(Un)Sustainable Aviation

Complex Interactions in the Quest for Green Flight

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring 2025

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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I. Introduction

> I began to understand why young men with apparently everything to make them happy on Earth persist in leaving it by means of aeroplanes.... What lures them is the call of a new world waiting to be conquered, the sense of power, of detachment from everything humdrum, or even human, the thrill that makes all the other sensations stale and vapid, the exhilaration that for the moment makes each one of them a king (Magazine, S., & Glenshaw, P. (2021).

From the earliest days of flight, it was clear mankind had a desire to see the world from a new perspective. The development of the airplane, starting with the Wright Brothers in 1903, continuing to modern day, has persisted in revolutionizing man's view of the Earth - first visually but then conceptually. Seemingly all at once, the world shrank in size. While this revolution was only reserved for a few at first, new technology would open this new possibility to the world.

By introducing the 707 in 1958, Boeing ushered in a new era of human flight. Suddenly, aviation became a highly desirable mode of transportation, and a new industry was born. As airline prices started to drop in the late 1960s and early 1970s, the number of fliers rapidly increased, quadrupling from 1955 to 1972. The “Jet Age” had started (Sutter, 2006, “Commercial Flying”, 2022). This rapid expansion can be seen in data and its prominence in pop culture. Music, movies, and television all began to be littered with references to aviation. Perhaps coined best by Frank Sinatra's 1958 hit song “Come Fly With Me,” people all over the world were ready to “glide, starry-eyed” to exotic lands once out of reach (Sinatra, 1958). Although commercial aviation today is not quite as novel or glamorous, demand continues to grow. Industry, alongside the International Civil Aviation Organization (ICAO), forecast a significant increase in commercial flights, exceeding a twofold increase from 2019 to 2050 (“Boeing Cascade Climate

Impact Model", "Future of Aviation"). Unfortunately, alongside this rapid growth comes the growing fears of climate impacts. According to projections, the aviation industry may account for 22% of anthropogenic climate change by 2050 (Cames et al., 2015, Planès et al., 2021, p. 2). Anthropogenic climate change refers to changes in the Earth's weather patterns originating in human activity. The Earth's warming juxtaposed with the growing impact of the aviation industry on the environment has put the general public, scientists, and legislators at odds with the aviation industry.

NASA administrator Bill Nelson stated, "'Science leaves no room for doubt: Climate change is the existential threat of our time.'" He goes on further to explain … "'[the warming of the Earth is] an indisputable fact that underscores the need for bold action to safeguard the future of our country – and all of humanity'"("NASA"). As a result, many governments, international organizations, and activists have called for action to limit emissions as much as possible. Other groups (and administrations) have been more skeptical about climate change. This paper will use systems analysis to evaluate climate action, using the aviation industry as a lens through which the interactions between various regimes - economic, social, environmental, and technological - can be better understood and leveraged to achieve a greener society.

II. Problem Definition

Is Climate Change Real?

To evaluate how climate action works, it is first necessary to study what is happening to the climate. A metric scientists have devised to determine long-term climate behavior is called global mean surface temperature (GMST). To calculate GMST, surface temperature measurements are normalized to show only the differences in temperature in specific locations

against long-term averages. NOAA and a multitude of independent researchers using different analyses of temperature data have all come to the same conclusion - the Earth is warming (“Global Temperature NOAA”, 2024, “NASA,” Betts et al., 2011, p. 67). NOAA explains further. They endorse GMST as a useful means of evaluating the Earth’s energy budget. The Earth’s energy budget is defined as “the difference between solar irradiance absorbed and radiated energy emitted”(Planès et al., 2021, p. 1). In other words, the energy budget is how much heat from the sun is retained within the atmosphere versus how much heat is reflected into space. Carbon emissions have altered this budget and result in more energy staying within the atmosphere than leaving it, thereby causing warming (“Global Temperature NOAA”, 2024, “NASA,” Betts et al., 2011, p. 67). Calculating the GMST over time shows how the Earth’s energy budget changes. Shown below in Figure 1 is a graph of the Earth’s GMST from 1880 - 2020. A clear warming trend can be seen from 1980 onwards without a single year of below-average GMST. According to NOAA, the Earth in 2023 was 1.18 degrees Celsius warmer than the pre-industrial era (“Global Temperature NOAA, 2024). On average, 2023 was the warmest year ever, and it has been 47 years since the Earth had a below-average GMST. Evidently, the Earth is continuing to grow warmer.

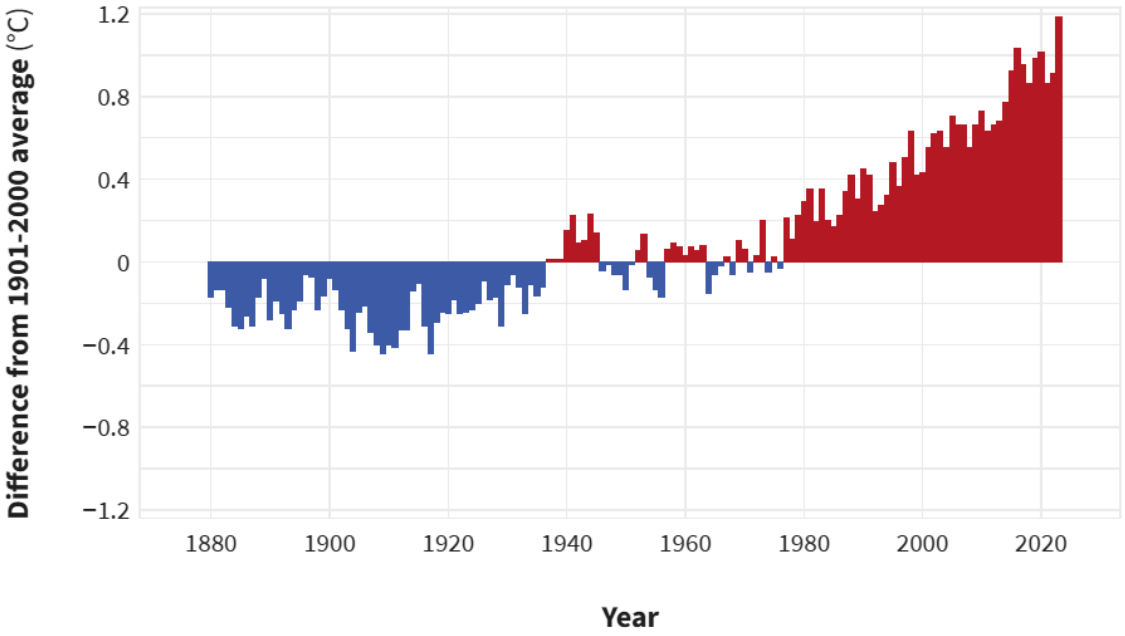

Figure 1. *Surface Temperature of the Earth Over Time.* Adapted from *Climate Change: Global Temperature,* by National Oceanic and Atmospheric Administration (NOAA), 2024, NOAA Climate.gov (https://www.climate.gov/global-temperature). Copyright 2024 by NOAA.

Skeptics are quick to point out that this warming is relatively small. After all, 2023 was only 1.18 degrees Celsius warmer than the pre-industrial averages, and some of the worst-case scenarios looking forward constitute a warming of somewhere between 3 and 4 degrees Celsius by the year 2100 (NASA, Clémençon, 2016, p. 18). Although these numbers seem inconsequential, the impacts of such warming are not. Because of the enormous size of the Earth and the large amount of water, it takes a major change to affect the average temperature of the planet, even a small amount ("Global Temperature NOAA", 2024). To put 3-4 degrees of warming into perspective, the most recent ice age was only associated with a 5 degrees Celsius decrease in temperature ("What's the coldest the Earth's ever been? | NOAA Climate.gov", 2021). Therefore, small changes in the Earth's temperature can have massive repercussions.

Some impacts associated with an increase in average temperature of just 1.5 degrees Celsius are heat waves, more intense hurricanes, flooding, agricultural impacts, decrease in freshwater, and damage to various organisms and ecosystems both on land and in the oceans ("NOAA," 2024, Hoegh-Guldberg et al., 2019, p. 1). If 2 degrees of warming occurs, 18% of insects, 16% of plants, and 8% of vertebrates would lose at least half of their climate-determined geographic range (Hoegh-Guldberg et al., 2019, p. 5). This would put many species at higher risk for extinction, with the possibility of large effects up and down the food chain. Many of these impacts are projected using historical data; however, there is reason to believe that climate change and impacts due to climate change may accelerate as the Earth warms. A key concept in climate research is called a tipping point. In this context, a tipping point is defined as "critical thresholds in a system that result in rapid systemic change when exceeded" (Hoegh-Guldberg et al., 2019, p. 7). Essentially, once the GMST reaches a certain level, the mechanisms Earth has for regulating itself fail and can lead to rapid, irreversible effects. This is why limiting this increase in GMST is so critical (Hoegh-Guldberg et al., 2019, p. 5, Betts et al., 2011). It is clear that the Earth is getting hotter and that this increase in temperature may have catastrophic effects on society. Humans are causing the Earth's climate to change, and the results of this climate change are dire if not mitigated.

One more argument skeptics commonly make is that climate change is happening, but humans do not cause it. According to a study done on the scientific community's opinion on climate change, "the broadly-defined scientific consensus likely far exceeds 99% regarding the role of anthropogenic GHG emissions in modern climate change, and may even be as high as 99.9%" (Lynas et al., 2021, p. 6). Scientists strongly agree that climate change is happening and is caused by human emissions, not natural processes.

Flying Frenzy

Along with a rising awareness of climate change is an increased spotlight on the aviation sector's emissions. Taking into account effects from other impacts of the aviation industry (e.g., condensation trails), aviation currently accounts for approximately 3.5% of the total Effective Radiative Forcing (ERF) (Planès et al., 2021, p. 2). ERF refers to the change in the balance of energy going in and out of the atmosphere. The positive ERF of 3.5% that aviation is contributing means that emissions from this sector currently account for 3.5% of the current warming. While this number is relatively small, an increase in demand for air travel alongside no clear path to decarbonization means that aviation could contribute massively to climate change in the coming years. As seen in Figure 2 below, the predicted compound annual growth rate (CAGR) of flights between 2015 and 2045 is 4.1%. This means that each year the number of flights increases by 4.1%. By 2050, this corresponds to more than double the number of flights in 2020. (“Boeing Cascade Climate Impact Model”, “Future of Aviation”).

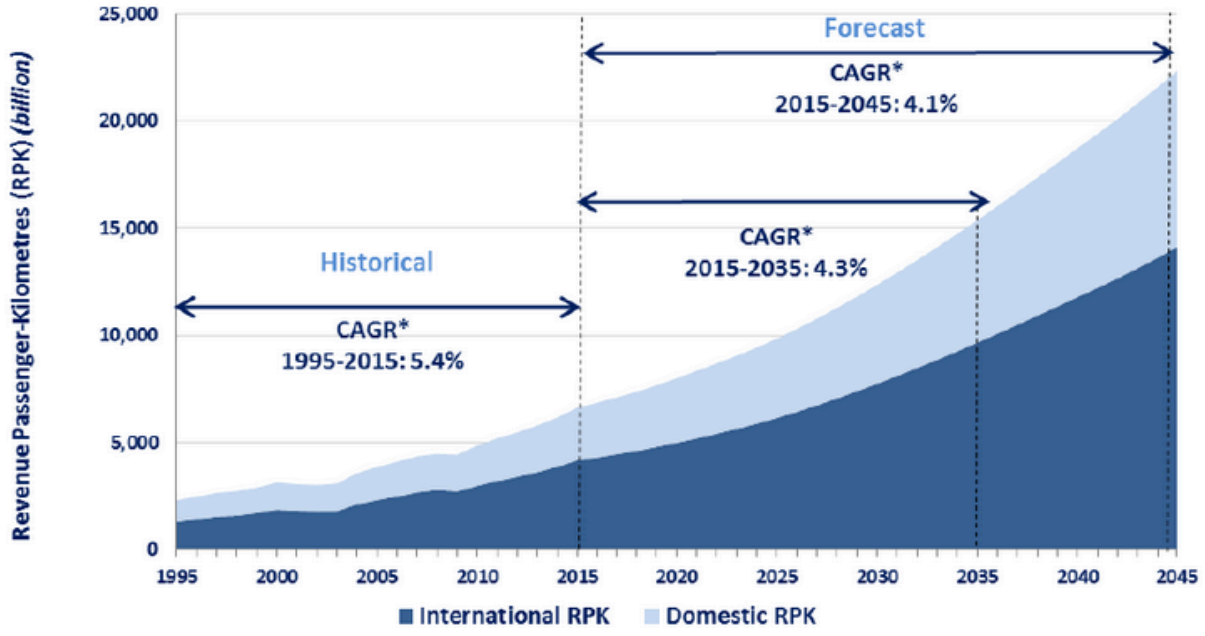

Figure 2. *Compound Annual Growth Rate (CAGR) in Aviation.* Adapted from *The Future of Aviation*, by International Civil Aviation Organization (ICAO), 2024, ICAO (https://www.icao.int/Meetings/FutureOfAviation/Pages/default.aspx). Copyright 2024 by ICAO.

Dreams of a more connected world have been achieved, but not without alarming side effects. The environment and the airline industry are on a collision course. The Earth is warming due to carbon emissions, and the aviation industry is growing rapidly. Because of this situation, action is already being taken to decarbonize this and other sectors. This problem is particularly challenging for the aviation sector because of the critical importance of weight and safety. The answer in terms of legislation and technology is currently unclear. This paper will use Actor Network Theory to examine the legislative, economic, technological, and social aspects of mitigating climate change, specifically focusing on the aviation industry.

III. Research Approach

Complex Interactions

In this paper, aviation will be utilized as a lens for examining the broader scope of climate action in the United States. The aviation industry will provide valuable insight into the carbon-dependent society as a whole and will provide a means for examining many of the challenges society faces in decarbonizing in general.

Latour (1996) provides a helpful framework for looking at large socio-technical systems. His Actor-Network Theory (ANT) looks at society as a large interconnected web of “actors” - both human and non-human - which he refers to as “actants.” Within this framework, each actant

is looked at based on its connections to other entities. These connections shape the various actants and create outcomes and power dynamics in society. Latour further clarifies:

> The difficulty of grasping ANT is that it has been made by the fusion of three hit to unrelated strands of preoccupations: - a semiotic definition of entity building; - a methodological framework to record the heterogeneity of such a building; - an ontological claim on the "networky" character of actants themselves (Latour, 1996, p. p. 374).

Breaking this down point by point, “a semiotic definition of entity building” refers to the definition of entities or actants by the connections they have. For instance, an airplane may be looked at by how it is connected to regulators, how it is used by people, and how it impacts the environment. Next, “a methodological framework to record the heterogeneity of such a building” refers to placing the objects in the way they were defined in the previous step in a large network to see the big picture. Finally, “an ontological claim on the 'networky' character of actants themselves” refers to the claim that every actant exists in a web of connections.

To examine climate change through the lens of commercial aviation, this paper will utilize ANT to analyze the interactions between international organizations, governments, airlines, technologies, and the general public. The goal is that studying these actants will give a clearer view of how climate action works and how power is distributed and flows across this vast network.

First, I will examine the definition of Sustainable Aviation itself. Subsequently, I will look at the Paris Climate Agreement, followed by broad political perspectives and their impact on the issue. Then I will examine technologies being developed to solve the issue and how they

fit into the larger landscape. Finally, I will look at airlines to see what role they might play in creating a green aviation industry.

IV. Results

What is "Sustainable Aviation?"

There is certainly evidence to show the concept of sustainability, particularly in aviation, is catching on. Unfortunately, far too many times sustainability is just that - a mere concept. McManners explains, "To insert the word into a policy document, accompanied by some marginal changes, is enough to allow policy makers to claim that sustainability has been considered" (McManners, 2016). He further explains how aviation stands out as a particularly difficult sector to consider sustainability. Before looking at how sustainability is working in aviation, it is necessary to take a closer look at the term sustainable aviation and how it is defined.

It is important to achieve a clear consensus to unify and achieve a common goal. The United States government expressed this in its Aviation Climate Action plan, stating, "To be effective, a goal should be clear, achievable, and ambitious with specific actions and milestones that can be taken to achieve it." (Williams, p. 3). The term sustainable aviation was originally coined by the European Federation for Transport and Environment - a collection of Environmental NGOs - in 1998. Sustainable aviation was defined as "'basic mobility to all citizens without damaging nature and the environment (Sledsens, 1998)'– as straddling the ecological and economical interpretations of sustainability (Perman et al., 2003)" (as cited in Walker and Cook, 2009, p. 379). This definition, while a start, does little to look at the issue of an increasingly polluting industry. The concept of not damaging the environment in this statement severely underemphasizes the complex landscape of the problem. Walker and Cook

(2009) give a clear example of how this plays out in reality. These authors provide an example of an airport. Increasing the size of an airport can reduce taxi times, thereby massively reducing carbon emissions. However, this doesn't account for the effects of "biodiversity, land-take, surface access congestion, loss of heritage or air, soil and water pollution" (Walker and Cook, 2009, p. 384). Not only are trade-offs present between economic, social, and environmental factors, but as seen through ANT, each of these perceived realms is yet another complex web of negotiations. As Walker and Cook (2009) point out, the concept of sustainable aviation is unclear. Walker and Cook go so far as to propose that different organizations "attempt to frame sustainable aviation to suit their own objectives" (Walker and Cook, 2009, p. 378). From the perspective of ANT, this is exactly what is happening. While it is important to come to a consensus to achieve a common goal, this does not mean it is necessary to limit this definition to a short sentence. The concept of achieving a singular definition for sustainable aviation is not feasible. Rather, the definition is a complex web of negotiations and interests, much more similar to what Walker and Cook point out, versus the US government and it should be recognized as such.

So Far So (Not) Good?

Climate action has become increasingly politicized and polarized within the United States. Recently, the United States has backed out of the Paris Climate Agreement (AP News). To understand the Paris climate agreement, Clémençon (2016) suggests it is necessary to examine the historical context in which it exists. Since the 1980s, the European Union has been calling for strict climate action, while the United States has been hesitant. The European Union has long been calling for legally binding goals, and the United States has rejected these efforts. This was first seen in 1997 when the United States ultimately agreed to the Kyoto Protocol. In

some ways, this agreement was groundbreaking, namely the setting of different goals for developed and developing countries and the emphasis on the need for developed countries to take initiative. Additionally, it did include legally binding goals for developed countries like the United States. These provisions of the agreement would prove to be a great step forward in climate policy. However, the United States would not sign the agreement without an important concession - emissions trading. Clémençon defines this term as "the idea that countries would be able to purchase emissions rights from other countries or get offset credits by financing projects in developing countries that reduce emissions" (Clémençon, 2016, p. 4). This type of system is known as cap-and-trade. It allowed private industry to game the system and resist reducing emissions. The alternative is known as a carbon tax. A carbon tax would make companies pay a cost proportional to their carbon dioxide emissions. Then, this tax would hopefully be used by the government to fund research into green technologies. Clémençon claims that choosing a cap and trade system over a carbon tax set back climate action by 20 years. Even though the United States received a major concession from this agreement, the next administration would quickly pull out of the agreement in 2001, citing that the US efforts do not make sense if developing countries continue to grow and pollute more and more without consequence, while the US harms its economy. This is the same "all or nothing" perspective evident in US politics, limiting the ability to work towards a common goal. The US's objections from a broad point of view make sense, however, the Kyoto agreement was signed with the intent of developed countries serving as leaders in this space to set an example for the rest of the world. This is a notion not novel to the US. In 1987, the United States led an effort known as the Montreal Protocol, which served to reduce the usage of a chemical that depleted the Earth's ozone layer. This involved different goals for developed and developing countries. Even though this deal was structured similarly, the

US was willing to take a leadership role. This suggests a deeper reason for the US backing out of the agreement. The real reason the US backed out of the Kyoto Protocol is that the US did not want to enter into any agreement acknowledging past emissions. The acknowledgement of past emissions would make the United States responsible for natural disasters and other climate impacts. This is a complicated issue. The truth is that climate change disproportionately affects developing countries, particularly island states. However, I believe this rhetoric and logic is detrimental to finding a solution. There is no way to directly link an event such as a hurricane to a particular country's carbon emissions. Making developed countries liable for such events immediately raises red flags and causes politicians to be suspicious of climate action. If we want to achieve a greener society, we must acknowledge past mistakes, but not legally bind nations to pay for consequences that could not be directly linked to them. This is not to say that developed nations do not have a moral obligation to assist in such scenarios, but they should not be considered at fault for such events. Another reason the US took issue with the Kyoto agreement was that China and India would not be under any binding emissions targets. This sentiment is similar to the present administration's approach to climate action. President Trump claims that international climate agreements "'steer American taxpayer dollars to countries that do not require, or merit, financial assistance in the interests of the American people.'" ("Trump signs executive order", 2025). It was no secret that President Trump felt this way during his campaign, however, he still won the election, even the popular vote. Reasons beyond climate action led to the result of the election, however, this result still shows how a large portion of the public feels about the issue.

There is some insight into how we got to this point. Clémençon (2016) explains that leading up to the Paris Climate Accord, Europe was desperate to come to an agreement,

regardless of what concessions they had to make. Similarly, President Obama worked hard to construct the agreement in a manner to eliminate the need for Senate approval. This made it so that no binding emissions goals could be set. This also limited the amount that the American public felt they contributed to this agreement, as it circumvented the role of the representatives they elected. Further mistakes are present in the finer details of the Paris Climate Accord. Interestingly, the accord focuses on a 1.5-degree limit to warming. Barrage, L., & Nordhaus, W. (2024) constructed a model to assess the impacts of climate change and climate action. This model is known as the Dynamic Integrated Climate-Economy (DICE) model. It is widely considered the leading model for evaluating environmental and social impacts of climate change. This model determined that meeting this goal would need much more severe climate action than originally thought, and such action would send the world into a global depression (Barrage and Nordhaus, 2024, p. 5). Climate action has continually been compromised in coming to an agreement. While some may argue that an agreement is better than no agreement, how the Paris Accord was constructed eroded public confidence in its value. By neglecting the vast array of impacts, climate change has fallen to a mere argument. In reality, it is an incredibly pressing issue that affects all of society. When the power of climate action flows down from large international organizations, a portion of Americans are inherently distrustful of the action. This severs connections within the interconnected web Latour uses, and limits the power of such efforts. For Americans specifically to get behind climate action as a whole, it is necessary for the efforts to either come from communities everywhere or for the results of such actions to be concretely linked to everyday life. Climate action needs to be carefully considered from the perspective of everyday people to decide where legislation can compromise and where it must hold firm.

But Would Authoritarianism Work?

I would posit that many people would suggest the populist or grassroots view I have suggested as idealistic and not useful for solving this issue. Faced with the complexity of this problem and ever-changing negotiations between the various actants within the sector, some scholars have gone so far as to suggest authoritarianism as a solution to the climate crisis (Hirsch, 2022, p. 1). From an initial look, this makes sense. It is difficult to garner widespread support for the issue, which is dire, so it is necessary to make decisions for the common good regardless of public sentiment. Beyond just scholars, individuals may even welcome authoritarian ideas when faced with dire circumstances. According to a study on individuals in Spain and Germany, "While individuals may reject the abstract ideas of authoritarian rule and intolerance, they may readily endorse authoritarian ideas when targeted at dealing with societal threat" (Hirsch, 2022, p. 10). Riofrancos (2025) further explored this issue. She explains that the relatively fast changeover of leaders in democracy, combined with voters looking for short-term improvements in their daily lives, makes long-term climate action very difficult to sustain. Even if one president decides to take action, the next may have a completely different opinion. This has been exactly the case in the United States. While authoritarianism may seem useful to combat climate change from a large-scale point of view, it oversimplifies reality.

The answer to climate change is not an authoritarian government. Riofrancos (2025) explains that democracies and their freedom of the press are critical to addressing broad societal issues such as climate change. Free information flow and the limited number of years a politician will hold office keep them accountable to the general public. Democracies, while not perfect, give a window into the messy fabric of society. They concretely act upon the different connections between actants, allowing voters to decide based on interactions of themselves and

the groups they belong to in society. While an authoritarian leader may use a crisis to gain power, they are ill-equipped (and not generally intending) to improve the quality of life for the general public.

The answer is not authoritarianism, but democracy in its current state does not seem to be getting the job done in the United States either. The issue of climate change has become highly politicized, meaning that when one party loses power, the stance on climate action reverses course. The problem should be looked at on a much smaller scale, not as a black and white issue. It is a fact that a healthier environment benefits all of society. No one wants to live in a world where the nature they love is destroyed, particularly the fresh water, the greenery, and the climate in their hometowns. Yet still, a large proportion of the population opposes climate action. This is once again a result of the problem being framed in a way that neglects the smaller complexities of the problem. Riofrancos astutely suggests that planetary well-being needs to be directly linked to improvements in the daily lives of the general public to garner widespread support. Similarly, both Jenkins et al. (2021) and Fam (2024) argue for a government planning agency focused on creating Net-Zero infrastructure and communicating with local communities to maximize local benefits and gain support. If climate action continues to be a largely political argument on a large scale, climate goals will never be achieved. To limit climate change, reframing the current problem into smaller actions and local impacts, and looking at trade-offs rather than ignoring them will be critical.

Technology

The political landscape governing climate change and aviation is very complicated, and it will impact the technological development necessary to meet the goals set. Fortunately, many technological advancements in this sector are being worked on despite the large political uncertainty. For instance, increasing fuel efficiency is a goal that airlines and industry are pushing for. This is because more fuel-efficient aircraft radically reduce cost and increase profitability. Unfortunately, this motivation alone is not enough to decarbonize the sector.

In the 2021 Aviation Climate Action Plan, Williams (2021 FAA) describes some technological and process-based efforts to reduce carbon emissions. One such example of how the United States Government is partnering with industry to develop new technologies is the Sustainable Flight National Partnership (SFNP). This is an effort led by NASA aimed at creating new narrow and wide-body aircraft that will hopefully lead to a 25-30% lower fuel burn and a 10-15 decibel noise reduction. Currently, NASA and Boeing are working together to create a transonic truss-braced wing design for a narrowbody flight demonstrator. Ranasignhe et al. (2019) examined the current state of turbofan engine development. While there are many promising advancements, there are also many challenges. Production models of jet engines using many advancements have worn out abnormally fast, which has led to engine shortages among airlines. Additionally, these advancements are beginning to yield diminishing returns. Ranasignhe et al. further argue that major technological advancement needs to come soon to meet emissions goals. This involves turboelectric propulsion, alternative fuels, and new aircraft configurations. Because of the high risk of these technologies, government incentives and programs will need to be present to make these feasible and make meeting emissions goals feasible. For instance, many obstacles become apparent when examining electric, hybrid electric,

and hydrogen aircraft. To name a few: poor energy density, high cost, issues with storage, and a general lack of infrastructure (Avogadro, N., & Redondi, R. (2024), p.2). Sustainable Aviation fuels are also promising as they can be utilized within previously built aircraft and work well within the confines of current infrastructure. Price has been cited as the main drawback, however, when examining closer, other issues arise as well. Fam and Fam (2024) note the carbon neutrality of biofuels is a contested concept. Biofuels are generally created from animal waste or plants. For plants in particular, the carbon emitted by burning these fuels is said to have been absorbed by the plants, making for a carbon-neutral process. However, Fam and Fam go on to state, “First-generation biofuels can—on average—have lower GHG emissions than fossil fuels, but GHG savings for most of the feedstocks are not nearly 100 %” (Fam and Fam, 2024, p. 854). This is due to land-use changes (e.g. deforestation), emissions associated with transportation, and processing. Furthermore, the increase in fuel efficiency of aircraft is a complicated issue. Miyoshi and Fukui (2018) examined the Rebound Effect in commercial aviation. The rebound effect is a phenomenon in which increasing the fuel efficiency of an aircraft lowers fares and increases demand. This means that more fuel-efficient aircraft can lead to an increase in carbon emissions because fuel is one of the airline's major costs. The complex web of interactions within the industry presents itself as a confounding problem. Even so, many promising efforts are already working to create a greener industry. Even though each has its drawbacks, each has great potential to reduce emissions with the help of carefully thought-out legislation.

Airlines

The airlines play an interesting role in this issue. It is easy to place the burden of this problem on them. Although they certainly have some responsibility, they represent a struggling industry. Airlines have failed to be as profitable as originally thought. This is seen by the current state of airline operations.

> "The 'Big Four' airlines American, Delta, Southwest, and United—frequent flyer programs are worth markedly more than the business of providing actual air travel. In other words, thanks to their frequent flyer programs, airlines have become financial institutions that 'happen to fly planes on the side'" (Goldfine, p. 235).

This is a particularly concerning issue. Goldfine notes that the lack of regulation for these frequent flier programs makes airlines very powerful to take advantage of customers. Putting more burden on airlines will only embolden them to find more ways to pass on costs and/or take advantage of the general public. I do not believe that creating a world in which only the rich can afford to fly on planes is one that is truly "sustainable."

This issue is further complicated within the context of airlines because research supports that the appearance of being a green corporation boosts public opinion, loyalty, and business (Wu et al., 2018, p. 1438). The intentions of the airlines do not matter as long as they are reducing their emissions, however, there are cases in which a company can appear to be sustainable, but is not. As explained earlier, "green efforts" such as increasing the size of an airport or increasing the fuel efficiency of an aircraft do not always create a more sustainable society.

V. Conclusion

Using ANT, it becomes clear that creating a sustainable aviation industry is very complex in the true sense of the word, sustainable. This is due to the inability to accurately define sustainable aviation. The answer is not to grasp at an imperfect definition, but to recognize sustainable aviation as a complex web of ever-changing relationships. The various actants involved in the industry have complex interactions whereby sustainability for one of the actants may be unsustainable for other actants. This has been clear within climate action, specifically the Paris Climate Accord. Concessions and differing perspectives limit its ability to maintain support by Americans, specifically and to create change. Different political theories have been suggested as solutions to the problem, which have their own set of drawbacks and trade-offs. The airline industry is not structured to take on the challenges of becoming green without the help of legislation. Even technology's impact is complicated. Fuel efficiency and biofuels are just some ways “green” technologies can have benefits and drawbacks.

Sustainability seen through the lens of various actants within the aviation industry, is a convoluted web of connections. Trade-offs do not just exist between economic, social, environmental, and technological factors, but actually within each of these realms themselves. Sustainable aviation, and the establishment of a sustainable society in general, is a puzzling issue because of this. This paper, while limited in its ability to fully explore each of these realms, hopefully can provide insight into how the problem should be looked at. It is important to recognize this complex fabric and to help connect it to everyday life so real people can make informed decisions to usher in a truly sustainable future for all.

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