is responsible for sky brightening. "I'm talking about a sub-visual contrail-generated haze of ice, which we do not classify as a cloud but gives the blue sky more of a whitish tint."[95] His conclusion was direct: "We might be actually conducting some unintentional geoengineering here."[96] The Smithsonian Magazine reported this finding with the title "Airplane Contrails May Be Creating Accidental Geoengineering."[97] This finding was not mentioned on EPA's contrail or geoengineering webpages.

Under Section 302(h), aviation-induced solar dimming constitutes a direct and measurable welfare harm to visibility, solar energy production, and agricultural productivity.[98]

4. Contrail Avoidance as Geoengineering

Despite the outrage expressed by 37 states with pending legislation, the FAA, NASA, NOAA, and ICAO are only concerned with avoiding contrail formation in 2% of flights that they claim

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[92] Kärcher, *supra* note 88, at 1824.

[93] Lewellen, D. C. (2014). *Persistent contrails and contrail cirrus. Part I: Large-eddy simulations from inception to demise.* Journal of the Atmospheric Sciences, 71(12), 4392–4419. https://doi.org/10.1175/JAS-D-13-0316.1
(Analyzes the microphysics of contrail evolution and explicitly models how large ice crystals fall from mature contrail-induced cirrus to form localized precipitation streamers.)

[94] Dedekind, Z., Proske, U., Ferrachat, S., Lohmann, U., & Neubauer, D. (2024). *Simulating the seeder–feeder impacts on cloud ice and precipitation over the Alps.* Atmospheric Chemistry and Physics, 24(9), 5389–5404. https://doi.org/10.5194/acp-24-5389-2024 (Validates the microphysics of the seeder-feeder mechanism, detailing how ice particles precipitating from upper-level clouds into lower clouds accelerate droplet coalescence and significantly enhance or alter surface precipitation rates.); Unterstrasser, S., & Gierens, K. (2010). *Numerical simulations of contrail-to-cirrus transition – Part 2: Impact of initial ice crystal number, radiation, stratification, secondary nucleation and layer depth.* Atmospheric Chemistry and Physics, 10(4), 2037–2051. https://doi.org/10.5194/acp-10-2037-2010 (Models the microphysical transition of contrails into contrail-induced cirrus shields, demonstrating how precipitating artificial ice crystals interact with and seed lower atmospheric layers.)

[95] Long, C. (2015). *Evidence of Clear-Sky Daylight Whitening: Are We Already Conducting Geoengineering?* NOAA ESRL Global Monitoring Annual Conference, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder. https://gml.noaa.gov/publications/annual_meetings/2015/

[96] *Accidental Geoengineering?* Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder. (2015). https://cires.colorado.edu/news/accidental-geoengineering

[97] Zielinski, S. (2015). *Airplane Contrails May Be Creating Accidental Geoengineering.* Smithsonian Magazine. https://www.smithsonianmag.com/science-nature/airplane-contrails-may-be-creating-accidental-geoengineering-180957561/

[98] 42 U.S.C. § 7602(h), *supra* note 4.

may lead to "warming contrails" that form cirrus clouds.[99] The mechanism being pursued is operational: by predicting ISSR where persistent contrails form, flight paths can be adjusted to avoid them — or, conversely, routed through them deliberately to produce "cooling contrails" during daylight hours when their reflective effect exceeds their heat-trapping effect. Google's AI contrail forecasting tool, already integrated into American Airlines' flight planning software, is the operational implementation of exactly this approach.

EPA and FAA have been telling concerned citizens that contrails are harmless water vapor for over two decades. Meanwhile, government agencies, international groups, and the aviation industry attempt to control the warming effect of contrail cirrus with zero regard for the public's clear demands: stop clouding our skies and blocking the sun.

This position ignores the Section 302(h) welfare harms documented throughout this Petition and contradicts the plain statutory text.[100]

The "cooling" fallacy fails: the CAA provides no exception for pollutants with perceived "beneficial" effects. Petitioners request that EPA take regulatory action, consistent with the Agency's statutory obligations under the CAA, to reduce the formation of AIC and persistent contrails regardless of asserted thermal impacts (e.g., "cooling contrails"). Such action may include measures addressing emissions characteristics and atmospheric conditions associated with contrail formation, consistent with applicable aviation safety requirements.

Nothing in this Petition alters the existing statutory roles of federal agencies; implementation of any resulting standards would occur within the established framework of U.S. aviation governance.

> **ICAO (2010):** Dr. Ulrich Schumann addressed the ICAO Colloquium on Aviation and Climate Change, where the operational objective was explicitly framed as "less warming, **MORE** cooling contrails; **predictable for operational planning**" — a statement that aviation operations have the goal of modifying atmospheric conditions at a structural level.[101]
>
> **FAA ACCRI (2017):** Dr. Rangasayi Halthore, head of the FAA's Aviation Climate Change Research Initiative (ACCRI), documented agency-level awareness that contrail formation could be operationally managed, stating: "we would like to have **MORE** CIC [Contrail-Induced Cirrus: are man-made, high-altitude ice clouds created when persistent linear contrails from aircraft engines spread, diffuse, and last for hours in cold, humid air. Synonymous with AIC] during day and none during night." This framing treats aviation cloudiness as a controllable variable — not an incidental byproduct.[102]

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[99] *Contrails Research Roadmap, supra* note 77.; IATA, *supra* note 33, at 13.
[100] 42 U.S.C. § 7602(h), *supra* note 4.
[101] Schumann, U. (2010). *Recent research results on the climate impact of contrail cirrus and mitigation options.* ICAO Colloquium on Aviation and Climate Change, United Nations. https://weathermodificationhistory.com/icao-presentation-intentional-geoengineering-contrail-cirrus/ (archived material)
[102] Halthore, R. (2017). *Responses to citizen enquiry on the nature of contrail and contrail-induced cirrus clouds.* FAA Aviation Climate Change Research Initiative (ACCRI). https://climateviewer.com/downloads/Citizen-Inquiry-of-Contrails-Jim-Lee-and-Dr-Rangasayi-Halthore-2017.pdf

Royal Aeronautical Society (2021): The "Greener by Design" Contrail Avoidance Group documented industry-level discussions of deliberately routing flights into ISSRs to form "cooling contrails." The group explicitly noted: "half the group foresaw political reluctance to consider deliberately forming contrails on the grounds that it could be considered geoengineering."[103] The group concluded that "the option that offers the quickest and the biggest impact is direct contrail management."[104] See **Figure 4** below for further information on "geoengineering with contrails."

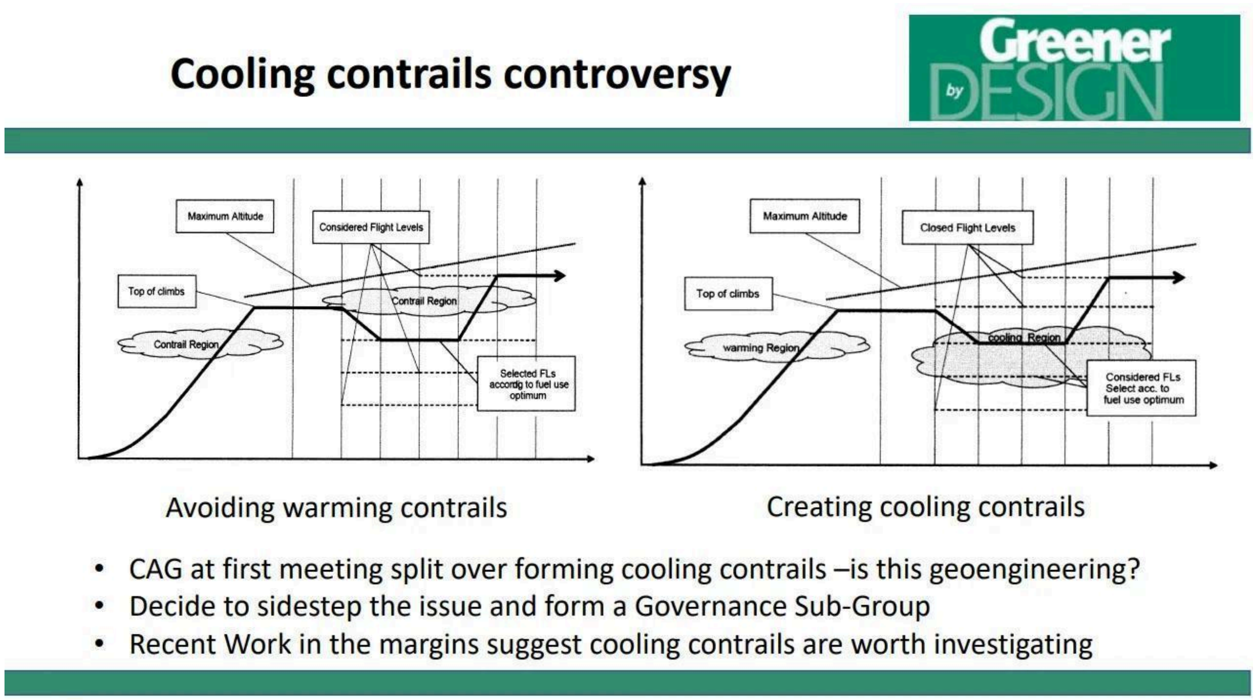

Figure 4: "Contrail Avoidance Group (CAG) at first meeting split over forming cooling contrails -is this geoengineering?" "Cooling contrails are worth investigating."[105]

Breakthrough Energy, Google AI, and American Airlines (2025): Breakthrough Energy has a stated goal that "Adjusting 5% of flights could avoid up to 80% of contrail warming."[106] Their model for predicting ISSR locations and the "climate impact" of AIC is based on Dr. Ulrich Schumann's Contrail Cirrus Prediction Tool.[107] fifteen years after his presentation at the ICAO Colloquium on Aviation Climate Change, this is how Schumann is able to "make less warming, **MORE** cooling contrails; **predictable for**

[103] *Geoengineering - could contrails cool the planet?* Royal Aeronautical Society. (2021) .https://web.archive.org/web/20210511222522/https://www.aerosociety.com/news/easy-does-it-for-greener-skies/
[104] *Contrails and Contrail Management.* Royal Aeronautical Society. (2023). https://web.archive.org/web/20240212010506/https://www.aerosociety.com/media/20657/contrails-and-contrail-management-briefing-paper.pdf
[105] Green, J. (2021). *RAeS conference report: Mitigating the climate impact of non-CO_2 aviation's low-hanging fruit.* Greener by Design Specialist Group, Royal Aeronautical Society. https://web.archive.org/web/20240212010119/http://goldfinger.utias.utoronto.ca/IWACC5/IWACC7/Green.pdf
[106] *Contrail Avoidance for the Climate.* Breakthrough Energy. (2024) https://contrails.org/
[107] Schumann, U. (2010). *A contrail cirrus prediction tool.* In Proceedings of the 2nd International Conference on Transport, Atmosphere and Climate (TAC-2) (Vol. 2010, pp. 69-74). DLR. https://elib.dlr.de/68002/; Schumann, U. (2012). *A contrail cirrus prediction model.* Geoscientific Model Development, 5(3), 543-580. https://doi.org/10.5194/gmd-5-543-2012

operational planning." Breakthrough Energy and Google AI have now partnered and are using Schumann's Contrail Cirrus Simulation and Prediction Model (See **Figure 5**), which they have integrated with American Airlines' flight planning software to run contrail avoidance trials:

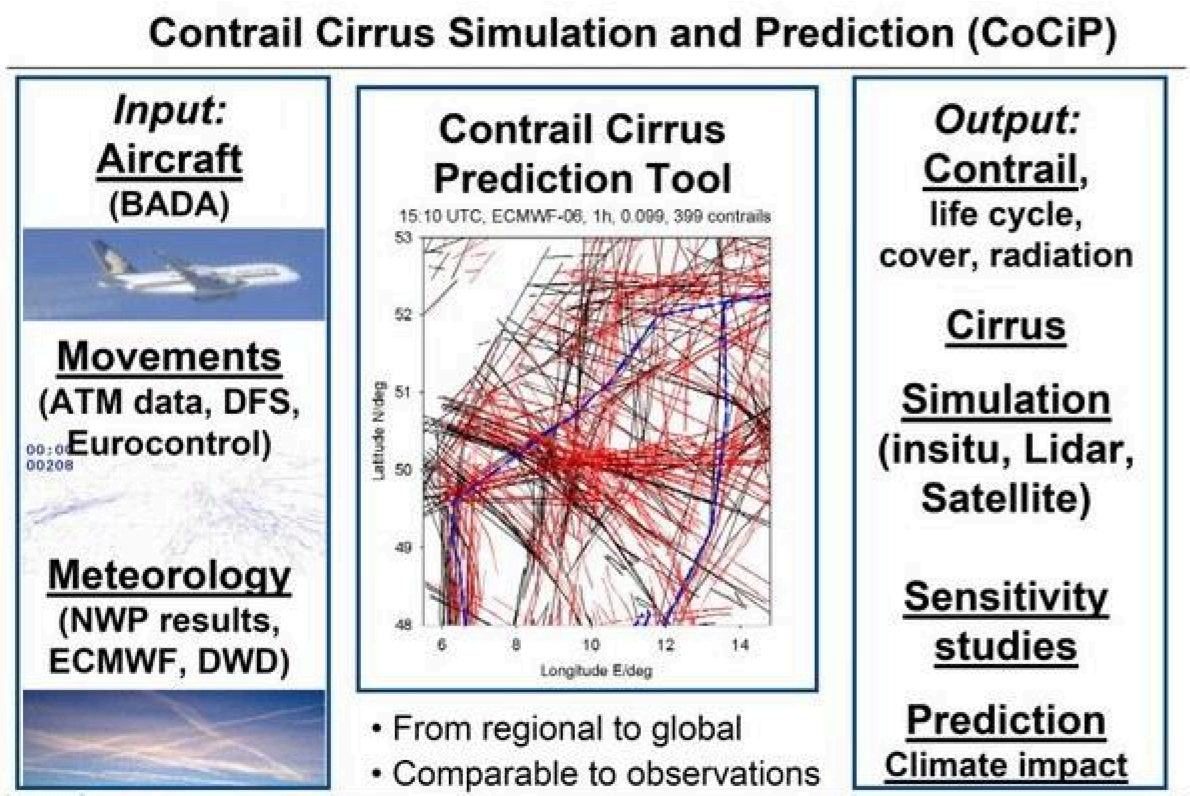

Figure 5: Ulrich Schumann's "Contrail Cirrus Simulation and Prediction (CoCiP)."[108]

In 2023, Google Research partnered with American Airlines and Breakthrough Energy to test AI-based contrail forecast maps across 70 flights, achieving a verified **54% reduction in contrail formation** — the first proof point that commercial flights can verifiably avoid contrails at negligible fuel cost.[109]

In a scaled follow-on trial spanning 2,400 transatlantic flights between January and May 2025, Google's AI contrail forecasts were integrated directly into American Airlines' flight planning

[108] *Contrail Cirrus Prediction Model (CoCiP).* DLR Institute of Atmospheric Physics. https://www.dlr.de/en/pa/research-transfer/research-infrastructure/models/contrail-cirrus-prediction-model-cocip

[109] Google Research. (2023, August 8). *Google AI is helping airlines mitigate the climate impact of contrails.* Google Blog. https://blog.google/technology/ai/ai-airlines-contrails-climate-change/ (Google Research, American Airlines, and Breakthrough Energy achieved a 54% reduction in contrail formation across 70 test flights using AI-based forecast maps; additional fuel burn was 2% per adjusted flight, or approximately 0.3% across an airline's total fleet).

software, producing a **62% reduction in contrail formation** rate compared to the control group.[110] The aviation industry's own operational partner has demonstrated that small altitude adjustments — already executed in routine turbulence avoidance — can eliminate contrails with a fuel penalty of approximately 0.3%.

Current satellite predictions of ISSR have a 50–80% error rate compared to *in situ* measurements.[111] This error rate is the basis of our request to install humidity sensors on commercial aircraft to increase the accuracy of ISSR prediction and avoidance.

These measures are technologically feasible and consistent with ongoing federal and industry research initiatives, demonstrating that meaningful reductions in AIC formation can be achieved using existing or near-term capabilities.

We are not requesting that some planes avoid making contrails that might "trap heat." Petitioners request that EPA establish regulatory controls that reduce or eliminate AIC and persistent contrails regardless of perceived thermal impacts.

The necessary technological capabilities already exist; what remains is the establishment of clear regulatory standards. This Petition is submitted to address that gap.

5. Visibility Impairment

EPA regulates visibility under the Regional Haze Rule, 40 C.F.R. § 51.308, and CAA § 169A, 42 U.S.C. § 7491, for Class I areas — yet aviation produces identical physics nationwide. This constitutes an arbitrary asymmetry that cannot survive scrutiny under *State Farm*.[112]

CAA § 302(h), 42 U.S.C. § 7602(h),[113] defines welfare to include visibility as an independent enumerated value applicable nationwide. CAA § 169A, 42 U.S.C. § 7491,[114] independently establishes the national goal of preventing anthropogenic visibility impairment in mandatory Class I Federal areas — national parks, wilderness areas, and memorial parks — with natural conditions as the baseline. Because AIC-generating flight paths traverse airspace above and adjacent to these protected areas nationwide, AIC satisfies both provisions simultaneously.

At night, AIC and aviation-borne aerosols constitute a documented threat to ground-based astronomy and national scientific infrastructure. As early as 2001, the International Astronomical Union warned in Preserving the Astronomical Sky that increasing aviation could produce fewer photometric nights in the northern hemisphere — degrading the very observing conditions upon which multi-billion-dollar taxpayer-funded observatories depend.[115] The same Aerosol Optical

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[110] Google Research. (2026, March 19). *Google AI helps airplanes avoid contrails in a new study.* Google Blog. https://blog.google/innovation-and-ai/models-and-research/google-research/contrail-avoidance-research/ (in a scaled trial of 2,400 transatlantic flights from January 15 to May 13, 2025, AI contrail forecasts integrated into American Airlines' flight planning software produced a 62% reduction in contrail formation rate compared to the control group; reported by The Associated Press, March 19, 2026).
[111] IATA, *supra* note 33, at 13.
[112] *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, *supra* note 43, at 43.
[113] 42 U.S.C. § 7602(h), *supra* note 4.
[114] CAA § 169A, 42 U.S.C. § 7491 (2018).
[115] Patat, F. (2001). *Aviation and jet contrails: Impact on astronomy.* In R. J. Cohen & W. T. Sullivan III (Eds.), Preserving the astronomical sky (IAU Symposium No. 196, pp. 173–178). Astronomical Society of the Pacific. https://doi.org/10.1017/S007418090016406X

Depth (AOD) increase that whitens daytime skies also degrades the nighttime optical environment essential to Space Situational Awareness (SSA) capabilities and national security.

The clear sky — free of man-made cloud cover — is the Section 302(h) baseline.[116] AIC is a measurable, growing, and scientifically well-documented departure from that baseline. The statutory text does not exempt it. The jurisdictional authority to act already exists. What remains is for EPA Administrator to exercise the authority required under Section 231.[117]

Section 302(h) defines 'effects on welfare' broadly and non-exhaustively.[118] Visibility, weather, and climate each appear as independent welfare values. AIC — contrails, contrail cirrus, and aviation-modified natural cirrus — affects all three simultaneously.

The legal framework is as follows:

1. **CAA § 302(g):** Aircraft engine emissions (soot, water vapor, sulfate aerosols) fall within the CAA's definition of "air pollutant" — physical and chemical substances emitted into the ambient air.[119]
2. **CAA § 302(h):** Those emissions, through transformation and combination in ice-supersaturated air, produce AIC that contributes to effects on visibility (increased optical thickness, reduced light transmission), weather (altered local radiation balance), and climate (net positive radiative forcing exceeding all other non-CO_2 aviation effects) — each independently enumerated as a welfare value.[120]
3. **CAA § 231(a)(2)(A):** When an air pollutant from aircraft engines causes or contributes to air pollution that may reasonably be anticipated to endanger public health or welfare, EPA Administrator is directed to propose emission standards.[121]
4. **CAA § 169A:** Congress has declared it a national goal to prevent and remedy anthropogenic visibility impairment in mandatory Class I Federal areas, with natural conditions as the baseline. Because AIC-generating flight paths traverse the airspace above and adjacent to Class I areas nationwide, aviation-induced visibility impairment directly implicates this statutory mandate.[122]

Visibility is a welfare category. Its degradation is regulated. Aviation-induced visibility degradation has not been regulated. This Petition seeks to address that regulatory disparity.

EPA's authority under the CAA is not limited to pollutants in their immediately emitted form. The Act encompasses substances which, by reason of their emission into the ambient air, undergo transformation and combination to produce harmful effects. EPA has long regulated secondary pollutants — such as ozone and secondary particulate matter — precisely because they form through atmospheric processes following emission. AIC is analogous: a direct and foreseeable transformation of emitted water vapor, soot, and sulfur compounds under known

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[116] 42 U.S.C. § 7602(h), *supra* note 4.
[117] 42 U.S.C. § 7571, *supra* note 2.
[118] 42 U.S.C. § 7602(h), *supra* note 4.
[119] 42 U.S.C. § 7602(g) (2018).
[120] 42 U.S.C. § 7602(h), *supra* note 4.
[121] 42 U.S.C. § 7571(a)(2)(A), *supra* note 3.
[122] 42 U.S.C. § 7491, *supra* note 9.

atmospheric conditions. As such, AIC falls within the scope of air pollution that may reasonably be anticipated to endanger public health or welfare under Section 231.[123]

6. The Sunshine Economy

Solar irradiance is a foundational environmental input supporting multiple sectors of the U.S. economy, including agriculture, solar energy generation, and ecosystem productivity — each of which falls within the CAA's definition of 'welfare' under 42 U.S.C. § 7602(h).[124] Persistent AIC alters the distribution and intensity of incoming solar radiation, thereby affecting these welfare-related systems.

Energy loss in Photovoltaic (PV) solar stations caused by cirrus homogenitus and homomutatus (AIC) varies by scale.[125] In high-traffic corridors (such as Central Europe), these clouds cause an instantaneous reduction in power output of up to 10% during persistent contrail-cirrus events.[126] On an annualized regional basis, the loss is estimated between 0.5% and 1.5% of total solar yield in regions with heavy flight traffic.[127] For Concentrated Solar Power (CSP) systems, which rely on direct radiation, the localized losses are significantly higher, with direct irradiance drops of up to 72% recorded during sun-obstruction events.[128] No equivalent domestic measurement program exists — itself a consequence of the regulatory vacuum this Petition addresses.[129] These impacts on economic productivity, energy output, and environmental conditions fall squarely within the CAA's definition of welfare under Section 302(h).

Sunshine hours explain 25–50% of tourism demand variation — meaning aviation-induced solar dimming directly threatens one of the United States' largest economic sectors.[130]

In 1958, Palm Springs tourism officials complained that persistent contrails were whitening the sky and degrading sunshine quality over the resort city.[131]

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[123] See 42 U.S.C. § 7602(g), (h), *supra* note 4.; *Massachusetts v. EPA*, *supra* note 7, at 528-29.; U.S. Envtl. Prot. Agency, *Integrated Science Assessment for Ozone and Related Photochemical Oxidants* (2013). https://www.epa.gov/isa/integrated-science-assessment-isa-ozone-and-related- photochemical-oxidants.

[124] See 42 U.S.C. § 7602(h), *supra* note 4 (defining "effects on welfare" to include, inter alia, effects on weather, visibility, and climate, as well as impacts on economic values).; U.S. Envtl. Prot. Agency, *Integrated Science Assessment for Ozone and Related Photochemical Oxidants*, *supra* note 123.

[125] Burkhardt, U., & Kärcher, B. (2011). *Global radiative forcing from contrail cirrus.* Nature Climate Change, 1(1), 54–58. https://doi.org/10.1038/nclimate1068

[126] Gruber, S., Munz, M., & Kniffka, A. (2018). *Contrails and their impact on shortwave radiation and photovoltaic power production – a regional model study.* Atmospheric Chemistry and Physics, 18(9), 6393–6411. https://doi.org/10.5194/acp-18-6393-2018

[127] Boucher, O. (1999). *Air traffic may increase cirrus cloudiness.* Nature, 397(6714), 30–31. https://doi.org/10.1038/16169; Sasse, R. (2012). *Analyse des regionalen atmosphärischen Wasserhaushalts unter Verwendung von COSMO-Simulationen und GPS-Beobachtungen [Analysis of the regional atmospheric water balance using COSMO simulations and GPS observations].* KIT Scientific Publishing. https://doi.org/10.5445/KSP/1000024938

[128] Weihs, P., Rennhofer, M., Baumgartner, D. J., Gadermaier, J., Wagner, J. E., Gehring, J. E., & Laube, W. (2015). *Potential impact of contrails on solar energy gain.* Atmospheric Measurement Techniques, 8(3), 1089–1096. https://doi.org/10.5194/amt-8-1089-2015

[129] 42 U.S.C. § 7602(h), *supra* note 4.

[130] Falk, M. (2014). *Impact of weather conditions on tourism demand in the peak summer season over the last 50 years.* Tourism Management Perspectives, 9, 24-35. https://doi.org/10.1016/j.tmp.2013.11.001. Sunshine hours explain 25–50% of tourism demand variation — making aviation-induced solar dimming a direct economic threat to the sector.

[131] *Jet Trails Dim Sun, Palm Springs Gripes*. Spokane Daily Chronicle (Dec. 6, 1958) (contemporaneous news report documenting Palm Springs Chamber of Commerce complaints regarding persistent contrails). https://news.google.com/newspapers?nid=1338&dat=19581206&id=VwBYAAAAIBAJ&sjid=FfcDAAAAIBAJ&pg=6955%2C1632252&hl=en

> "As you know, our entire economy is dependent upon tourist trade, which is predicated on our bright sunshine and warm climate. Recently our sky has resembled a mob of exuberant sky riders performing an aerial circus. The 'contrails' are not disappearing but are breaking down into a haze and creating a cloud-like appearance in the sky. With the unlimited expanse of barren, uninhabited land in the west, does such activity have to be centered over a resort area, which is offering the visitor cloudless skies and unlimited sunshine?" ~ Jimmy Cooper, Manager, Palm Springs Chamber of Commerce (1958).

Sixty-seven years later, Florida tourism advocates and clean-sky proponents testified before the House subcommittee argued that uncontrolled atmospheric manipulation could destroy Florida's coastal tourism, leading to the passage of Senate Bill 56: Geoengineering and Weather Modification Activities.[132] Accordingly, alterations in solar radiation associated with aviation-induced atmospheric effects fall within the scope of welfare impacts that EPA is obligated to evaluate under the CAA.

The atmospheric effects described above are not confined to a single altitude layer. Emissions released during flight operations persist, transform, and redistribute across atmospheric strata, contributing to both upper-atmosphere phenomena, including AIC, and ground-level pollutant exposure in communities near flight corridors and airports. This vertical integration of emissions and impacts reflects a continuous pathway of air pollution subject to regulation under the CAA.

C. Ground Level: Localized Acute Toxicity Zones

As Hudda et al. observed in their 2014 and 2016 studies, a significant increase in UFP concentration extended up to 16 km downwind of airports.[133] Vossoughi et al. (2019) demonstrated increased acute systemic inflammation in individuals following exposure to airport-related UFPs.[134] Aviation exhaust includes carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs), such as naphthalene, and metallic nanoparticles — exposures for which no binding occupational exposure limits currently exist for aviation workers.[135] Epidemiological evidence indicates no clearly established safe threshold for SO_2 exposure.[136]

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[132] Florida Senate Bill 56: *Geoengineering and Weather Modification Activities.* (2025). https://www.flsenate.gov/Session/Bill/2025/56/

[133] Hudda, N., Gould, T., Harber, K., & Fruin, S. A. (2014). *Emissions from an international airport increase particle number concentrations 4-fold at 10 km downwind.* Environmental Science & Technology, 48(12), 6628–6635. https://doi.org/10.1021/es5001566; Hudda, N., Simon, M. C., Zamore, W., Brugge, D., & Durant, J. L. (2016). Aviation *Emissions Impact Ambient Ultrafine Particle Concentrations in the Greater Boston Area.* Environmental science & technology, 50(16), 8514–8521. https://doi.org/10.1021/acs.est.6b01815

[134] Vossoughi, M., Schikowski, T., Vierkotter, A., Sugiri, D., Hoffmann, B., Teichert, T., Herder, C., Kramer, U., & Luckhaus, S. (2019). *Short-term airport-related air pollution exposure and decrements in lung function.* Environmental International, 124, 393–400. https://pmc.ncbi.nlm.nih.gov/articles/PMC6368339/

[135] Bendtsen, K. M., Bengtsen, E., Saber, A. T., & Vogel, U. (2021). *A review of health effects associated with exposure to jet engine emissions in and around airports.* Environmental Health, 20(1), 10. https://doi.org/10.1186/s12940-020-00690-y; Heeb, N. V., Muñoz, M., Haag, R., Wyss, S., Schönenberger, D., Durdina, L., ... & Brem, B. T. (2024). *Corelease of genotoxic polycyclic aromatic hydrocarbons and nanoparticles from a commercial aircraft jet engine–dependence on fuel and thrust.* Environmental Science & Technology, 58(3), 1615-1624. https://doi.org/10.1021/acs.est.3c08152

[136] Orellano, P., Quaranta, N., Reynoso, J., Balbi, B., & Vasquez, J. (2021). *Short-term exposure to sulfur dioxide (SO_2) and all-cause and cause-specific mortality: A systematic review and meta-analysis.* International Journal of Environmental Research and Public Health. https://pmc.ncbi.nlm.nih.gov/articles/PMC7937788/

These exposures fall within the scope of air pollution that may reasonably be anticipated to endanger public health under Section 231 of the CAA.[137]

These ground-level exposures represent the localized manifestation of a broader atmospheric emissions system originating from aviation activity

1. Soil, Water, and Crops

Aviation emissions injected into the UTLS do not remain airborne permanently. Through wet and dry deposition, sulfates, metallic aerosols, and nitrogen oxides settle onto agricultural soils and into watersheds across the continental United States. This deposition constitutes a direct assault on the "soils," "water," "crops," and "vegetation" explicitly enumerated in Section 302(h) — and it is occurring entirely outside any regulatory framework.[138]

Airport soils are contaminated: Copper (Cu), Nickel (Ni), Lead (Pb), and Zinc (Zn) at 1.34–3× background; 33.7% germination inhibition.[139] A 2025 study in Science found that 14–17% of global cropland already exceeds toxic metal thresholds — affecting up to 1.4 billion people, globally.[140] The metals driving that crisis include cadmium, lead, chromium, copper, and nickel: the same metals documented in aviation exhaust and shown by peer-reviewed research to deposit in soils and sediments at levels that correlate directly with air traffic volume.[141] Aviation's contribution to this global soil metal burden remains entirely unregulated and unquantified.

Despite this documented pathway of deposition and harm, no comprehensive domestic monitoring program exists in the United States to quantify heavy metal deposition in soils surrounding airports or along flight corridors. While limited studies have examined specific pollutants, such as lead from piston-engine aircraft, there is no coordinated federal effort to measure, track, or regulate the broader suite of metals associated with aviation emissions, including copper, nickel, zinc, and chromium. This absence of systematic data collection and oversight constitutes a critical regulatory gap, preventing full assessment of aviation's contribution to soil contamination and its associated impacts on agriculture, ecosystems, and public health.

In addition to chemical deposition, aviation emissions alter the radiative environment in ways that directly affect plant function and ecosystem dynamics.

Photosynthetically Active Radiation (PAR) reduction disrupts crop phenology; the "Wildfire

[137] 42 U.S.C. § 7571, *supra* note 2.
[138] 42 U.S.C. § 7602(h), *supra* note 4.
[139] Brtnický, M., Pecina, V., Baltazár, T., Vašinová Galiová, M., Baláková, L., Bęś, A., & Radziemska, M. (2020). *Environmental impact assessment of potentially toxic elements in soils near the runway at the international airport in Central Europe.* Sustainability, 12(17), 7224. https://doi.org/10.3390/su12177224
[140] Hou, D., Jia, X., Wang, L., McGrath, S. P., Zhu, Y. G., Hu, Q., ... & Nriagu, J. (2025). *Global soil pollution by toxic metals threatens agriculture and human health.* Science, 388(6744), 316-321. https://doi.org/10.1126/science.adr5214
[141] Abegglen et al., *supra* note 46, at 181 (metals including Cr, Fe, Mo, Pb, Cu, Ni, and Cd confirmed internally mixed with aviation soot); Ray, S., Khillare, P. S., Kim, K.-H., & Brown, R. J. C. (2012). *The effect of aircraft traffic emissions on the soil surface contamination analysis around the international airport in Delhi, India.* Asian Journal of Atmospheric Environment, 6(2), 118–130. https://doi.org/10.5572/ajae.2012.6.2.118 (sediment heavy metal concentrations correlated directly with air traffic volume at airport sites).

Paradox" compounds this.[142] The "Wildfire Paradox" mechanism suggests that aviation-induced aerosol scattering reduces direct-beam radiation in favor of diffuse light, increasing forest canopy density. This shift enhances photosynthesis but suppresses evapotranspiration, creating denser, drier, and more fire-prone forests, with the effect driven by altered radiation quality rather than direct thermal changes.[143]

2. Human Health: The Body Count

74,300 premature deaths/year due to aviation attributable $PM_{2.5}$ and ozone exposure.[144] A 67-study meta-analysis confirmed linear, threshold-free SO_2 dose-response,[145] and a 399-city study found mortality associations with SO_2 *below* current WHO guideline levels — establishing that no safe threshold exists and foreclosing any *de minimis* defense based on compliance with existing standards.[146] A transition to 15 ppm sulfur fuel alone is estimated to prevent 1,020 U.S. deaths annually.[147]

Reduced sun exposure further compounds these harms, with pediatric Vitamin D levels measured at 12.4 ng/mL (deficient) compared to 26.1 ng/mL in controls.[148] Children bear a disproportionate burden — a fact recognized in multiple legal authorities mandating heightened protection.[149]

In 2010, airplane crashes killed about a thousand people annually, whereas plane emissions kill about ten thousand people each year, researchers say:[150]

"Aircraft emissions impact human health through degradation of air quality. The majority of previous analyses of air quality impacts from aviation have considered only Landing and Takeoff (LTO) emissions. We show that aircraft cruise emissions impact human health over a hemispheric scale and provide the first estimate of premature mortalities attributable to aircraft emissions globally. We estimate ~8000 premature mortalities per year are attributable to aircraft cruise emissions. This represents ~80% of the total impact of aviation (where the total includes

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[142] Mercado, L. M., Bellouin, N., Sitch, S., Boucher, O., Huntingford, C., Wild, M., & Cox, P. M. (2009). *Impact of changes in diffuse radiation on the global land carbon sink.* Nature, 458, 1014–1017. https://doi.org/10.1038/nature07949

[143] Durand, M., Lintunen, A., & Ezhova, E. (2026). *Forest canopy interactions with aerosols: important considerations in approaching future impacts and climate management.* New Phytologist, 249(1), 114-122. https://doi.org/10.1111/nph.70636

[144] Eastham, S. D., Chossière, G. P., Speth, R. L., Jacob, D. J., & Barrett, S. R. (2024). *Global impacts of aviation on air quality evaluated at high resolution.* Atmospheric Chemistry and Physics, 24(4), 2687-2703. https://doi.org/10.5194/acp-24-2687-2024

[145] Orellano et al., *supra* note 136.

[146] O'brien, E., Masselot, P., Sera, F., Roye, D., Breitner, S., Ng, C. F. S., ... & Network, M. C. R. (2023). *Short-term association between sulfur dioxide and mortality: a multicountry analysis in 399 cities.* Environmental health perspectives, 131(3), 037002. https://pmc.ncbi.nlm.nih.gov/articles/PMC9994178/

[147] Kapadia, Z. Z., Spracklen, D. V., Arnold, S. R., Borman, D. J., Mann, G. W., Pringle, K. J., Monks, S. A., Reddington, C. L., Benduhn, F., Rap, A., Scott, C. E., Butt, E. W., & Yoshioka, M. (2016). *Impacts of aviation fuel sulfur content on climate and human health.* Atmospheric Chemistry and Physics, 16(16), 10521–10541. https://doi.org/10.5194/acp-16-10521-2016

[148] Agarwal, K. S., Mughal, M. Z., Upadhyay, P., Berry, J. L., Mawer, E. B., & Puliyel, J. M. (2002). *The impact of atmospheric pollution on vitamin D status of infants and toddlers in Delhi, India.* Archives of disease in childhood, 87(2), 111-113. https://doi.org/10.1136/adc.87.2.111

[149] Exec. Order No. 13045, 62 Fed. Reg. 19,885 (1997). https://www.federalregister.gov/d/97-10695; Exec. Order No. 14212, 90 Fed. Reg. 9,833 (2025); Make America Healthy Again Commission, Make Our Children Healthy Again Assessment. https://www.federalregister.gov/d/2025-02871

[150] Inman, Mason. (2010). Plane Exhaust Kills More People Than Plane Crashes. National Geographic. https://web.archive.org/web/20120615024606/http://news.nationalgeographic.com/news/2010/10/101005-planes-pollution-deaths-science-environment/

the effects of LTO emissions), and ~1% of air quality-related premature mortalities from all sources."[151]

This burden is borne in the United States itself: Eastham et al. (2024) found that 37% of aviation-attributable $PM_{2.5}$ exposure within the United States originates from domestic emissions, with an estimated 1,610 premature deaths annually from $PM_{2.5}$ alone — demonstrating that aviation's pollution burden is not solely external, but materially affects the U.S. population.

D. The Tripartite Endangerment: Aviation Particulate Emissions Under CAA §§ 231 & 302(h)

EPA's own partial findings on lead (2023) and nvPM (2022) have already conceded the endangerment premise. What remains unaddressed is the overwhelming majority of the particle burden — the volatile PM, the ultrafine fraction, the secondary aerosols — for which EPA has offered no justification for continued inaction.

1. Public Health: A Documented Kill Chain

- **~74,300 premature deaths per year worldwide** are attributable to aviation-emitted particulate matter and ozone, according to a 2024 high-resolution global assessment using the Goddard Earth Observing System-Chemistry (GEOS-Chem) model, which found approximately 21,200 $PM_{2.5}$-attributable and 53,100 ozone-attributable premature mortalities from aviation emissions in 2015.[152] The same study found that US domestic aviation emissions are responsible for 37% of all aviation-attributable PM2.5 exposure occurring within the United States — confirming that the mortality burden is not a foreign import but a domestic health crisis within EPA's jurisdiction.
- **No safe threshold exists.** $PM_{2.5}$ dose-response studies spanning 67 countries and over 600 cities have established that health damage occurs at all observed concentrations.[153] EPA itself has acknowledged this principle in its own National Ambient Air Quality Standards (NAAQS) reviews.
- **Ultrafine particle (UFP) concentrations near airports are catastrophically elevated.** Research at LAX documented a 100–900% increase in particle number concentrations extending 18 km downwind.[154] At 10 km downwind, particle number concentrations increased 4-fold over background.[155] These UFPs are sub-40 nm — small enough to cross cellular membranes by nonphagocytic mechanisms and they penetrate indoors, exposing residents even in their homes.

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[151] Barrett, S. R., Britter, R. E., & Waitz, I. A. (2010). *Global mortality attributable to aircraft cruise emissions.* Environmental science & technology, 44(19), 7736-7742. https://doi.org/10.1021/es101325r
[152] Eastham et al., *supra* note 144, at 2687.
[153] Yu, W., Xu, R., Ye, T., Abramson, M. J., Morawska, L., Jalaludin, B., ... & Guo, Y. (2024). *Estimates of global mortality burden associated with short-term exposure to fine particulate matter ($PM_{2.5}$).* The Lancet Planetary Health, 8(3), e146-e155. https://doi.org/10.1016/S2542-5196(24)00003-2
[154] Hudda et al., *supra* note 133, at 8514.
[155] Hudda, N., Simon, M. C., Zamore, W., & Durant, J. L. (2018). *Aviation-related impacts on ultrafine particle number concentrations outside and inside residences near an airport.* Environmental science & technology, 52(4), 1765-1772. https://doi.org/10.1021/acs.est.7b05593

- **Over 5 million people, including 360,000+ children under five,** reside near airports where piston-engine aircraft operate and that counts only leaded-fuel airports.[156] The population near major jet airports is vastly larger: 40 million Americans live near major airports, disproportionately lower-income and minority communities.[157]
- **Fuel transition is a proven life-saving intervention.** Researchers have estimated LTO attributable premature mortalities in the hundreds annually from $PM_{2.5}$ alone,[158] with full-flight cruise emissions adding substantially more.[159] The literature supports that a comprehensive fuel transition could prevent on the order of 1,000 U.S. deaths per year.
- **EPA cannot claim ignorance.** The agency's own 2022 nvPM rulemaking preamble acknowledged that scientific studies show exposure to ambient PM is associated with a broad range of health effects.[160] Having found endangerment for lead and having regulated nvPM, EPA has no coherent basis for ignoring the remaining vast majority of the aviation particle burden.

2. Economic Welfare: Explicit § 302(h) Harms

- **Crops, soils, and property — concentrated solar power (CSP) — are directly damaged.** Aviation emissions degrade air quality across continental scales. U.S. domestic aviation emissions alone contribute 37% of all aviation-attributable PM2.5 exposure within the United States meaning the welfare harms are overwhelmingly domestic in origin and squarely within EPA's jurisdiction.[161]
- **Tourism and property values are suppressed.** Communities near airports face documented declines in quality of life, property values, and economic activity linked to noise and air quality degradation — harms that Section 302(h) explicitly enumerates.[162]
- **Soil contamination near airports is measurable and persistent.** Studies of airport-adjacent soils have documented heavy metal and PAH concentrations at 1.34–3× background levels — contamination that impairs agricultural productivity and triggers remediation obligations.
- **Hospitalization costs are quantifiable.** Research estimates that one standard deviation increase in airport-attributable air pollution at California's 12 largest airports generates $1 million per day in respiratory and cardiovascular hospitalization costs for the 6 million people living within 10 km.[163]
- **These are not speculative harms.** Every element listed above — crops, soils, property, economic values, personal comfort and wellbeing — appears in Section 302(h)'s

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[156] *EPA Lead Finding*, 88 Fed. Reg. at 72,380.
[157] Fisher, Brooke. *Clearing the air.* University of Washington Civil & Environmental Engineering (CEE) Department. (2021). https://www.ce.washington.edu/news/article/2021-06-15/clearing-air
[158] Levy, J. I., Woody, M., Baek, B. H., Shankar, U., & Arunachalam, S. (2012). *Current and future particulate‐matter‐related mortality risks in the United States from aviation emissions during landing and takeoff.* Risk Analysis: An International Journal, 32(2), 237-249. https://doi.org/10.1111/j.1539-6924.2011.01660.x
[159] Barrett et al., *supra* note 151, at 7736.
[160] *Control of Air Pollution From Aircraft Engines: Emission Standards and Test Procedures.* 87 Fed. Reg. 72,312 (Dec. 22, 2022). https://www.federalregister.gov/d/2022-25134
[161] Eastham et al., *supra* note 144, at 2687.
[162] 42 U.S.C. § 7602(h), *supra* note 4.
[163] Habre, R., Zhou, H., Eckel, S. P., Enebish, T., Fruin, S., Bastain, T., ... & Gilliland, F. (2018). *Short-term effects of airport-associated ultrafine particle exposure on lung function and inflammation in adults with asthma.* Environment international, 118, 48-59. https://doi.org/10.1016/j.envint.2018.05.031

enumerated welfare effects.[164] EPA is not being asked to stretch the statute; the statute was written for exactly this.

3. Visibility: The Arbitrary Exemption

- **Aviation emissions degrade visibility at continental scale — implicating both CAA § 302(h)'s welfare mandate and the independent national visibility goal established by § 169A.** Sulfate, nitrate, and organic aerosols from aviation contribute to regional haze through the same light-scattering physics that EPA regulates under the Regional Haze Rule for Class I wilderness areas.
- **The physics are identical; the exemption is not.** EPA has spent decades requiring states to demonstrate "reasonable progress" toward natural visibility conditions in national parks and wilderness areas — yet exempts aviation-origin PM from this same framework. This is the definition of arbitrary and capricious under the APA.
- **Contrails and contrail cirrus are visible proof of aviation's atmospheric footprint.** These persistent ice clouds, formed from aviation water vapor and soot, are themselves a form of visibility impairment.
- **EPA cannot regulate the same pollutant from power plants and vehicles but exempt it from aircraft.** The CAA does not authorize selective blindness. If sulfate aerosols impair visibility when emitted from a smokestack, they impair visibility when emitted from a turbine engine at 36,000 feet.

4: The *De Minimis* Defense Is Foreclosed

EPA's own actions have eliminated any credible argument that aviation PM is trivially small:

- **Lead endangerment finding (October 2023):** EPA determined that lead emissions from aircraft engines operating on leaded fuel cause or contribute to air pollution that endangers public health and welfare. Lead is a trace constituent of aviation emissions.[165]
- **NvPM emission standards (November 2022):** EPA finalized PM emission standards replacing the smoke opacity standard with new nvPM mass and number limits - the first-ever particle number standards from EPA for any source.[166] If nvPM warranted regulation, the far larger volatile and secondary PM fractions cannot be dismissed as *de minimis*.
- **Together, the aforementioned findings cover approximately 1% of the total aviation particle burden.** Having regulated the trace fractions, EPA has implicitly conceded that aviation PM endangers health and welfare. The remaining 99% demands the same treatment — or a reasoned explanation for the disparity that can survive judicial review.

Bottom line: The science proves harm to human and environmental welfare, the statutes are clear, and EPA's own prior findings have conceded the premise. What is missing is not evidence — it is regulatory will.

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[164] 42 U.S.C. § 7602(h), *supra* note 4.
[165] *EPA Lead Finding*, 88 Fed. Reg. at 72,380.
[166] *EPA nvPM Finding*, 89 Fed. Reg. at 92,787.

VI. CONCLUSION

Commercial aviation emits approximately 747 million pounds of sulfur annually, contributing to an estimated ~74,300 premature deaths, exposing millions to elevated ultrafine particle concentrations, embedding metals in atmospheric aerosols, altering regional precipitation patterns, reducing solar irradiance, and contributing to contamination of soils and watersheds — without a comprehensive regulatory framework governing these emissions. Under *Loper Bright*, the statute says "shall." The Agency's prior findings limit reliance on a *de minimis* rationale. The resulting regulatory gap has enabled ongoing public health and welfare impacts.

Prolonged regulatory inaction is not without consequence. Where the statute requires an endangerment determination, failure to act allows continued exposure of the nation's air, water, soil, and food systems to pollutants that may reasonably be anticipated to endanger public health and welfare. Congress has conferred the authority. The scientific record is substantial. The remaining question is whether the Agency will fulfill its statutory duty or provide a reasoned explanation for its course. Future generations will bear the consequences of that decision.

The record before the Agency demonstrates that emissions from commercial aviation — including their reasonably foreseeable atmospheric effects — may reasonably be anticipated to endanger public health and welfare within the meaning of the CAA. Where such a record exists, the statute requires reasoned regulatory action. Our children — and their children's children for seven generations to come — deserve to inherit skies that are clear, air that is clean, and a regulatory system that keeps its promise to protect them. The American people — their land, their food, their water, their skies, and their children — are entitled to that answer now.

Where such a record exists, the Act requires reasoned regulatory action, not continued inaction or deferral.

Petitioners respectfully request that the Agency initiate rulemaking to address these emissions in accordance with its statutory obligations.

VII. NOTICE OF INTENT TO SEEK JUDICIAL REVIEW

Should the Agencies fail to act within 180 days, Petitioners intend to seek judicial review under APA § 706(1).[167] Under the *Telecommunications Research & Action Center v. FCC* (TRAC) factors,[168] delay is unjustifiable.

Petitioners reserve Public Trust Doctrine claims.[169] Each action herein is independent and severable. The severable core — endangerment finding and fuel sulfur standard — proceeds on existing authority alone. Petitioners further reserve the right to seek judicial review of EPA's failure to address anthropogenic visibility impairment under CAA § 169A, 42 U.S.C. § 7491,[170]

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[167] APA, 5 U.S.C. § 706(1). https://www.law.cornell.edu/uscode/text/5/706

[168] *Telecomms. Rsch. & Action Ctr. v. FCC*, 750 F.2d 70, 80 (D.C. Cir. 1984). https://openjurist.org/750/f2d/70

[169] *Ill. Cent. R.R. Co. v. Illinois*, 146 U.S. 387, 452 (1892). https://supreme.justia.com/cases/federal/us/146/387/

[170] 42 U.S.C. § 7491, *supra* note 9.

which operates independently of the endangerment framework and imposes a separate non-discretionary duty.

VIII. PRAYER FOR RELIEF

WHEREFORE, the Petitioners respectfully demand:

GRANT this Petition pursuant to APA § 553(e);[171]

ISSUE an Endangerment Finding under Section 231 listed in III.A of this Petition;[172]

PROMULGATE regulations consistent with Section III.B. of this Petition.

CONDUCT public hearing(s) consistent with Section 231(a)(3).[173]

Respectfully submitted,

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Reinette Senum
Lead Petitioner
GenSeven and SaveOurSkies.org

[171] 5 U.S.C. § 553(e), *supra* note 1.
[172] 42 U.S.C. § 7571, *supra* note 2.
[173] 42 U.S.C. § 7571(a)(3), *supra* note 2.