

Spring 5-2019

Aviation Sustainability

Elizabeth Gemmer
gemmere@bgsu.edu

Follow this and additional works at: <https://scholarworks.bgsu.edu/honorsprojects>



Part of the [Aviation Commons](#)

Repository Citation

Gemmer, Elizabeth, "Aviation Sustainability" (2019). *Honors Projects*. 425.
<https://scholarworks.bgsu.edu/honorsprojects/425>

This work is brought to you for free and open access by the Honors College at ScholarWorks@BGSU. It has been accepted for inclusion in Honors Projects by an authorized administrator of ScholarWorks@BGSU.

Aviation Sustainability

Elizabeth L. Gemmer

Bowling Green State University

Table of Contents

Abstract.....Page 3

Introduction.....Page 4

Definition: The Three Pillars.....Page 4

Why Sustainability is Important.....Page 5

Past: Environmental Pillar.....Page 8

Past: Economic Pillar.....Page 10

Past: International Civil Aviation Organization (ICAO).....Page 10

Past: The UK.....Page 12

Past: Demand Management and an Aviation Charge.....Page 12

Present: Air Transport Action Group (ATAG).....Page 15

Present: Cathay Pacific Airlines.....Page 15

Present: Environmental Pillar.....Page 16

Present: International Air Transport Association (IATA).....Page 17

Present: Sustainable Airports.....Page 18

Present: Organizations.....Page 19

Future: Sustainable Aviation Fuel (SAF).....Page 20

Future: International Civil Aviation Organization (ICAO).....Page 20

Future: Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)...Page 21

Future: International Air Transport Association (IATA).....Page 21

Conclusion.....Page 22

References.....Page 23

Abstract

Sustainability in aviation has become a prominent issue. There is a substantial amount of information on sustainability measures taken and discussed at the local and global levels.

However, the information is spread out over a wide array of sources and many people are not aware of what is being done. There have been many past efforts to integrate sustainability into aviation, those efforts continue today and will continue into the future. Aviation is a rapidly growing industry; as the industry grows and there becomes even more of a need for sustainability measures to keep it a viable mode of transport, there will be even more attention focused on it and allow it to become an even more visible and integrated idea.

Introduction

Aviation plays an integral role in society, connecting people all over the globe for work and pleasure. It drives the economy through employment and the transport of goods. While aviation brings numerous benefits, it also has many environmental costs. Society is becoming increasingly concerned with climate change, and sustainability has become a prominent issue in recent years. The aviation industry is no exception to this; there have been many efforts in the past decade to integrate sustainability into the industry and more vigorous efforts continue today and will continue into the future. The integration of sustainability requires the understanding and involvement of all those in the industry.

Definition: The Three Pillars

Sustainable development is defined as the capacity to meet the needs of the present without compromising the ability of future generations to meet their own needs (ICAO, 2011). Specifically, there are three pillars of sustainability: economic, social, and environmental. In order for something to be truly sustainable, it must balance all of these pillars (ICAO, 2011). The International Civil Aviation Organization (ICAO) publication where this information is found, continues to elaborate on sustainability, saying that it is “a complex notion that seeks to define not only environmental impacts but also the balance between these impacts and ongoing social and economic development objectives” (ICAO, 2011). The economic pillar of sustainability, of course, relates to whether the industry is able to be financially successful. The social pillar relates to the community aspect of things. It looks at what impact is being had on the community in terms of benefits or detriments and how that is going to affect the growth of the community. Finally, there is the environmental pillar, which is typically the pillar most people think about when they hear the word “sustainability”. The environmental pillar relates to the specific

environmental issues and the impact they are having, whether it be CO₂ emissions, noise pollution, runoff, etc (ICAO, 2011). That is the definition used in the industry, however there are many different perceptions that can contradict that; according to an ICAO publication on aviation and sustainability, recent perceptions of aviation sustainability have tended to only focus on the negative environmental issues (ICAO, 2011). In addition, the publication points out that sustainability in aviation is often condensed to mean just the reduction of environmental impacts. This, however, does not take into account the other pillars. For that reason, this definition can be detrimental to the cause (ICAO, 2011). Taking into account the three pillars, there are many reasons to advance sustainable practices in the aviation industry, and numerous examples of how that has been done in the past, present and what is to come in the future.

Why Sustainability is Important

Aviation connects over 220 countries, with the aviation sector employing 6 million people worldwide. Approximately 2.6 million passengers travel by air each year, with 36,000 airport pairs having non-stop connections. In fact, 80% of the world's cities reachable by at most 2 connections. In addition, 41% of goods travel by air. Carbon Dioxide emissions from aviation make up 2% of global CO₂ emissions (ICAO, 2011). Aviation is extremely important to today's global society, but it continues to grow with both positive and negative effects. According to an ICAO publication on aviation and sustainability, the passenger air travel market has grown 80 times since the 1950's, with Revenue Passenger Kilometers (RPK's) flown 160 times as large and Freight Tonne Kilometers (FTK's) 200 times as large as the 1950's. The world's economy has grown 9 times, and overseas markets and globalized supply chains would not be able to function and grow without aviation (ICAO, 2011). In addition, aviation is able to bring about numerous sustainability related benefits, including, freedom of mobility, health and welfare from

poverty reduction and growing economies, and economic benefits from employment, trade and business, cultural enrichment, technology transfer, military security and many others contributing to a global society (ICAO, 2011). There are clear benefits to air transport, but there is an environmental cost to it, and in order to keep it a viable mode of transport the cost needs to be mitigated with the benefits (Gill, 2015). It is estimated that by 2030 domestic and international travelers will reach 6 billion and be traveling on about 50 million flights, that is about double the level of 2011. Because aviation is growing so fast, efforts to mitigate the environmental impact need to continue to minimize the negative effects (ICAO, 2012). As a publication by a sustainable aviation group in the UK puts it, “The rapid and sustained growth in air travel has created significant detrimental environmental impacts. Noise, air quality and the contribution of aviation to climate change are causes of public concern at a local, national, and global levels.” (Sustainable Aviation , 2005).

A three pillared approach to sustainability in aviation is crucial to ensure that as aviation continues to grow, it is still going to be economically, socially and environmentally viable in the future, and able to connect society across the globe. ICAO states that, “Aviation can, therefore, be viewed as making a positive contribution to sustainability if on balance it demonstrates an overall reduction in enviro-socio-economic impacts and/or an increase in positive enviro-socio-economic impacts.” (ICAO, 2011). In the past decade or so there have been a number of efforts to address sustainability in the aviation industry, those efforts continue even more vigorously today, and are likely to continue into the future. A quote from an article written by the Executive Director of the Air Transport Action Group (ATAG) sums it up quite well, “The most important thing is to work together. In a hugely competitive industry like ours, it is vital that we have shared goals, allowing all sector of the industry, be they airlines, airports, manufactures or air

navigation service providers to take on their share of the burden, but also benefit from the opportunities.” (Gill, 2015). There are a number of different ways to define sustainability in aviation, however, it is clear that as the industry continues to grow, so does the need for action to not only mitigate the negative effects, but to ensure that aviation is viable economically, socially, and environmentally in the future.

While the definition of sustainability in the aviation industry is important to focus on, it is perhaps, more important to focus on why sustainability is important to the aviation industry. One of the fastest growing sectors of the economy is aviation, it consumes a substantial amount of fossil fuels, contributes to climate change and does not assume a proportionate responsibility for the damage that is occurring (Cambridge, 2004). Aircraft CO₂ emissions are expected to quadruple by 2050 from 2010 levels (Goreham, 2019). Estimates show that the total CO₂ emissions from commercial aviation could reach roughly 1.2 billion tonnes annually by 2025, simultaneously, the quantity of nitrogen oxides released from aircraft engines could rise from 2.5 million tonnes in 2000 to 6.1 million tonnes in 2025 (American Institute of Aeronautics and Astronautics , n.d.). This is a substantial increase and contributes not only to global warming, but to health problems as well. In addition, the number of people affected by aircraft noise is rising, from 24 million people in 2000 to 30.5 million people in 2025; because of the scope of these problems, there is an urgency to deal with them (American Institute of Aeronautics and Astronautics , n.d.). According to a paper on aviation sustainability from the Stockholm Environment Institute, “sustainable development requires careful thought and prudence about environmental capacity, climate change and equity”. The authors explain that the growth in aviation is threatening this, and making it even more of a priority to implement measures to make aviation sustainable (Cambridge, 2004). A considerable positive from this is the ability of

the aviation industry to play a role in technology. As the aviation industry adopts sustainable practices and technologies, they will spill over into other sectors and areas of life and from there will continue to benefit global society (ICAO, 2011). Aviation is currently experiencing considerable growth; this growth comes with many benefits for society, but there also considerable negative environmental impacts of aviation in terms of air pollution, noise pollution and a number of others. In order to curb these effects and continue to sustain aviation as a viable mode of transport, measures must be put in place and action must be taken.

Past: Environmental Pillar

Prior to 2015, a number of aviation sustainability measures have been put into place in many areas in aviation. A main area for sustainable innovation is in aviation fuel, which would fit into the environmental pillar. The purpose of sustainable innovations in aviation fuel is to reduce the amount of air pollution, most specifically CO₂, caused by the engines of aircraft. Sustainable fuels were one of the first sustainability measures to be developed, and they are promising solutions for the future of aviation (ICAO, 2011). The first sustainable aviation fuel (SAF) flight was flown by a Virgin Atlantic 747 from London to Amsterdam in February of 2008 (Gill M. , 2018). Since then, the use and development of sustainable aviation fuels has continued to grow. Many different airlines have done test flights with different types of SAF, from algae to municipal waste (Gill M. , 2018). Climate Solutions' Sustainable Advanced Fuels Program is working with Sustainable Aviation Fuels Northwest (SAFN) to develop biofuels in the Northwest that are both sustainable and economically viable (Sustainable Aviation Fuels Northwest , n.d.). Through their work and research, SAFN was able to create a report titled, "Sustainable Aviation Fuels Northwest(SAFN): Powering the Next Generation of Flight". The report, published in May 2011 has helped to guide policy discussions at the state and federal

level (Sustainable Aviation Fuels Northwest , n.d.). Some airports in Norway and Australia for example, have been able to obtain sufficient working quantities of SAF, and airlines such as United, Cathay Pacific and KLM are using these fuels, with access to a limited quantity (Gill M. , 2018). In 2008, there was only one flight using SAF. In 2017 there were 100,000. The goal is to reach 1 million by 2020 (Gill M. , 2018). In addition to advances in alternative fuels, Rolls Royce his developing a new engine, the CTi, composite carbon and titanium, that will help reduce emissions by cutting fuel burned (Goodwill, 2014). British Airways and Virgin Airways have been testing cleaner fuels (Goodwill, 2014). In addition, the commercial viability and sustainability of a biofuels industry in the Northwest is being assessed. Feedstock availability, cost, timetable, transport, refining, land and water use and the actual usage by airlines are being looked at. There are a surprisingly large number of feedstocks available, including camelina, forest residues, municipal solid waste and algae (Sustainable Aviation Fuels Northwest , n.d.). AvFuel Technology Initiatives Corporation was developed in January of 2012 with the goal to achieve industry advancements in bio fuels and renewable fuels both internationally and domestically (Hubbard, 2018). There is considerable work being done on biofuels, there are currently 300 fuel initiatives underway, with commercial flights using biofuels from various feedstocks, and this work is projected to continue in the future (ICAO, 2011). In July 2011 ASTM D7566 was approved, this allowed aviation fuels produced from hydroprocessed esters and fatty acids (HEFA) and derived from feedstocks such as camelina, hatropha, algae and cooking oil to be used on commercial flights (ICAO, 2011). Sustainable Alternative Fuels is able to meet the three pillars of sustainability by reducing greenhouse gas emissions, improving local air quality, and providing new sources of employment, but they also help to reduce the volatility of fuel prices (ICAO, 2012).

Air quality is a main issue facing the aviation industry, and there are many things being done to mitigate that. Air quality limits are in place and are being met at all airports in the UK, with the only exception being the nitrogen dioxide levels around Heathrow (Goodwill, 2014). There are also improvements in noise levels; aircraft now are 25% quieter than in the 1960's (ICAO, 2012). Aircraft have also become 70% more energy efficient in the last 40 years (ICAO, 2012). ICAO set standards in the past for noise and local air quality, and new standards for CO₂ emissions are coming in 2013 (ICAO, 2012).

Past: Economic Pillar

Much of the work that is being done with sustainable fuels could be placed in the economic pillar as well. Economic benefits are being created by the development of sustainable aviation fuels, such as the creation of jobs and the stabilization of fuel prices (ICAO, 2012). The UK, which is on the forefront of aviation sustainability, is a perfect example of actions that would fit in the economic pillar. The UK government, among other measures, is providing 25 million pounds (roughly 32.5 Million US dollars) of funding for the construction of demonstration scale advanced bio fuel plants (Goodwill, 2014).

Past: International Civil Aviation Organization (ICAO)

The International Civil Aviation Organization (ICAO) has developed four key areas that their initiatives fall into: 1. State action plans/assistance to States, 2. Sustainable alternative fuels for aviation, 3. Market based measures, 4. Global aspiration goals. In addition, they are focusing on technology to enhance the environmental performance of aviation operations and working to develop standards both for the certification of aircraft and for CO₂ emissions (ICAO, 2011) (ICAO, 2012). There are a number of ICAO documents that support this, and demonstrate that they are industry wide initiatives.

ICAO also developed a set of initiatives and measures known as policy tools or a tool suite. These include environmental certification for aircraft, regulation of air transport, market based measures, State action plans, new technology, and sustainable alternative fuels. There is also a concrete portion of the suite that includes technical tools such as a CO₂ emissions calculator for passenger flights, a fuel savings estimation tool (IFSET), and a green meetings calculator that calculates the optimal location for a meeting in terms of CO₂ emissions from air travel based on the number of participants and their city of origin (ICAO, 2012).

ICAO Assembly Resolution A37-19 did a number of things for sustainability in aviation. This document encouraged States to submit climate change action plans, with the submissions being voluntary. Annual reports on internal aviation CO₂ emissions were also encouraged to be submitted, with ICAO hoping to establish this at the end of June 2012 (ICAO, 2011). In the UK, Germany and Netherlands, taxes have been placed on air travel, hoping to even out the costs and make the consumer more aware of their impact (Goreham, 2019). There have also been clear goals laid out, including cutting carbon emissions in half by 2050 and carbon neutral growth from 2020 (Gill M. , 2018). ICAO developed the Action Plan Emissions Reduction (APER) website. This website allows action plans to be submitted and provides materials to help in preparing them, it also gives information about action plans already being implemented by States (ICAO, 2011). The 35th ICAO Assembly endorsed the development of an open emissions trading system, and then the 36th Assembly developed a framework for MBM's so as to avoid duplicate or overlapping MBM's and to encourage this as a global approach (ICAO, 2011). The 37th Assembly then agreed on 15 guiding principles for the MBM's in Resolution A37-19 (ICAO, 2011). This assembly also agreed on a 2% annual fuel efficiency improvement and to stabilize global CO₂ emissions at 2020 levels and to achieve carbon neutral growth from 2020 forward

(ICAO, 2012). ICAO also maintains the Global Framework for Aviation Alternative Fuels. This is an online platform that shows hundreds of global initiatives and activities related to SUSTAF, allowing others to see what is being done around the world (ICAO, 2012).

Past: The UK

The publication of Sustainable Aviation in the UK demonstrated that all the sectors of the industry are working together to focus on a long term strategy that balances all three pillars of sustainability (Sustainable Aviation , 2005). From the 2003 Air Transport White Paper and a joint industry and government report, it was clear that the sustainable development of the UK aviation industry was key to the economic, environmental and social well-being of the UK. This led to an industry push toward sustainability (Sustainable Aviation , 2005). The UK, working with airlines, airports, aircraft manufacturers and air navigation service providers developed a national sustainability strategy that created ways to monitor and report progress to the goals the paper set out (Sustainable Aviation , 2005). Some of these goals include improved fuel efficiency of aircraft, reducing NOx emissions by 80% and reducing noise by 50% for new aircraft, and finding solutions to include aircraft CO₂ emissions in the EU Trading Scheme by 2008 (Sustainable Aviation , 2005).

Past: Demand Management and an Aviation Charge

Demand management is another sustainability measure discussed in a publication from the Stockholm Environment Institute. The paper highlights the example of demand management used for cars in Europe and the fact that it worked. Demand management is basically the idea that sustainable development can be achieved by managing the demand for something, in this case air travel, so it still satisfies the needs of humans, but does so by doing more with less, reducing pollution and managing and reducing the use of finite resources and raw materials (Cambridge,

2004). The publication points out that, “Aviation is a prime candidate for demand management precisely because its rate of growth is large enough to cancel out gains from technical improvements.” (Cambridge, 2004). There are three main approaches to demand management. The first principle, in simple terms, is the “polluter pays principle”. Basically, this suggests that the price of the ticket would rise and absorb the environmental costs that are being generated by the user, so basically the full cost of the flight would be built into the ticket price, which would reduce the demand for aviation (Cambridge, 2004). The second principle, a modal shift strategy, means that passengers would be transferred from air travel to high speed trains or sleeper trains, which have a lower environmental impact and would lower the impact of aviation to keep it within the constraints (Cambridge, 2004). The third approach is that of electronic substitution. The idea behind this is simple. If it is possible to use video conferencing or teleconferencing to avoid air travel it should be done (Cambridge, 2004).

Later in the paper, the authors discuss an aviation charge in Europe. They look at multiple studies and find that a European aviation charge is “‘both environmentally effective and feasible.’ A charge level equivalent to 0.20 US dollars per litre of fuel is expected to roughly halve the projected growth in emissions from civil aviation in Europe. A charge on calculated emissions is expected to be the most efficient and least likely to distort competition or precipitate a transfer of passengers and/or operations to airports just outside European air space.” (Cambridge, 2004).

The report published by the Stockholm Environment, published in 2004, then goes on to make a number of recommendations: the first recommendation is to “establish a wide-ranging dialogue that brings together regulators, government, the industry, citizens and NGOs.” The second recommendation is to implement a measure to internalize the externalization of costs;

basically meaning the airline ticket should reflect the real price of the journey the passenger is taking and that extends to the environmental impacts they are creating. The third recommendation is to adopt the values on noise thresholds World Health Organization recommends and to put in place policies to “deliver a healthy noise environment.” The fourth recommendation of the report is to “implement surface access strategies that can deliver at least 50 per cent of all passengers to and from the airports by non-car modes of transport.” The fifth recommendation is to adopt the “environmental bubble” concept, which would give airports “clear quantitative limits for a small set of pollutants.” The sixth recommendation is “a ban on night-time flights (2300-0700 hrs) to protect human health.” The seventh recommendation is to make “air tickets subject to VAT (in Europe) and its equivalent in non-European countries.” The eighth recommendation is to implement “governmentally supported strategies delivered by clearly defined partnerships to shift passengers from air transport to rail for journeys of up to 500km in length.” The ninth, and final, recommendation is to implement “improved methods for recording and monitoring the greenhouse gas emissions from aviation globally, and the incorporation of aviation’s emissions in national and international reduction strategies to achieve a 60 per cent reduction in greenhouse gases from aviation by 2050.” (Cambridge, 2004)

The goal of the SEI report, among other things was to help inform the public about the issue of sustainability in aviation. The report aimed to educate the public on the choices available to them so that they can reduce emissions throughout their trip (Cambridge, 2004).

Present: Air Transport Action Group

Just as in the past, there are a number of things being done in the present in regards to sustainability in aviation. The Air Transport Action Group is a leader in the industry and has three global goals: 1. Achieve a 1.5% average annual fuel efficiency improvement from 2019 to 2020. This was already being met in 2015. 2. Stabilize net CO₂ emissions at 2020 levels with carbon neutral growth after that 3. Reduce aviation's net CO₂ emissions by 50%, with 2005 as the benchmark. They are then using a 4 pillar strategy to achieve these goals; the four pillars are, new technology, more efficient operations, improved infrastructure and global market based measures for aviation emissions (Gill M. , 2015).

Present: Cathay Pacific Airlines

Cathay Pacific is an excellent example of an airline that is focused on sustainable development in many different areas of their operations. In June 2016, they received 26 new Airbus A350s. These aircraft offer a 25% improvement in fuel efficiency compared to other twin engine wide body aircraft (Magusson, 2017). Cathay Pacific's strategy covers a range of activities, ensuring the materials they source for their products are sustainable, to the way they operate their aircraft and the technology they use in their aircraft are sustainable and can ensure the long-term survival of the company (Magusson, 2017). The airline also uses techniques such as, lighter galley carts and lighter trays in the cabins which they say saves up to 150kg of CO₂ per flight (Magusson, 2017). They have also been able to reduce waste, "The airline has also found creative ways to minimizing waste. Its latest premium economy amenity kits serve as a good example of this. "We wanted to explore what alternative materials could be used instead of traditional ones like cotton or wool. Our suppliers came up with a really good solution of using

used plastic bottles to make our amenity kit bags,” explains Chan. “By cooperating with a local Hong Kong design firm, we created something that looks stylish and matches our branding.” This way of thinking manifests itself elsewhere in the cabin. The carpets on Cathay’s new A350s are made from repurposed nylon material from recycled carpets and fishing nets that have been retrieved from the ocean (Magusson, 2017). Sustainable business practices make sense in the short term, too. “We’re finding increasingly that many of our customers are a lot more interested in understanding the environmental impacts that aviation has,” notes Phillippe Lacamp, Cathay’s senior vice-president for the Americas. “We are getting to the point where they are beginning to drive some of our decision-making on the obvious things: supply chain integrity, investments in biofuels, waste recycling ... That in itself is a differentiator.” (Magusson, 2017). Cathay pacific was also one of the first in the industry to adopt biofuels, they then went on to hire a full-time biofuels manager in 2010 and were the first airline to invest in fulcrum bio energy (a US based sustainable bio fuel developer); the goal behind this was to achieve carbon neutral growth by 2020 (Magusson, 2017).

Present: Environmental Pillar

Oct 2018 an event announced to reaffirm the industries commitment to advancing the development and adoption of sustainable alternative jet fuel SAJF – The event is Business Jets Fuel Green: A Step Toward Sustainability, scheduled for January 2019 at Van Nuys Airport VNY in southern California – jet fuel blended with SAJF will be available at the airport during the event, it’s a collaboration of the four FBOs on the airport (Hubbard, 2018). SAJF is a certified drop-in fuel, so it’s safe and ready to use. It doesn’t impact aircraft performance in

either the air or on the ground, and does not require any modifications to the aircraft (Hubbard, 2018).

Present: International Air Transport Association (IATA)

The International Air Transport Association (IATA) is also very involved in the steps toward sustainable development in the aviation industry. IATA is calling for a number of measures, related to sustainable aviation fuel (SAF), to be implemented globally. The first measure is to “implement the policy to de-risk investments into SAF production plants, including loan guarantees and capital grants for production facilities.” The second is to establish “support for brokering aviation off-take agreements.” The third is also to establish “support for SAF demonstration plants and supply chain research and development.” The fourth is to implement “tax incentives for public-private partnerships for early-stage plant development.” And the fifth, and final, measure is to “develop a harmonized transport and energy policy including inter-department coordination, such as agriculture, transport, energy and military.” (Gill M. , 2018)

IATA and member organizations are committed to emissions reductions, one of the ways they do this is SAF. IATA has training courses on this. They are looking to using it on a bigger scale in the future, they aim to use SAF in a truly sustainable way, SAF can reduce the overall carbon footprint by over 80% - source 7 they also offer a carbon offset program. They also have a program called IATA Environmental Assessment (IEnvA)- it is a voluntary program designed as an evaluation system to independently assess and improve the environmental management of an airline. It allows an airline to focus on improving what they already have, rather than developing an Environmental Management System from scratch. They also have FRED+, which is an easy to use and intuitive platform to support and facilitate CO₂ emissions reporting for

aircraft operators and states subject to CORSIA, helps reporting in accordance with ICAO standards, gives them analytics, benchmark reports, insights

Present: Sustainable Airports

There are a number of airports all over the world that are taking measures to integrate sustainable practices or technologies into their operations. Airports in the UK are in the forefront of this, and there are airports in the US that are following that trend. Seattle Tacoma International Airport is one of these airports. They are looking to be one of the first airports in the world to offer a reliable supply of low-carbon fuel for airlines. In 2017, they were still looking into ways to make that an economically viable possibility (Rocky Mountain Institute, n.d.).

Another program looking to bring sustainability to general aviation airports, is the Colorado Airport Sustainability Program. It is called a general aviation sustainability toolkit. This toolkit contains resources to help the smaller general aviation airports become more sustainable in all three of the pillars in their day to day operations. Airports are able to enter their information from the airport, this could be specific or general, the toolkit, then helps give a picture of the airport in relation to the three pillars of sustainability and operations, to help make improvements where they are needed (Colorado Department of Transportation, n.d.).

The Los Angeles County division of airports is also putting sustainable practices into place at their airports. They have water conservation initiatives, lighting upgrades to LEDs, a pavement preservation program, investment in renewable energy, emissions reductions via installment of electric charging stations. Most of these things have already been implemented or are in the process of being implemented (C&S Companies, 2017).

Present: Organizations

The Good Traveler is a nonprofit collaboration among airports and transportation authorities, they are working with RMI (global nonprofit focused on transforming energy use) to work on the good traveler aviation carbon reduction program. This program empowers airports, organizations, individuals and cities to reduce their environmental footprint through carbon offsetting. RMI is contracting with San Diego International Airport to administer the program according to a November 2017 press release (Rocky Mountain Institute, n.d.).

There is also the Sustainable Aviation Fuel Users Group. This group focuses on biofuels, their use, how they work and most effective practices. It is a way for others in the industry to see what is being done in terms of biofuels and how they can make use of them in their situation. It also allows for the development of biofuels and the most effective practices for their use (Sustainable Aviation Fuel Users Group , n.d.).

In addition, there is a website dedicated to sustainability in the aviation industry. It is called airportsustainability.org and is in partnership with Sustainable Aviation Guidance Alliance. The website allows you to search a wide variety of criteria, and access sustainable practices that are being done in the industry. The website will then show you costs to implement, savings once implemented, staffing and other requirements, energy reduction, social and environmental benefits and airport characteristics your search results could be used with (Sustainable Aviation Guidance Alliance , n.d.). The website also has options where you can share information with others and engage with stakeholders. There is also a section dealing with sustainability plans, and ways to measure your progress (Sustainable Aviation Guidance Alliance , n.d.).

Future: Sustainable Aviation Fuels (SAF)

There are a number of future efforts that are now starting to be implemented or that are in the development phase. Sustainable fuels are promising for the future, they reduce greenhouse gas emissions, improve local air quality and provide a new source of employment, and they also stabilize fuel price volatility; through these things, providing a source of economic development, while also reducing emissions. Sustainable aviation fuels are being implemented in the present. However, the goal for the future is to create much larger quantities of the fuel and to make it more readily available at airports. A quote from an ICAO publication on aviation and sustainability makes this clear, “The challenge ahead is to be able to affordably scale – up biofuels production utilizing sustainable biomass sources and conversion methods.” (ICAO, 2011).

Many in the industry are wondering what to do to encourage other airlines, besides those such as Cathay, to adopt sustainable eco-friendly practices. Lacamp, Cathay’s senior vice president for the Americas, thinks the answer could lie with airports. He suggests they could offer incentives such as a percentage reduction off landing fees or priority slots to airlines that use biofuel. “It’s something we’ve been looking at across the Americas ... A very interesting area to explore is how they might want to position themselves as being green airports.” (Magusson, 2017).

Future: International Civil Aviation Organization (ICAO)

ICAO is continuing to set out future goals for its member states in all three pillars of sustainability. The Assembly Resolution A37-19 “established global aspirational goals for international aviation of 2% annual fuel efficiency improvement up to 2050 and stabilized CO₂ emissions at 2020 levels.” (ICAO, 2011).

Future: Carbon Offsetting and Reduction Scheme for International Aviation (CORSA)

CORSA is the Carbon Offsetting and Reduction Scheme. It has a four pillar strategy that includes new technology and operations, better infrastructure and a global carbon offset and reduction scheme to come into effect in 2021. One of the main components of the technology pillar is SAF, or sustainable aviation fuel, the use of this type of fuel could potentially cut carbon emissions by 80% (Gill M. , 2018). CORSA, which was established in Oct 2016, will be in effect from 2021 to 2035. CORSA is still in the process of being reviewed and implemented. Before it can officially be implemented a number of things need to be corrected and amended, including reporting guidelines which must be made more transparent, the package must make clear that only CORSA Eligible Emissions Units can be used for compliance, and the criteria for sustainable aviation fuels must be improved before they can be involved in the package, etc (Kovacs, 2018).

CORSA used as the primary tool toward carbon neutral growth of international aviation, pilot application phase from 2021 first phase from 2024 and full effectiveness from 2027 to 2035 (Center for Aviation , 2018).

Future: International Air Transport Association (IATA)

According to an IATA publication, the industry has agreed to “ambitious collective targets for carbon neutral growth from 2020 and a 50 percent cut in emissions by 2050 relative to 2005 levels.”. This strategy covers all of the relevant dimensions of CORSA: improved technology, more efficient operations and infrastructure and alternative fuels. IATA is also asking governments around the world to intervene and provide economic incentives for fleet renewal and incentives for the development of efficient technology and low carbon fuels (ICAO,

2011). IATA has also created a roadmap for sustainability, which identifies efficiency technologies that could reduce emissions 20 to 35 percent per aircraft by 2050 (ICAO, 2011).

Conclusion

Sustainability is a topic receiving more and more attention recently. Aviation plays an important role in society. It brings numerous benefits, but it also brings many environmental costs. Society is becoming increasingly concerned with the changing climate and sustainability has become a prominent issue in recent years. Sustainable development is defined as the capacity to meet the needs of the present without compromising the ability of future generations to meet their own needs (ICAO, 2011). Aviation takes a three pillared approach to that, with an economic pillar, a social pillar and an environmental pillar. All of these play an important role in the sustainable development of aviation. Numerous efforts have been made in the past decade to integrate sustainability into the industry, more vigorous efforts continue today and will continue into the future to ensure aviation is a viable, sustainable industry. While it is not yet the norm, organizations all over the world such as ICAO and IATA, countless governments and airlines and many others in the industry are taking steps toward a sustainable future of aviation.

References

American Institute of Aeronautics and Astronautics . (n.d.). *Sustainable (Green) Aviation* .

Retrieved February 2019, from <https://www.aiaa.org/Secondary.aspx?id=27919>

C&S Companies. (2017, May). *Streamlined Aviation Sustainability Plan* . Retrieved February

2019, from Los Angeles County Department of Public Works:

<https://dpw.lacounty.gov/avi/airports/documents/Streamlined%20Aviation%20Sustainability%20Plan%20-%20Final.pdf>

Cambridge, J. W. (2004, July). *Aviation and Sustainability*. Retrieved February 2019, from

https://mediamanager.sei.org/documents/Publications/Future/aviation_sustainability.pdf

Center for Aviation . (2018, January 22). *Environmental Sustainability for Aviation* . Retrieved

February 2019, from Center for Aviation : <https://centreforaviation.com/analysis/airline-leader/environmental-sustainability-for-aviation-395173>

Colorado Department of Transportation. (n.d.). *Colorado Airport Sustainability Program*.

Retrieved February 2019, from Colorado Department of Transportation:

https://www.codot.gov/programs/aeronautics/CO_Airport_Sustainability_Program

Gill, M. (2015, October 25). *Michael Gill: Can Aviation Help Us Meet the Development Goals?*

Retrieved February 2019, from GE Reports: <https://www.ge.com/reports/can-aviation-help-us-meet-the-development-goals/>

Gill, M. (2018, April 16). *Sustainable aviation fuels, the next frontier for air transport* .

Retrieved February 2019, from Open Access Government: 1.

<https://www.openaccessgovernment.org/sustainable-aviation-fuels-the-next-frontier-for-air-transport/44547/>

- Goodwill, R. (2014, November 10). *Sustainable Aviation* . Retrieved February 2019, from UK.gov: <https://www.gov.uk/government/speeches/sustainable-aviation>
- Goreham, S. (2019, January 2). *'Sustainable' Fuels Unlikely to Replace Hydrocarbons for Air Travel*. Retrieved February 2019, from Master Resource: <https://www.masterresource.org/goreham-steve/sustainable-fuels-aviation/>
- Hubbard, D. (2018, October 16). *National Business Aviation Association* . Retrieved February 2019, from General Aviation Industry Announces Event to Reaffirm Commitment to Sustainable Alternative Jet Fuel: <https://nbaa.org/2018-press-releases/general-aviation-industry-announces-event-reaffirm-commitment-sustainable-alternative-jet-fuel/>
- ICAO. (2011). *Aviation & Sustainability*. Retrieved February 2019, from https://www.icao.int/environmental-protection/documents/publications/6606_en.pdf
- ICAO. (2012). *Global Aviation and Our Sustainable Future*. Retrieved February 2019, from https://www.icao.int/environmental-protection/Documents/Rio+20_booklet.pdf
- Kovacs, Z. (2018, February 1). Retrieved February 2019, from International Coalition for Sustainable Aviation : <https://www.icsa-aviation.org/>
- Magusson, A. (2017, April 20). *Sustainability in Aviation: Cathay Pacific's Long-Term Plans Reap Short-Term Rewards*. Retrieved February 2019 , from Apex: <https://apex.aero/2017/04/21/sustainability-aviation-cathay-pacific-longterm-plans-shortterm-benefits>
- Rocky Mountain Institute. (n.d.). *Sustainable Aviation* . Retrieved February 2019, from Rocky Mountain Institute: <https://www.rmi.org/our-work/transportation/sustainable-aviation/>

Sustainable Aviation . (2005, June). *A strategy towards sustainable development of UK aviation* .

Retrieved February 2019, from http://www.aerohabitat.eu/uploads/media/18-05-2006_-_Sustainable_Aviation_summary_document.pdf

Sustainable Aviation Fuel Users Group . (n.d.). *Biofuel Use*. Retrieved February 2019, from

Sustainable Aviation Fuel Users Group: <http://www.safug.org/>

Sustainable Aviation Fuels Northwest . (n.d.). Retrieved February 2019, from Climate Solutions:

<https://www.climatesolutions.org/programs/saf/resources/safn>

Sustainable Aviation Guidance Alliance . (n.d.). *Sustainable Principles and Practices*. Retrieved

February 2019, from Sustainable Aviation Guidance Alliance :

<http://www.airportsustainability.org/>