Capacity Growth Drives Aviation Volume at Newark Liberty International Airport and Increases Carbon Emissions

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Table of Contents

Acknowledgement

This report has developed, in part, from a series of interview with Port Authority of New York and New Jersey (PANYNJ) employees that shared specific knowledge of the particularities of aviation emissions reduction strategies, and airport emissions mitigation procedures at the Newark Liberty International Airport. I would like to thank Mr. Nathaniel Kimball for corroborating on the nexus of aviation emissions strategies implemented by the PANYNJ and the Federal Aviation Administration, and on other initiatives concerning the future of aviation emissions mitigation at Newark Liberty International Airport (EWR). I would also like to thank Mr. Edward Knoesel for sharing his knowledge of airport and airline sustainability operations. Special thanks to Mr. Robert Belzer who provide critical information to formulate an informed discussion, and Miss Nicole Schott-Harris, and Professor Maurie Cohen for their input on the development of my report.

Abstract

This report analyzes the sustainability initiatives implemented by the Port Authority of New York and New Jersey (PANYNJ); as they address air pollution emissions by substantially reduce fossil fuel consumption by the airline industry and the airport in a push for more viable alternatives such as biofuels. The Newark Liberty International Airport must conform to environmental policies that tightens and limits economic growth, and infrastructure expansion. The collaborative effort between the PANYNJ and the FAA to reduce aviation emissions is in the economic, environmental, and national interest of the aviation industry, as they aim to make NextGen the future of aerospace aviation traffic control, and advanced aeronautic performance for a sustainable reduction in jet fuel burning, which saves money to subsequently reduce carbon emissions, and greenhouse gases (GHG). The findings of this report should reveal marginal successes on the front of the air pollution reduction, meanwhile sustainable biofuel are being pushed to address the need to drastically reduce carbon emissions from the airport's emissions inventory.

Little is known of the successes of this strategies for Newark Liberty International Airport (EWR); as the report seeks to examine its successes, or lack thereof, in the community. The discussion will zoom in on the lack of transparency between EWR and the city of Newark, NJ. Currently the relationship between PANYNJ and local environmental groups are strained and more concerned with noise. Ironically, the development of some advanced technologies such as more efficient and sophisticated aircraft engines, which are quitter and has the capability to reduce carbon emissions, emit greater levels of nitrogen oxide—a deadly gas that kills even with limited exposure. As a result there will be greater pressures to be more innovative.

Introduction

The Newark Liberty International Airport (EWR) is one of the busiest airports for ridership in North America, and is the overnight small package center for the New York and New Jersey region where over 630, 000 metric tons of cargo passing through its facilities each year. Since the inception of the EWR Management Plan in 2012, the PANYNJ has made some small advances to reduce its carbon emissions. It is important to keep in mind that aviation sustainability strategies are still in its infancy; as the sustainability strategies at EWR are ongoing daily occurrences, but the airport is considered too busy to micro manage every sustainability strategy, thus it is left to the airlines to ensure compliance with these strategies. Therefore, carbon emission reduction data from airlines at EWR are only quantifiable by annual pecuniary gains by the airlines.

In the effort to address air pollutant emissions the Port Authority of NY & NJ outlined and published their energy and greenhouse gas emissions strategies in an outlined and published document in 2012 called the Port Authority of NY & NJ Sustainable Management Plans for Newark Liberty International Airport, and the Port Authority has conducted periodic greenhouse gas and criteria pollutant inventories for its airports since 2006. Hence, this report examines the emissions that contribute to the Newark, NJ area air quality due to ground based airport aviation activities from Newark Liberty International (EWR) in the present era. That is the PANYNJ has adopted a sustainability policy since 2008 which called for an 80% reduction in greenhouse gas emissions for all PANYNJ facilities by 2050, as well as the development of climate change adaptation and risk management strategies (PANYNJ Sustainable Management Plans, 2012).

There are several sources of on-airport emissions that significantly contribute to greenhouse gas (GHG) emissions and "ozone-depleting substances include nitrogen oxides, sulfur dioxide, carbon monoxide and particulate matter." To date, aircraft emissions top the list of sources of pollutants coming out of EWR, this discussion will zoom in on the specificities of these recent measures that the PANYNJ and its accommodated airlines have implemented to mitigate GHG emissions and air pollution on the local level.

Relatedly, the 2014 Port Authority of NY & NJ Sustainability Report outlines the successes of its energy and fuel management strategies, which including reducing energy demand, increasing the use of renewable energy and alternative fuels and transitioning to more efficient equipment and aircraft. A key feature in the de-carbonization of the aircraft's involves the use of Advanced Aviation Biofuels, which showed admirable promise in 2013, with the potential for 70-80% reductions in lifecycle greenhouse gas emissions in relation to conventional jet fuel. In addition, the new collaborative initiative between the PANYNJ and the Federal Aviation Administration (FAA) is NextGen—a move towards performance based navigation that will redefine conventional aviation flight patterns.

In order to come to an informed discussion, this report draws on the underlying issues surrounding aviation emissions reduction strategies at the Newark Liberty International Airport. The discussion entails what role the PANYNJ has in lowering emissions, the airline's responsibility in lowering aircraft emissions, the modernization of aviation technologies to reduce carbon emissions, and more importantly how aircraft emissions affect Newark residence. The closing statements of this discussion will reiterate key discussion points and the findings of this report.

Role of the Port Authority of New York and New Jersey in Lowering Emissions

Newark Liberty International Airport was originally "built on 68 acres of marshland by the City of Newark" and was operated by several different proprietors which includes the Army Air Corps, and the PANYNJ who has expanded upon its infrastructure since 1948 (The PANYNJ). In the present era, there is still the need for capacity growth but there is growing concerns for environmental accountability. With that in mind, the PANYNJ has acknowledged their role in the environmental scheme of emissions mitigation, but accepts little accountability for their sustainability practices. To date, the PANYNJ accommodates over thirty different airlines at EWR, therefore the need for capacity growth—to pull in greater annual revenue and meet ridership demands for airlines—is given more priority over stewardship and sustainability practices.

"The Port Authority has very little to do with what goes on at the airport and it is the airline's responsibility" to ensure that aircraft emission strategies are enforced daily, said Edward Knoesel (an airport sustainability expert at the PANYNJ). So what exactly is the Port Authority's role in lowering emissions? "Right now, the different things the Port Authority can do along its own operations is to use only low sulphur diesel fuel for all our vehicles that are diesel, our fleets are clean fleets," adds Mr. Knoesel "we have hybrids and compressed natural gas vehicles." The greening of Port Authority vehicles, however represent a very small fraction of the airport's GHG emissions.[1] "We try to run all our facilities and all our vehicles as clean as possible. The

[1] "At ground level, airport operations, including those motor vehicles traveling to and from the airport, ground service equipment, and stationary sources such as incinerators and boilers, also produce emissions," (Aviation And The Environment: GAO-08-706T." GAO Reports, 2008).

Port Authority's overall emissions are small, it is mostly the aircraft, and then they [airlines] just adopt the international rules on engines." The regulation standards for aircrafts are governed by the International Civil Aviation Organization (ICAO).[2]

Aviation emissions are "a major part of the airport's GHG inventory" said Nathaniel Kimball (an airport sustainability expert at the PANYNJ), and the Port Authority sees their ground management system, which reduces the need for unnecessary taxiing on the surface, as the measures by which they will "chip away at emissions every year."[3] The ground management system was introduced by United Airways and is now integrated into airport strategies for aircraft emission mitigation. Currently this aviation emissions reduction strategy is the most encouraged at EWR, but there is no evidence that the PANYNJ have established an aviation department dedicated to checking the airlines that operate out of EWR on their emissions reduction activities. Moreover, the notion that the PANYNJ has any inclination to publicly disclose sensitive information pertaining to the "airport's GHG inventory," would cause undesired public scrutiny on health risks, and increased political and environmental pressures which may lead to decreased annual revenue. Relatedly, when presented with an inquiry on the air quality of Newark Mr. Robert Belzer, a longtime community advocate and leader of the NJ Coalition Against Aircraft Noise, asserts that no such inventory exists:

> I am not aware of any formal program at Newark Airport with regard to sustainability at the facility, however, my guess is that the PANYNJ has informal

[2] The ICAO has recently updated their emissions requirements for new engines in the near future, (also see Richardson 2012).

[3] The ground management plan is a partnership between the Port Authority and its airlines to hold aircrafts at their gates with the engine off while the central dispatcher assigns an available runway. (Sustainability Report)

> strategies to curb emissions. The PANYNJ does not calculate an emissions inventory and projected inventory for the airport--a simple strategy. Unfortunately, given the demand for services at Newark Airport, my guess is that emissions will be increasing. (Robert Belzer, personal interview, April 3, 2016)

Along with their airport emission strategies the Port Authority is required to work towards reducing greenhouse gas emission for all its facilities. That is, the Port Authority must take in consideration the environmental impact of any implementation of new infrastructure that might cause further pollution to the air quality from airport emissions.[4] This process requires seeking National Environmental Policy Act (NEPA) approval from the Federal Aviation Administration (FAA)—the federal approval for provide funding, or an approval of changing the Airport Layout Plan (ALP).[5] "Anytime we change the layout plan by demolishing a building, or constructing a building, or making modifications to roadways, taxiways, or the street side, the FAA has to approve that change to make sure it confirms with air requirements" said Edward Knoesel.[6] Relatedly, in a letter to Mr. Knoesel in 2014, the Federal Aviation Administration approved the Port Authority Aviation Department's APL to the FAA for phase 1 of their

Figure 1. http://undergrnd.com/services/airport.html

[4] Public concerns in the United States and Europe on the health effects of airport emissions led to tighter "air quality standards" which may "economically hinder airport expansion projects" (Aviation And The Environment: GAO-08-706T." GAO Reports, 2008).

[5] The Airport Layout Plan is a requirement for all airports to have a series of drawings which depicts upon the airport.

[6] The projected emissions from any new construction which are submitted to the FAA ensure that there will be no further deterioration to the air quality.

Aviation Fueling System Modification at EWR. In the wake of Super-storm Sandy, the Proposed Action Plan called for "the modification and upgrade to existing fueling systems at EWR to enable it to operate in a more efficient manner,"[7] See Figure 1, (Federal Aviation Administration, 2014).

> If we get money from the feds or we change the ALP we have to assess the environmental impact of that action, and one of those impacts is air emissions. Because under the Clean Air Act standards for air quality… the state has to take certain actions to move towards being in compliance. What we have to do now is show that our projects are not going to cause any more deterioration to the air quality and that we're still in compliance with the Clean Air Act… so if we were building a new terminal building, for example, we've got to take all the emissions and add them up for construction and show the FAA that they're not to the level that will cause any further deterioration (Edward Knoesel, personal interview, March 17, 2016).

At EWR, mobile ground power units, preconditioned air, and gate power (about 400 Hz), are provided at terminal gates to reduces the need for the aircraft's to run their auxiliary power units (APUs) for air conditioning and heating while the aircraft is not in motion on the airport surface. "That's something we're always encouraging" said Mr. Knoesel, these external power sources use "power from Con Ed or from PSE&G, so it's not local from the airport." This led to

[7] "The EPA is solely responsible for setting environmental standards for aircraft, FAA is charged with actually regulation of the industry, and the act [CAA] requires EPA to consult with FAA in setting standards" (Richardson, 2012).

the inquiry about the potential for emissions from these supplemental power sources for auxiliary power units. According to Mr. Knoesel, plugging into gate power is "like plugging in your own air conditioner, the emissions are at the power plant… so it's not local emissions from the airport… it's out of the airport inventory." In other words, out sight out of mind; as this reflects the PANYNJ understanding of environmental stewardship. In addition, in the grand scheme of airport emissions reduction, the reality is there is no empirical proof, rather no public record, that providing gate power to an aircraft at the airport results in significant emissions reduction for APUs.

> It's very difficult for airports to quantify that because we can't go running around and seeing which airplanes are hooked up and which ones are not. It's very difficult to quantify emission reductions from not using an APU because we're so busy, we have so many flights in our airports that we can't keep track, and the airlines don't even keep track (Edward Knoesel, personal interview, March 17, 2016).

The reduction in carbon emissions from ground operation emissions reduction strategies at Newark Liberty International Airport is disproportionate with the scale of the immediate problem—significantly reducing GHG emissions. There are a host of strategies implemented at EWR to reduce its emissions, but the strategies in this section best capture the direction and pace at which the PANYNJ is working to stay in compliance with the CAA. If EWR wishes to see continued growth it will need to do more to meet the demands to reduce its GHG emissions—EWR must become innovators. A good example for airport emissions mitigation is an airport in

Billund, Denmark,[8] which services commercial, private and cargo flights. The Billund Airport planted 12 hectares of willow on their fields, which suffices 10-15% of their energy needs for heating buildings and aircrafts when it is cold, and back into the Billund City grid, (Green Sustainable Airports, 2012). The facility's approach to emissions reduction is focused on airport innovation as well as community needs. (See figure 2 for a comparison between EWR and Billund Airport's sustainability approach). Relatedly, there have been many different approaches to the reduction of aircraft emissions and some may assert that EWR could accommodate smaller privatized aircrafts to encourage those who can afford it, which would limit the volume of larger aircrafts flying over the City of Newark. That is the prevailing privatization of air travel, where "additional developments are evident in the marketing of personal aero-mobility and contributing to the creation of new innovative niches" has partially offset the reduction in aviation emissions, but this has its downside (Cohen 2010).[9]

[8] European airports are often recognized for their innovative sustainable practices in emissions reduction.

[9] Given the scale of operations at EWR, "privatized" airplanes with smaller engines could replace commercial jetliners, which may reduce carbon emissions, but an overabundance of small planes could equal the GHG emissions of a fleet of jetliners (Cohen, 2010).

The Airline's Responsibility in Lowering Aircraft Emissions

Airlines are in the business of making money and are not necessarily invested in the aircraft emissions strategies because of the environmental impact of burning fuel, but rather for monetary gain. At the heart of the sustainability strategies in the opportunity for growth in aviation revenue, as airlines are more concerned with how much fuel can be saved during aircraft on-ground and in flight operations, which equates to millions saved per year, rather than how much pollution is emitted for jet engines that can cause health problems to the local neighboring communities of the city of Newark, and eventually the ozone. "Airlines will do anything to save fuel because fuel is a very big cost for them so when conditions are favorable," said Ed Knoesel "when they're taxing from the gates out to the runways they'll only use one engine and that saves a lot of fuel, and anytime you're saving fuel your lowering emissions."

If saving fuel equates to reducing emissions, how is this quantifiable? Since all GHG emissions trace back to the engines of an aircraft[10] the best possible response to this question is to discuss the type of fuel source the engine is burning, the environmental efficiency of the aircraft engine, and a comparison between the rate at which fuel is burnt during surface operations--taxiing, and during landing or takeoff. Aircraft activities[11] in and around the airport contribute to emission sources such as "carbon monoxide, sulfur oxides, particulate matter, nitrogen oxides, unburned hydrocarbons, hazardous air pollutants, and ozone," (Aviation and

[10] The FAA states that the magnitude of the impact of all pollutants from aircrafts, not including carbon dioxide that causes climate change is unknown. (see Aviation And The Environment: GAO-08-706T, 2008)

[11] "Aircraft accounts for about 70 to 80 percent of aviation emissions, producing emissions that mainly affect air quality below 3,000 feet and increases greenhouse gases at higher altitudes," (Aviation And The Environment: GAO-08-706T, 2008)

The Environment: GAO-08-706T, 2008). These sources of emissions are directly related to idle taxiing, and the airport and the airlines are keen on ensuring very little unnecessary taxiing on the surface, which causes delays, the possibility of flight cancellations, millions in fuel consumption, air pollution to surrounding communities, and eventually ozone depletion (Aviation And The Environment: GAO-08-706T, 2008), (also see Norton, 2014).[12] Moreover, "flight operations that occur on the local level are called the landing and takeoff cycle (LTO). The cycle begins once an aircraft reaches the mixing zone (3,000 ft.) upon its descent. The cycle continues as the aircraft lands, taxis to the gate, taxis back out for takeoff, and climbs out past the mixing zone during takeoff," (Norton, 2014). See Figure 2 for LTO pattern.

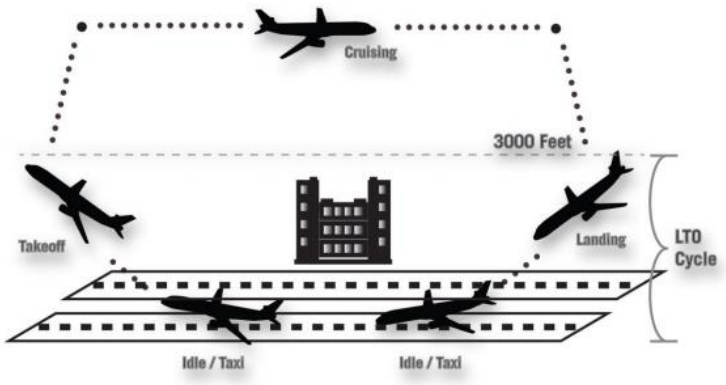

Figure 2. (Norton, 2014)

This report does not entail a rigorous formal numerical/scientific analysis of EWR emissions inventory for 2015-2016, partly because there are no public records as "GHG emissions inventories are not mandated by federal regulations," however, Figure 3, and Figure 4 clearly illustrates the finding of a scholarly study taken for EWR emissions inventory for calendar year 2008, (see Norton, 2014), (also see Figure 5 for FAA study).

[12] "FAA estimates that it will cost the industry about $14 billion to equip aircraft to take full advantage of NextGen," (Aviation And The Environment: GAO-08-706T, 2008)

Large Hub Total and Boeing 777-200/300 LTO Cycles			
Airport	LTO Cycles[1]	Boeing 777-200/300 LTOs	GHG Emissions (CO_2e)
LAX	275,771	5,030	634,424[a]
JFK	223,144	7,833	866,027[b]
EWR	218,180	5,335	588,366[c]
MSP	217,076	5	327,736[d]
SFO	200,403	4,219	495,239[c]
LGA	191,311	0	428,742[c]

1. Operational data based on TMFSC data from FAA databases

[a] Based on 2009 emissions inventories (LAX 2013)

[b] Based on 2011 emissions calculations completed in this study

[c] Based on 2008 emissions inventories (Peeters 2010)

[d] Based on 2009 emissions inventories (Metropolitan Airports Commission 2010)

Figure 3. (Norton, 2014)

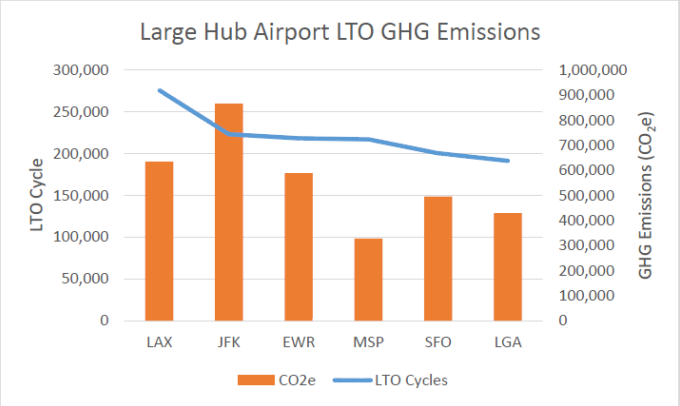

Figure 4. (Norton, 2014)

Given some of the benefits and drawbacks of aviation engines, what else are airlines doing to save on fuel to lower aircraft emissions? "Airlines are putting winglets on the tips of plane wings, those cost a million dollars to refit an airplane, but they pay for themselves because it reduces drag, and it saves fuel, and anytime you're saving fuel you're reduces emissions" said Mr. Knoesel. In addition, to refitting aircrafts to boost "operational efficiency" airlines are investing in newer aircrafts to upgrade their fleet but the airline industry faces financial strains to "upgrade their fleets to new, state-of-the-art aircrafts, such as the Boeing 787 and Airbus A38, which are […] more fuel efficient, and emit lower levels of greenhouse gases," (Aviation And The Environment: GAO-08-706T, 2008).[13] Relatedly, it is also a technological challenge to substantially reduce aviation carbon emissions without inadvertently causing higher nitrogen emissions:

> NASA's efforts to improve jet engine designs illustrate this challenge: While new designs have increased fuel efficiency, reduced most emissions, and lowered noise, they have not achieved comparable reduction in nitrogen oxide emissions.

[13] Boeing is one of the leading airlines in the aviation industry.

> Nitrogen oxide emissions have increased because new aircraft engines operate at higher temperature, producing more power with less fuel and lower carbon dioxide and carbon monoxide emissions, but also producing higher nitrogen oxide emissions, particularly during landings and takeoffs, when engine power settings are at their highest. It is during the landing/takeoff cycle that nitrogen oxide emissions also have the greatest impact on air quality.
>
> Aviation And The Environment: GAO-08-706T, 2008.

It is important to recognize that the strategies mentioned in this section will only partially offset the growth of CO_2 from aviation emissions,[14] but what does all this mean for Newark locals? What can the airline's at EWR do to improve air quality and reduce aviation emissions in urban areas like Newark. The best reasonable alternative right now is the NextGen initiatives which is spearheaded by the FAA; as opposed to other technologies like biofuels, which shows admirable promise but faces too many political and economic constraints to get airlines more proactive in aviation emissions reduction (Aviation And The Environment: GAO-08-706T, 2008, also see Gegg, 2014).[15] If NextGen is the solution, there will be a need for more expansion of airports infrastructure for optimal implementation, (Aviation And The Environment: GAO-08-706T, 2008). More comprehensive discussions will be allotted to the viability of biofuels and NextGen for aviation emission reduction in the coming sections.

[14] "Carbon dioxide is both the primary aircraft emissions and the primary contributor to climate change," (Aviation and the Environment: GAO-08-706T, 2008).

[15] In 2008 the European Union legislation (an independent European regulation for aviation GHG emissions), to force all airlines travelling in and out of Europe, to adopt their cap-and-trade-system that did not fall in line with ICAO standards was rejected by the American aviation industry because their aircrafts were "older, less fuel efficient fleets than their European competitors," (Aviation And The Environment: GAO-08-706T, 2008), (also see Richardson, 2012).

The Modernization of Aviation Technologies to Reduce Carbon Emissions

Advancements in technology have allowed the Port Authority to modernize ground-based activities. The ground-based management system, as previously discussed, is the top technique implemented at EWR to lower emissions. The PANYNJ has invested in a study of the amount of fuel being saved but have only limited their analysis to one airport, the John F. Kennedy Airport (JFK) in New York. "Specifically at JFK we're saving about 4.2 million gallons of fuel per year. We don't have the numbers for Newark," said Nate Kimball "but we expect that it is a relatively similar amount of fuel savings."

The Port Authority has identified that emissions from aircraft engines used during idle, taxi, and takeoff or landing account for the majority of aircraft emissions, therefore, gate power (previously discussed in section 1) over auxiliary power units, which powers critical systems such as the avionics in the cockpit, ventilation, and air-conditioning, are being pushed by the Port Authority to resolve these problem. Hence, all APUs are to be retrofitted with electric power hookups by the year 2022 (Management Plan, 2012). A criticism for this sustainable strategy, however, is that while aircrafts are not burning jet fuel when hooked up at the gates, the mechanical units used at the gates to supply an aircraft's with precondition are burning equal amounts of fuel for the aircraft's; unless all APUs convert to biofuels this sustainable program is a counterproductive measure, or a redundancy in the strategy.[16]

[16] NASA has dedicated a division for research and development to addressing aviation issues, and the study of future fuel efficient technologies that can be integrated into aviation systems. (Aviation And The Environment: GAO-08-706T, 2008)

The second biggest strategy implemented into the EWR airport aircraft emissions strategies is its Ground Based Augmentation System (GBAS), which is a partnership between PANYNJ and the Federal Aviation Administration (FAA) in a collaborative effort, as part of a national air traffic control system called the Next Generation Air Transportation System (NextGen), to save airlines millions in fuel, which will subsequently reduce carbon emission.[17] The GBAS "basically allows approaching aircrafts to follow a much more precise approach through the use of GPS [Global Positioning System], which cuts off distance that is needed to fly to the airport" said Nate Kimball, and "one of the major ways we're going to reduce some emissions for aircrafts in the future is through these more efficient NextGen flight paths." This is the intention for all airports nationwide; as the FAA has embarked on a national collaborative effort to make NextGen the future of a more efficient aircraft air traffic control.[18] In addition, NextGen is a new satellite surveillance technology that will inevitably make aircraft radar tracking obsolete by improving heavy aircraft separation requirements for more efficient airport aviation traffic. There is greater emphasis on the applicability of NextGen technologies at EWR to reduce aviation emissions for Newark locals in the next section.

Given the volatility of oil prices, the aviation industry is always looking for alternatives to save money on fuel, thus, PANYNJ and aviation industry believes money saved on fuel equates to emissions reduction, therefore, the honorable mention in this section is biofuels, which has emerged as one of the best alternative technologies for carbon based jet fuel. Typically,

[17] NextGen could reduce greenhouse gas emissions by 12% in 2025, and its related research and development on emissions reduction could further reduce aviation emissions impacts on areas surrounding airports. (also see Aviation And The Environment: GAO-08-706T, 2008)

[18] The future of NextGen will require the expansion of airports and runways, but growing public concerns about aviation emissions will hinder this necessary development of airport aviation infrastructure for NextGen initiatives. (Aviation And The Environment: GAO-08-706T, 2008)

biofuels "are any form of renewable energy that is derived from biomass," and is fast becoming an alternative technology for growing economic and environmental benefits for existing infrastructures, and in commercial aviation in North America (Gegg, 2014).[19] Ideally, the concept of biofuels requires that the net energy input in production must be less than the net energy throughput in manufacturing the fuel source. "Aviation biofuels involves either hydrotreating vegetable oils to make hydrotreated renewable (HEFA) fuels or performing gasification of biomass feedstock using the Fischer-Tropsch process (FT)" (Gegg, 2014).[20] In addition, The volatility of oil prices also makes airlines vulnerable and oftentimes forces airlines without deep pockets to either cancel flights or declare bankruptcy, which was the case in 2008 when the price of oil soared to US$147 a barrel. The challenge remains, however, in the sourcing of sustainable supplies of biofuels, which in part led to "short-term cooperation between airlines, airframe and engine manufacturers, airports, and biofuel suppliers."[21] These commercial partnerships have given way to trial commercial flight on biofuels. Moreover, "with the potential for 70-80% reduction in lifecycle GHG emissions in relation to conventional jet fuel" PANYNJ is now positioning itself for the possibility of transitioning to this new technology for both

[19] The overall carbon footprint of low-carbon fuels derived from biofuel sources "such as plant oils, algae, and biomass are safe as petroleum-based fuel, and compare favorably in terms of environmental impact," (Aviation And The Environment: GAO-08-706T, 2008).

[20] "Alternative fuels are not yet available in sufficient quantities for jet aircraft, as for some other uses, and therefore aviation cannot yet adopt this approach to reduce its greenhouse gas emissions" (Aviation And The Environment: GAO-08-706T, 2008).

[21] The push to make biofuels a standard for the airline industry is due, in part, to increase public and political pressures to address its environmental impacts, and to reduce carbon emissions. (Gegg, 2014)

economic and environmental benefits (PANYNJ for Newark Liberty International Airport Sustainability Report).[22]

> We did a project in 2013 where we did 25 flights with KLM, an airline from the Netherlands, where they flew from JFK to Amsterdam on biofuel, and it was a very successful trial, we think." What we're looking to do now is find another partner who will hopefully help us in some way permanently integrate biofuels into our fuel infrastructure, which some other airports are doing and we would definitely like to do. Aviation biofuels are a really interesting topic and one that we think is going to grow into something in the future that will help reduce emissions" (Nathaniel Kimball, personal interview, February 9, 2016).

These small but necessary steps to modernizing aviation technologies to reduce aviation emissions are destined to be meet with logistic and environmental challenges. The true reality of the issue behind modernizing aviation technologies is that aviation is still a far cry away from realizing viable renewable fuel sources as emission reduction technologies are still in its infancy, and the added pressures to stay in compliance with environmental regulations make it difficult to address growing concerns about airport facilities and the airlines adding too, rather than, reduce GHG emissions.[23] See section 2 for further discussion.

[22] "KLM operated one of the first revenue biofuel flights in July 2011, when it flew 171 passengers from Amsterdam to Paris in a Boeing 737 part-powered by biofuel derived from waste cooking oil" (Gegg, 2014).

[23] The EPA has yet to implement regulations of GHG for aviation under the CAA, instead they follow the standards set by the ICAO. (see Richardson, 2012)

Aircraft Emissions and Newark Residents

Newark is home to a network of aviation, seaport, rail, and transportation infrastructure, but the quality of life of Newark residents and commuters are as dependent upon this machine for living—the City of Newark, as it is upon the environmental impact of its infrastructure. The byproduct of Newark's bustling infrastructure is a steady growth in GHG emissions from local and industrial organizations such as PANYNJ. In an attempt to offset its airport's emissions, the Port Authority rolled out its Newark Liberty National Sustainability Management Plan, in a collaborative effort to reduce 80% GHG emissions from its facilities daily activities.[24] Since the inception of the sustainability strategies and projects outlined in the management plan results for the sustainability initiative in the near future have been static; as there is still much room for improvement. Proof of improved air quality, and transparency of the strategies implemented, in regards to sharing empirical data/results of GHG emissions between EWR and Newark residents is limited. Nevertheless, all aircraft emissions can be traced back to their engines and new technologies in engine design make it possible to achieve more carbon emissions reduction, but the same cannot be said for "levels of reduction in nitrogen oxide, which contribute to ozone formation"(Aviation And The Environment: GAO-08-706T, 2008).[25]

Newark residents remain relatively unaware of the possible health risk of aircraft emissions, and uninformed of the dire environmental impacts. The growing public concerns over

[24] "Aviation emissions represent less than 1 percent of air pollution nationwide, but their impact on air quality could be higher in the vicinity of airports,"(Aviation And The Environment: GAO-08-706T, 2008)(also see Richardson, 2012).

[25] According to the Intergovernmental Panel on Climate Change (IPCC), it is estimated that aircraft emissions will grow by 3% each year, at a more accelerated rate that emissions reduction due to "technological improvements," (Aviation And The Environment: GAO-08-706T, 2008).

air quality is mostly generated towards on-road ground transportation, and the aviation industry is quickly being called out on its contribution to the environmental impact of GHG emissions due to aviation activities near local communities.[26] Mr. Robert Belzer, director of the NJCAAN, "noticed that over the last fifteen years aircraft engines have gotten quitter due to advancement" in aviation technology, but while aviation equipment improve to mitigate noise the aircrafts are getting larger, which equates to higher volume of carbon emissions.[27] "The actual noise volume went down, but the passenger count went up primarily because the aircrafts got larger," adds Mr. Belzer, "which will generate more emissions."

The lack of transparency between the PANYNJ and the community is cause for concern, as the environmental impact of the airports and its airlines are relatively unavailable to the public, rather, non-existent due to being "too busy," according to Mr. Knoesel. There is little discussion of the airport's emissions reduction strategies in local news, and even less talk of health problems caused by air pollution from EWR. From a marketing platform the lack of transparency reflects poorly on PANYNJ credibility of any reduce emissions at EWR that has been published in their 2014 sustainability report. It is evident that if it is something as logical as encouraging less idle taxiing on the surface, and something feasible to do as providing gate power to reduce the need for aircrafts to use their APU's, then PANYNJ is seemingly very proactive in cutting emissions. That is if they have the technology to effectively reduce their carbon emissions they will certainly adopt it to uphold their environmental responsibilities. It is important to recognize, however, that PANYNJ does not generally exhibit poor stewardship;

[26] Ozone is a byproduct of nitrogen oxide from aircraft engines and "even short-term exposure to ozone is likely to contribute to permanent death of people with asthma, heart disease, and other preexisting conditions," (Aviation and the Environment: GAO-08-706T, 2008).

[27] The NJCAAN is primarily focused on the noise footprint of the aircrafts flying in and out of EWR, and the low altitude of aircrafts over Newark while inbound or in transit.

rather the underlined issue revolves around the "enormous amount of demand for use at the area facilities, and basically what they're up to is trying to drive more volume through the facilities and with that as their end game emissions are effectively going up," says Mr. Belzer. Moreover, the level of transparency between PANYNJ and Newark residents is non-existent at best. In a stern cretic of airport operations, according to Mr. Belzer on the issue of transparency, the PANYNJ is suspected of intentionally withholding basic calculations of the airport emissions inventory. This assertion suggests that an increased in airport capacity for ridership and commercial business at EWR will result in an increase of emissions; as the likelihood of efficiently reducing emissions is significantly diminished if there are no innovative initiatives set in place by PANYNJ to sustainably offset the inevitable increase in carbon emissions and GHG emission due to expansion of infrastructure at EWR.

> It's my opinion that it's deliberate," adds Mr. Belzer, "that they know that the emissions are going up, so why ask for trouble. I think they are fully aware of what they're doing, and less is good. It's an issue where the less transparency you provide, or any kind of transparency, is asking for increased scrutiny. At the end of the day my view is that fares are going to remain high at the airport, you'll get more aircrafts coming through the airport without a dough, but there will be continued excessive delays. (Robert Belzer, personal interview, April 15, 2016)

In 2001, the state of New Jersey issued legislation to "conduct a study of air pollution in and around certain airports and military bases," (State of New Jersey, 2001). The Newark Liberty International Airport proved to be wanting for improvements to its infrastructure emissions reduction capability, and a "bubble" was place around the airport and nearby air polluted areas in Newark. In addition, California was found to be "the only state with a higher air

quality problem than New Jersey," and the "bubbly methodology," which regulated the levels of emissions from each source, was modeled from the California South Coast Air Quality Management Plan, (State of New Jersey, 2001).

On April 6, 2016 the FAA published a study on their analysis which reviled that the noise footprint and emissions will increase at EWR, which Mr. Belzer believes was unintentional due to the negative emissions projection supported by the study. It indicates that EWR is transitioning from a level 2 Facility to a level 3 Facility. See Figure 5. It is not clear how much operations was modeled in to the study but the data serves as hard evidence from the FAA that the increased capacity and higher volume aircraft traffic has resulted in a rising levels of emissions. The actions of PANYNJ reflect its response to the aviation industry growth; as EWR becomes inundated with higher volume of aircrafts, PANYNJ must keep up with the huge demand for increased capacity from the growing aviation industry. With the hopes of formally getting PANYNJ to act prudently towards noise and emissions mitigation, NJCAAN will present its assessment of the recent study published by the

Level 2 DNL Exposure Newark Airport

DNL (DBA)	2017 Sq. Miles	2022 Sq. Miles	Increase
65	5.6	6.5	16.1%
60	14.4	16.6	15.3%
55	37.4	43.0	15.0%
50	97.8	112.0	14.5%
45	258.2	294.4	14.0%

Source: FAA; NCAAN Analysis.

Level 3 DNL Exposure For Newark Airport

DNL (DBA)	2017 Sq. Miles	2022 Sq. Miles	Increase
65	6.2	7.1	14.5%
60	16.0	18.4	15.0%
55	41.6	47.9	15.1%
50	109.2	125.6	15.0%
45	289.4	332.2	14.8%

Source: FAA; NCAAN Analysis.

Level 2 Emissions Inventory For Newark Airport

Criteria Pollutant *	2017	2022	Increase
CO	2,586.2	3,028.7	17.1%
VOC	421.8	440.2	4.4%
NOx	2,554.6	2,880.7	12.8%
SOx	272.1	316.2	16.2%
PM 2.5	24.3	27.0	11.1%
CO2	664,494	772,037	16.2%
Fuel Burn	210,616	244,703	16.2%

* In metric tons per year

Source: FAA; NCAAN Analysis.

Level 3 Emissions Inventory For Newark Airport

Criteria Pollutant *	2017	2022	Increase
CO	2,540.5	2,961.7	16.6%
VOC	415.8	432.4	4.0%
NOx	2,499.8	2,802.1	12.1%
SOx	266.3	307.9	15.6%
PM 2.5	23.9	26.4	10.5%
CO2	650,281	751,838	15.6%
Fuel Burn	206,111	238,301	15.6%

* In metric tons per year

Source: FAA; NCAAN Analysis.

Figure 5

FAA at the next round table meeting.[28] "I think that they're going to have problems," asserts Mr. Belzer, "we have enough information to demand some mitigation out of them, but it remains to be seen, all this stuff is an enormous battle when you're dealing with an agency like the Port Authority." He believes that the only way PANYNJ will work harder to mitigate noise and emissions is by garnering some political support to pressure PANYNJ into acting more aggressively to sustainably address the issues by implementing a formal program. The implementation of the airport bubble concept is such a program that is outlined in the NJCAAN mission statement which Mr. Belzer claims that EWR has yet to employ, and has been "ignored" by PANYNJ.

NextGen, as previously discussed, is a host of advanced technologies that aim to revolutionize air traffic control.[29] One technology from the NextGen initiatives is the Automatic Dependent Surveillance-Broadcast (ADS-B) satellite aircraft navigation system, "which allows closer and safer separation between aircrafts and more direct routing that will improve fuel efficiency and reduce […] exposure to aviation emissions" for

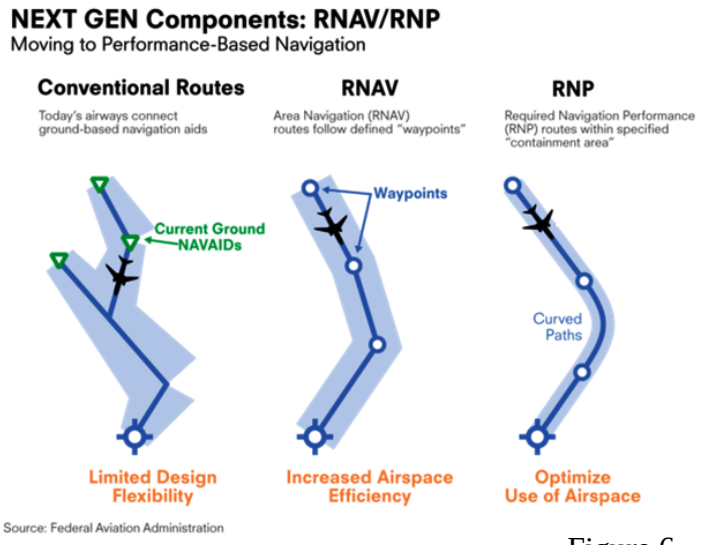

Figure 6

[28] According to Mr. Belzer, in 2015 New York Governor Anthony Como mandated that LaGuardia and JFK must participate in the part 150 study and join the round table discussions on noise and emissions in and around the area of the airports. The FAA indicated to the PANYNJ that they had to include New Jersey airports that they operated.

[29] "According to the FAA, the full implementation of NextGen could reduce greenhouse gas emissions from aircrafts by up to 12% by 2025" (Aviation and the Environment: GAO-08-706T, 2008).

Newark locals, (Aviation And The Environment: GAO-08-706T, 2008, emphasis added). Another facet of the NextGen initiative that could reduce aircraft emissions is Continuous Descent Arrivals (CDA)—a system in which aircrafts are kept at higher cruise altitudes as they approach the airport and "descend at near idle power till touchdown," (Aviation And The Environment: GAO-08-706T, 2008). See figure 5 for illustration. It is important to note however, that jet fuel burning in descent is less than fuel burning during takeoff from the runway. (See section 2 for discussion on aircraft takeoff). Relatedly, there are other NextGen initiatives that can reduce aviation emissions in urban cities like Newark. The first is Required Navigation Performance (RNP), which allows the pilot to descend on a precise route that will allow the airplane to avoid populated areas.[30] See figure 6 for illustration. The second related initiatives is Area Navigation (RNAV), which "compute an airplane's position, actual track and ground speed, and then provide meaningful information on the route of flight selected by the pilot,"(Aviation And The Environment: GAO-08-706T, 2008).[31]

The future of Newark's air quality is in the balance and PANYNJ must move from a state of reacting to negative environmental impact of airport and aviation activities to a state of innovation and exceed EPA standards. A key facet to this criticism is the necessity to work closer with local environmentalists and local organizations such as NJCAAN on issues that affect the health and wellbeing of Newark communities. Much can be learnt from European airports that had employed integrated sustainability strategies to serve both the airports and their cities. The Billund Airport in Denmark, for example, is an excellent case study of how

[30] Aviation operations in and around EWR emit nitrogen oxide which causes "ground-level ozone (also known as smog)," (Aviation and the Environment: GAO-08-706T, 2008).

[31] Given its scale of operations EWR would be a prime candidate ADS-B, CDA and RNAV or RNP procedures, with sequential implementation the showcase the capabilities of NextGen aviation technologies.

innovation and transparency can be achieved, (see discussion on Billund Airport is section 1). Moreover, the Port Authority must move towards selling sustainability to improve its marketability, as opposed to perpetuating the idea that it is only through convenient ground-based operations and fuel-saving strategies can significant emissions reduction be achieved. In other words, from a sustainability frame of reference, if there is greater transparency between Newark communities and PANYNJ, coupled with clear preventative measures on emissions reduction in the near future, then there may be room for economic growth and airport infrastructure expansion.

Conclusion

Aviation emission strategies at Newark Liberty International Airport are implemented to save airlines millions in fuel, which is expected to subsequent reduce emissions an improve the air quality in Newark. It is important to recognize the fundamental premise of the sustainability initiatives employed by PANYNJ is to reduce fuel burning by aircrafts while operational; not entirely to reduce emissions. The airlines are not necessarily concerned with the environmental impact of saving fuel, but from a marketing platform PANYNJ and airlines that use its facilities like EWR recognize that sustainability sells, rather, more aggressive and innovative sustainability strategies will allow for expansion. The take-away from this discussion is airlines are billion-dollar industries and they are in the business of making money, and any subsequent reduction in carbon emissions is a by-product of these aviation-emission strategies. In addition, aviation-emissions reduction is still in its infancy, and PANYNJ recognizes that these strategies work together for several objectives. The first is from a marketing platform—that they are not just acting in compliance with the environmental standards from the ICAO, or the state of New Jersey, but they have an obligation to employ counter measures that will mitigate CO_2 emissions. The second objective is the race toward a viable sustainable fuel source, but the notion that these new technologies are the best they can do is ill-advised. That is the PANYNJ need to do more than adapt to economic, political pressures; they need to need to become innovator if they wish to see accelerated increase in revenue, but more importantly they need to reevaluate their weak stance on sustainability with more ambitious goals towards reducing their carbon footprint.

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