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Airports and the General Conformity Process

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Executive summary

Air quality conformity refers to the process wherein federally supported plans, programs and projects are shown to meet the air quality requirements of the Clean Air Act Amendments (CAAA) and the applicable State Implementation Plan (SIP). Transportation conformity refers to actions approved or funded by the Federal Highway Administration or the Federal Transit Administration. General conformity refers to projects approved or funded by other federal agencies. Airport projects are usually subject to general conformity rules.

The Clean Air Act of 1970 set limits (National Ambient Air Quality Standards NAAQS) on the concentrations of six criteria air pollutants. The pollutants related to air transportation are:

- carbon monoxide (CO),
- particulate matter (PM_{10} and $PM_{2.5}$),
- nitrogen dioxide (NO_2),
- sulfur dioxide (SO_2),
- lead (Pb),
- ground level ozone (O_3).

If a geographical area does not achieve the limits (nonattainment area), it is required to act to decrease emissions below the NAAQS, and they must outline their plan to do so in the SIP. General conformity rule states that federally funded projects must conform to the SIP for achieving and maintaining the NAAQS, otherwise funding is stopped. Activities can be exempt from the general conformity rules based on several reasons, for example if they are grandfathered by the general conformity rules, if they are presumed to conform, or if the emissions are below “de minimis” threshold levels established by the EPA.

After it has been determined that a conformity analysis is necessary for a particular airport project, the emissions from that project will be predicted based on emissions modeling procedures. This is done using the Emissions and Dispersion Modeling System (EDMS), a software package designed by the FAA to model air quality at civilian airports and military bases. EDMS calculates the emissions from different sources and then models dispersion of these emissions within the vicinity of the airport.

Certain problems and concerns have arisen with EDMS concerning its accuracy and reliability.

In conformity analysis, both direct and indirect project emissions must be addressed. Indirect emissions occur at the same time and place as the action. Indirect emissions may occur later in time and/or away from the action itself but are still reasonably foreseeable. The sources of emissions at an airport are:

- Aircraft
  The significant emissions from aiurcraft engines are hydrocarbons, CO and NO_x. The types and amounts of emissions vary by different aircraft operations. The operations that are included in modeling are approach, taxi/idle, takeoff and climb out. Delays and congestion at airports have a strong influence on emissions from aircraft.

- Ground service equipment (GSE) and auxiliary power units (APU)
  Ground support equipment is used e.g. to load/unload the baggage and food carts, refuel, push the aircraft from the gate and tow it to the taxiway. Layout of the airport and the type of fuel used affect greatly to the emissions from GSE. Auxiliary Power Units (APU) are on-board engines (burning jet fuel) that supply power to aircraft while its engines are shut down.

- Ground Transportation
  Vehicles of employees and visitors, ground transportation providers, and the transportation of people and goods between airport facilities produce emissions. The significant emissions caused by on-road vehicles are carbon monoxide and volatile organic compounds.

- Other sources operating on the airport surface or in nearby vicinity, for example power plants and training fires.

After modeling the emissions it can be determined whether the emissions exceed the permitted limits or not. If the exceeding emissions are not budgeted in the SIP, then the project has to achieve conformity in three possible ways. The first one is to purchase emissions offsets of selected pollutants so there is no net increase in emissions within the Air Quality Management District. The second one is to use mitigation measures. These are reductions in the project's emissions below the de minimis levels. For example, using alternately fueled ground service vehicles can offset increased aircraft emissions. The third way to show conformity is to modify the SIP. To do this it is required that the current SIP is being implemented, all mitigation measures are being implemented, and that the emissions decrease will occur before the associated increase resulting from the project.

The general conformity process has provoked several contradictory views. It has been argued if it is a meaningful process to achieve air quality objectives. Airports see the conformity process as a burden to their development. Also, potential flaws have been said to exist in the execution of the process. The research opportunities in this field are numerous.

1. Introduction

As the demand for air transportation increases, airports must grow accordingly. As a result, the air quality impact of airports is coming under scrutiny by citizens, environmental and regulatory agencies, and the Federal Aviation Administration. Airports are complex emissions generators, with emissions generated by aircraft, ground service equipment (GSE), on-road mobile vehicles and many other sources. Many of these sources are not under the direct control of the airport, such as air carriers and ground transportation. The difficulties of regulating airport emissions reflect this complexity.

The U.S. EPA general conformity rule, promulgated in 1993, attempts to regulate the air quality impact of federal projects, including airports. The premise is that the government will not support any project to the detriment of the air quality in a region where air quality is problematic. In the case of an airport expansion project, the air quality impact is difficult to quantify and control. An airport expansion project could cause major construction, changes in ground access traffic, aircraft delays, and aircraft activities. The conformity process requires a quantification of the emissions impacts of these changes, yet many of the emissions are difficult to quantify.

This paper explores the intricacies of the general conformity rule and its limitations. Airport emissions sources are explored, along with measures to reduce emissions from each source.

2. The General Conformity Rule

U.S. EPA General Conformity Rule

National Ambient Air Quality Standards and the Clean Air Act

The Clean Air Act of 1970 set limits on the concentrations of six criteria air pollutants in the United States. Geographical areas are designated as attainment, nonattainment, and maintenance for each criteria pollutant in the National Ambient Air Quality Standards (NAAQS). Attainment areas have emissions concentrations that do not exceed the NAAQS. Nonattainment areas (NAAs) do not achieve the NAAQS for one or more pollutants and maintenance areas have been redesignated to attainment for specific pollutants. NAAs can be classified as serious, severe or extreme, depending on the number of NAAQS violations. All NAAs are required to act to decrease emissions below the NAAQS, and they must outline their plan to do so in a State Implementation Plan (SIP). A SIP is required for each of the criteria pollutants for which the NAAQS are exceeded. The NAAQS are outlined in Table 1.

Of the nation's fifty busiest airports, thirty are located in ozone nonattainment areas. Three of these are located in the most severe nonattainment area, the Los Angeles-South Coast Air Basin. It is estimated that the achievement of the NAAQS in the South Coast would avert 2700 deaths, eliminated 24 million "reduced activity days", prevent 122 million headaches, stop 202 million sore throats, and generate $14.3 billion in economic benefits each year.[1] A high level of pollutants around airports also poses an occupational hazard to airport employees.

Table 1: National Ambient Air Quality Standards

POLLUTANT	STANDARD VALUE (concentration)		STANDARD TYPE***
Carbon Monoxide (CO)			
8-hour Average	9 ppm	(10 mg/m^3)**	Primary
1-hour Average	35 ppm	(40 mg/m^3)**	Primary
Nitrogen Dioxide (NO_2)			
Annual Arithmetic Mean	0.053 ppm	(100 µg/m^3)**	Primary & Secondary
Ozone (O_3)			
1-hour Average*	0.12 ppm	(235 µg/m^3)**	Primary & Secondary
8-hour Average	0.08 ppm	(157 µg/m^3)**	Primary & Secondary
Lead (Pb)			
Quarterly Average		1.5 µg/m^3	Primary & Secondary
Particulate < 10 micrometers (PM-10)			
Annual Arithmetic Mean		50 µg/m^3	Primary & Secondary
24-hour Average		150 µg/m^3	Primary & Secondary
Particulate < 2.5 micrometers (PM-2.5)			
Annual Arithmetic Mean		15 µg/m^3	Primary & Secondary
24-hour Average		65 µg/m^3	Primary & Secondary
Sulfur Dioxide (SO_2)			
Annual Arithmetic Mean	0.03 ppm	(80 µg/m^3)**	Primary
24-hour Average	0.14 ppm	(365 µg/m^3)**	Primary
3-hour Average	0.50 ppm	(1300 µg/m^3)**	Secondary

SOURCE: U.S. EPA

* The ozone 1-hour standard applies only to areas that were designated nonattainment when the ozone 8-hour standard was adopted in July 1997. This provision allows a smooth, legal, and practical transition to the 8-hour standard.

** Parenthetical value is an approximately equivalent concentration.

****Primary standards* set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. *Secondary standards* set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

SOURCE: US EPA, “National Ambient Air Quality Standards (NAAQS)” (http://www.epa.gov/airs/criteria.html)

State Implementation Plans

State Implementation Plans (SIPs) serve three purposes. The first is to assess the nature of air quality within a jurisdiction. The second purpose is to determine the air quality improvements needed to maintain the NAAQS. The final purpose is to assign air pollution control responsibilities to a wide variety of sources in state.

In many states, such as California, the SIP is a collection of multiple local air quality management plans, established by Air Quality Management Districts (AQMDs) and counties. The SIP must outline a plan for achieving the NAAQS before an attainment year, determined by the current severity of the NAAQS violations. The SIP must take into account all growth in emissions from the baseline year until the attainment year. Aircraft and airport related emissions (such as ground service vehicles and surface vehicle traffic) may be contained in several categories of the SIP emissions budget or else may be under a general airport line, depending on the AQMD. Most SIPs include airport sources in multiple categories.

Many areas have SIPs that are outdated, inaccurate, or pending approval. The process of developing a SIP and getting it approved by the EPS is lengthy. The SIP must be developed by the local AQMD, submitted to and approved by the state EPA, and then submitted and approved by the U.S. EPA. As a result, the most recent approved SIP in an AQMD may be several years old. However, it is this SIP that must be used for comparison in a conformity analysis, even if a major revision is nearing final approval.

Goals of General Conformity

To ensure that federal actions do not interfere with a region achieving the NAAQS, the Environmental Protection Agency (EPA) created the **general conformity** rule. Essentially, the general conformity rule states that federally funded projects must conform to the SIP. Effective November 30,1993,

> "A Federal action must not adversely affect the timely attainment and maintenance of national air quality standards or emission reduction progress plans, cause or contribute to any new violations of an air quality standard, increase the frequency or severity of any existing violation, or delay the 'timely

attainment' of any standard or required interim emission reductions or milestones in any applicable area".[2]

General conformity applies to all federal projects and actions in NAAQS nonattainment and maintenance areas, with the exception of FHWA and FTA projects which are covered under **transportation conformity** (40 CFR part 51, subpart-T, see Appendix A). Transportation conformity requires that the Transportation Implementation Plan (TIP) for a region conform to the SIP. Airport projects utilizing federal grant funds, passenger facility charges to construct a project, or necessitating approval of an Airport Layout Plan (ALP) are subject to general conformity rules.

The general conformity rule had to be adopted by each state and air quality agency as a revision to the SIP before November 30, 1994. The general conformity rules adopted within a state may be stricter than the federal rule only if it applies equally to federal and non-federal activities.

Emissions Budgets

The airport emissions budget in a SIP is established by and for each AQMD or county. For example, in Sacramento, the emissions budget for the airport was developed by the local air district and utilized a growth factor of 4-5%. Sacramento airport did assure that enough emissions were budgeted to allow the airport to operate within the budget for a few more years, but beyond that, the SIP will have to be revised or the airport will have to find a way to decrease emissions.[3] Sacramento airport has had the benefit of a few military air base closures, giving the airport more room for emissions in the SIP. As the airport plans to expand, it would like to increase its emissions budget in the SIP, but there are no other sources with extra emissions to "borrow" from.

The challenges of establishing emissions budgets for airports are unlike other sources in the SIP. Airport emissions budgets must include emissions from aircraft, ground service vehicles, on-road mobile sources, and many other sources. Mobile sources move from region to region and pollute differently based on myriad factors. A solution to the challenge of accounting for the mobile sources that visit an airport would be to count all on-road vehicle traffic emissions in the TIP, including the segments of the trip contained in airport property. This would reduce redundancy and increase the simplicity of budgeting. Unlike airport emissions sources, stationary sources must go through permitting, so they are better accounted for in the SIP. Also, as the label implies, these sources are not moving.

According to Section 182 of the Clean Air Act, it is possible to get "emissions credits" for actions to reduce emissions beyond what is accounted for in the SIP. Jim Humphries, air quality coordinator at the Sacramento Airport, found that so much in the way of emissions reductions was written into law already that it is difficult to find additional measures that go above and beyond. The emissions credits are the product of state-developed Economic Incentive Programs (EIPs), which offer limited economic incentives to reduce emission beyond regulatory requirements. With sufficient funding, EIPs can facilitate and accelerate emissions reductions at airports, especially among airlines and tenants.

Application of the General Conformity Rule

Exempt Projects/Actions

The first step of the general conformity rule is determining if it is applicable to the federal action. Activities exempt from the general conformity rules are those that are exempt, presumed to conform, or associated with emissions below "de minimis" threshold levels (tons per year) established by the EPA.[4] Only one of these conditions must be satisfied to be exempt. These five scenarios are outlined in the following table and described in greater detail below.

Table 2: Exempt Projects and Actions

Conformity is not required of federal actions that are one of the following:
1. grandfathered by the general conformity rules,
2. exempted by the general conformity rules,
3. "presumed to conform" by the responsible federal agency,
4. "de minimis" in terms of the emissions caused,
5. already subject to transportation conformity.

1. There is a grandfather clause exempting projects that have completed or begun National Environmental Protection Act (NEPA) environmental analysis before January 31, 1994. Also exempt are projects where sufficient environmental analysis was completed to determine conformity before March 15, 1994 or else a written conformity determination was made before the same date.[5]

2. Projects that are not grandfathered may still be exempt for any of several reasons. These include: conducting or carrying out a program that has already been established to be conforming, such as prescribed burning actions which are consistent with a conforming land management plan; including new of modified stationary sources that require a permit under the New Source Review program; responding to emergencies or natural disasters; involving research, demonstrations or training; and responding to environmental rules and regulations.

3. Certain federal actions that would produce a negligible amount of emissions, or whose emissions impacts are not reasonably foreseeable are presumed to conform without further analysis. The former include judicial, legislative, and law enforcement activities, permit renewals for continuing activities, rulemaking and policy development, administrative actions, routine maintenance and transport activities, banking activities, prescribed burning, actions related to foreign affairs, and actions related to the management and disposition of federal property and relocation of personnel. The latter include oil leases on the Outer Continental Shelf and electric power marketing activities.

4. "De minimis" thresholds determine the emissions quantities below which a conformity determination is unnecessary. The limits are based on the total of direct and indirect emissions caused by the federal action. Thresholds exist in nonattainment areas for ozone precursors (hydrocarbons and oxides of nitrogen (NO_x), small particulates (PM-10), carbon monoxide, sulfur dioxide and lead. The de minimis thresholds vary by the air quality classification of each area or region. If the de minimis levels are exceeded in the analysis, a conformity determination may be necessary.[6] If the total falls below de minimis levels but the action is considered regionally significant (contributing greater than ten percent of a nonattainment area's emissions for a specific pollutant), then a conformity determination is required.

   Tables 3 and 4 list the de minimis thresholds for nonattainment and maintenance areas for each criteria pollutant. Projects with estimated emissions that exceed these limits are not exempt from a general conformity determination.

Table 3: De Minimis Thresholds for Nonattainment Areas:

Pollutant	**Tons/Year**
Ozone (VOC or NO_x)	
Serious NAAs	50
Severe NAAs	25
Extreme NAAs	10
Other ozone NAAs outside an ozone transport region	100
Marginal and moderate NAAs inside an ozone transport region	
VOC	50
NO_x	100
Carbon monoxide	
All NAAs	100
SO_2 or NO_2	
All NAAs	100
PM10	
Moderate NAAs	100
Serious NAAs	70
Pb	
All NAAs	25

Table 4: De Minimis Thresholds for Maintenance Areas:

Pollutant	**Tons/Year**
Ozone (NO_x), SO_2 or NO_2	
All maintenance areas	100
Ozone (VOC)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
Carbon monoxide	
All maintenance areas	100
PM10	

All maintenance areas	100
Pb (lead)	
All maintenance areas	25

SOURCE: U.S. EPA

5. Projects or emissions that are already accounted for in the transportation conformity process (see Appendix A) are exempt from the general conformity process. Issues that airports face in delineating between the two are discussed later.

General Conformity Analysis

Indirect/Direct Sources

In conformity analysis, both direct and indirect project emissions must be addressed. According to 40 CFR Part 51, **direct emissions** means “those emissions of a criteria pollutant or its precursors that are caused or initiated by the federal action and occur at the same time and place as the action”. **Indirect emissions** are “those emissions of a criteria pollutant or its precursors that (1) are caused by the federal action but may occur later in time and/or may be further removed in distance from the action itself but are still reasonably foreseeable; and (2) the federal agency can practicably control and will maintain control over due to a continuing program responsibility of the federal agency.

In the case of an airport expansion project, direct emissions would include increased aircraft emissions and construction emissions while indirect emissions would include vehicular traffic frequenting the airport. The exact definition of “control” in the context of indirect emissions is unclear. In the case of an airport project, air traffic displaced to another airport could be considered out of the control of the federal agency.

Conformity analysis must reflect emissions scenarios that are expected (1) during the attainment year mandate by the Clean Air Act, (2) during the year for which the total emissions from the action are expected to be the greatest and (3) during any year with a specific emissions budget. The year with the greatest emissions is the benchmark most commonly used. The analysis must use the latest and most accurate planning assumptions and emission estimation techniques available. Software and methods used to calculate emissions are described later in the paper.

<u>Emissions Modeling Requirements</u>

Emissions modeling requirements vary by criteria pollutant. Ozone and nitrogen dioxide require an area-wide analysis while lead and sulfur dioxide are assessed on a local basis. An area-wide analysis implies measuring the dispersion of the pollutant across the entire air basin. A local basis means modeling the concentrations of the pollutant just in the vicinity of the airport. Small particulates and carbon monoxide require a local and possibly area-wide analysis depending on their interaction with the local air. Table 5 outlines the modeling requirements for each criteria pollutant.

Table 5: General Conformity Emissions Modeling Options

Option for showing conformity	Type of emissions modeling required				
	Area-wide only		Local and possibly area-wide		Local only
	O_3	NO_2	PM-10	CO	Pb/SO_2
(1) Specified in attainment or maintenance demonstration	X	X	X	X	X
(2) Offsets within same nonattainment/maintenance area	X	X			
(3) Area-wide and local modeling			X	X	X
(4)(i) Local modeling only if local problem			X	X	
(4)(ii) Area-wide modeling only or meet (5)			X	X	
(5)(i) Emissions budget	X	X	*	*	
(5)(ii) Transportation plan	X	X	*	*	
(5)(iii) Offsets	X	X	*	*	
(5)(iv) Baseline/No increase	X	X	*	*	
(5)(v) Water project	X	X			

X = option to show conformity, * = option if area-wide problem
SOURCE: 40 CFR Section 51.858(a)

The conformity analysis excludes stationary source emissions covered by the New Source Review (NSR). New Source Review is an EPA permit process for new or modified stationary emissions sources such as waste burning or solvent use. Permits for new or modified major sources (emissions greater than the NSR threshold) located in attainment or unclassifiable areas are called Prevention of Significant Deterioration (PSD) permits. Permits for sources located in nonattainment areas are called

Nonattainment Area NSR permits. The permit requirements are different for the PSD and Nonattainment Area permits.

General Conformity Determination

A simple flowchart of the conformity process for an airport expansion project is shown in Figure 1. There are three ways for a project to show that it conforms to the SIP. They are emissions offsets, mitigation, and SIP revision.

Emissions Offsets

If a federal project's emissions are expected to exceed the budget outlined in the SIP, there are three options to achieve conformity. The first is to use emissions offsets so there is no net increase in emissions within the AQMD. 40 CRF Part 51 defines emissions offsets as "emissions reductions which are quantifiable, consistent with the applicable SIP attainment and reasonable further progress demonstrations, surplus to reductions required by, and credited to, other applicable SIP provisions, enforceable at both the state and federal levels, and permanent within the timeframe specified by the program."

The federal agency may work with the AQMD to purchase emissions offsets of selected pollutants. Currently, offsets can be purchased for ozone precursors and NO_x, but not for CO and PM. Offsets must be quantifiable, consistent with the SIP, within the same air district, enforceable, permanent and simultaneous to the emission increases. However, if an offset it used, *it must offset emissions to zero, not just de minimis levels*.[7] A project which exceeds de minimis thresholds by one ton/year wishing to use offsets would be required to offset *all* project emissions, not just the one ton in excess.

Mitigation

Mitigation measures, a second method used to show conformity, are decreases in emissions related to the project itself that reduce the project emissions below de minimis levels.[8] An example of this is to use alternately fueled ground service vehicles to offset increased aircraft activities. In contrast to offsets, mitigation measures are directly related to and simultaneous to the project. Mitigation measures can not just be vague plans or goals for the future. Offset and mitigation measures must be solid commitments, adhering to a timetable, and enforceable by the local AQMD or EPA by a rule or regulation. Mitigation strategies for various airport emissions sources are described in detail further on.

SIP Revision

Another way to achieve conformity is to modify the SIP. Implementing a SIP revision to demonstrate conformity has not yet occurred in California but has occurred in other states. A SIP revision takes the form of a written commitment from the state to the EPA to revise the SIP. This requires that the current SIP is being implemented, all mitigation measures (described below) are being implemented, and that the emissions decrease will occur before the associated increase resulting from the federal action.[9] Unfortunately, the revision of a SIP to accommodate airport emissions would require decreasing the emissions budget for another source, a difficult task.

If no SIP approved since 1990 exists for the area, a baseline comparison or build/no-build analysis is done to determine conformity. Baseline emissions reflect historic activity levels and future year scenarios are developed for critical years in the attainment process.

Airport projects have been able to demonstrate that a conformity determination is not necessary because the project emissions are already accounted for in the SIP, including the construction emissions (mostly PM-10). The airport may claim that it is only accommodating expected growth, already accounted for in the SIP. If a new runway is being constructed, and the capacity of the airport is being increased, this argument may not hold and conformity determination may be needed.[10]

In the Bay Area, San Jose International Airport has recently demonstrated that its expansion produced emissions below de minimis levels, Oakland International Airport will be producing environmental documents in the next year, and San Francisco International Airport is still in the planning phases of its runway expansion. It is anticipated that SFO will require a conformity analysis and determination for approval of the project.

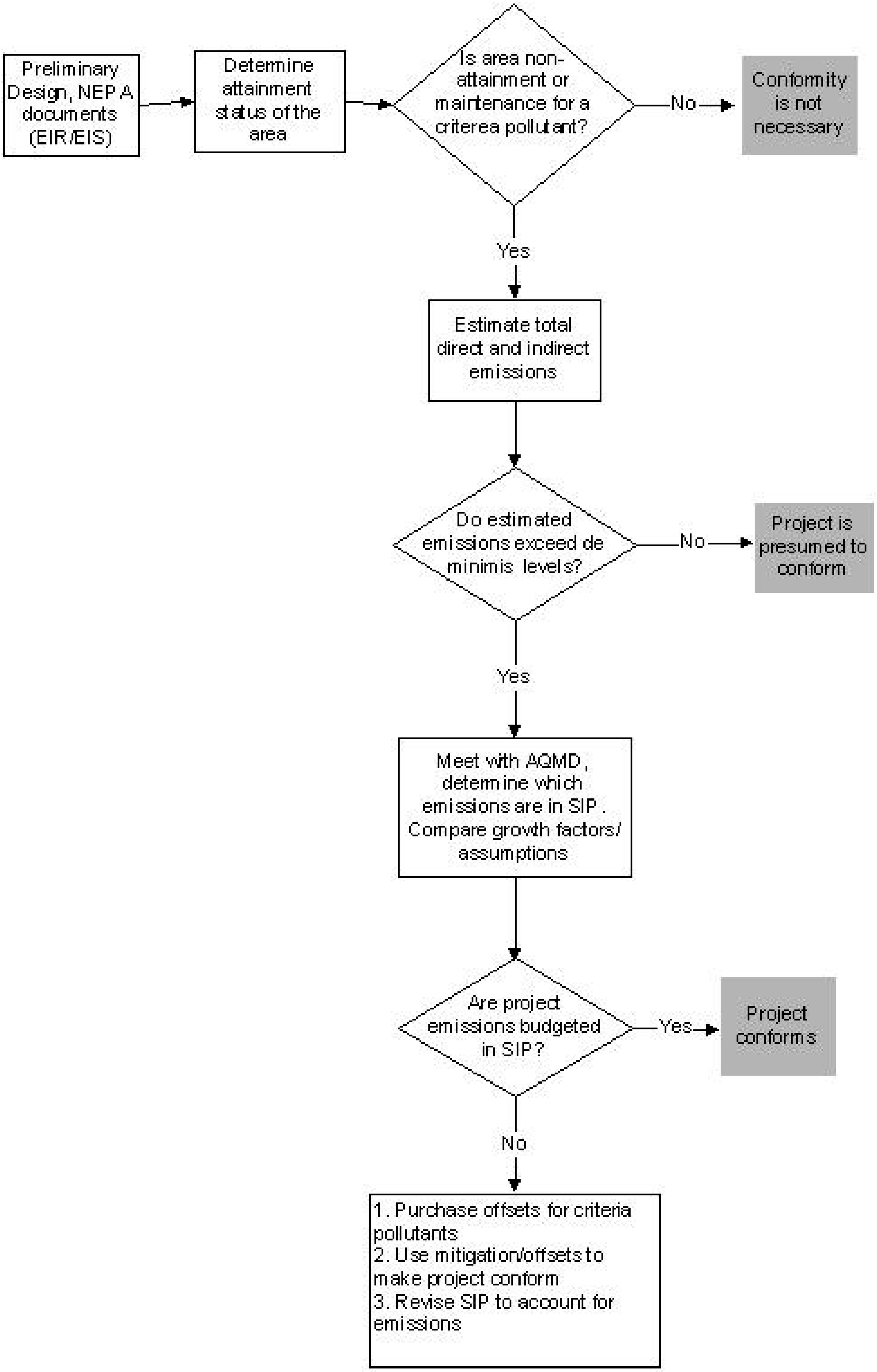
For federal projects that have been delegated to state or local agencies, that agency must complete the conformity determination on behalf of the federal agency. In the case of airport projects, the FAA is responsible for conformity determinations. The conformity determination is valid for five years. If the project ever changes significantly enough to alter emissions projections, conformity must be re-assessed.

Enforcement of General Conformity

There are two types of enforcement associated with the conformity process. The first is enforcement of the conformity process and its environmental benefits. The other is the enforcement of the mitigation measures and offsets included in the plan that achieved conformity. When the FAA is responsible for a conformity determination for an airport project, enforcement or approval comes solely in the form of litigation. The EPA may show disapproval for the conformity analysis or determination but can not impede the actions of the FAA. Litigation is generally backed by environmental groups since the EPA mission is not to prevent growth.[11] A court challenge to a conformity determination may begin after the determination is made. There have been cases of litigation such as the Miramar Air Force Base.

Enforcement of mitigation measures is the responsibility of the state or AQMD, which may choose to modify its SIP. A SIP is approved only when a state demonstrates it has the authority and resources to enforce its regulations. The SIP is enforceable by citizen suits under section 304 of the Clean Air Act. Since the EPA approves the SIP, the SIP is enforceable by the EPA under section 113 of the Clean Air Act. Many organizations have used the conformity process as a means to protest entire projects.

Figure 1: Outline of General Conformity Process



A general conformity determination is valid for five years if the action is not complete or is not part of a continuous program. After this time, a redetermination of conformity is necessary. Ongoing federal actions only require redetermination if changes in the action will result in emissions over de minimis levels.

California Governor's Certificate

General conformity is not the only air quality regulatory process for airports. As a result of the 1982 federal Airport and Airway Improvement Act (AAIA), the California Governor's Certification Process was established. The AAIA requires that the Governor of a state certify that the construction, location and operation of a new airport, new runway, or major runway extension will comply with applicable air and water quality standards.[12] The FAA has to apply to the California Air Resources Board (CARB) for the governor's certificate, which allows the airport to operate until certain operational limits are reached. At that point, the air quality impact of the airport must be evaluated and mitigated as needed.

The certification process is similar to the conformity process, except it is on the state level and has only been used at three airports: Ontario International Airport, San Jose International Airport and Sacramento International Airport. In the case of San Jose, the airport required a governor's certificate even though the emissions from its expansion plan were found to be below de minimis in the conformity process.

In the case of Sacramento Airport, the airport has now exceeded the certificate limits of 7 Million Annual Passengers (MAP), 139,000 air carrier operations and 4,270 parking spaces. These limits were set during the certification process in 1982, when a new runway was added. CARB can not de-certify the airport, but will instead work with the airport on mitigation methods, and amend the certificate. CARB does not penalize the airport. All airport activities, including those of tenants, are examined to determine their effect on air quality. Whereas the conformity process looks at de minimis emissions, the certificate process looks at absolute emissions, on an ongoing basis.

3. Airport Related Emissions

Overview of Airport Related Emissions

Airport emissions may constitute a significant portion of the criteria pollutants in a given air basin. Data for Sacramento airport is shown in the Table 6. Estimates for other airports are similar but are all expected to grow disproportionately to the region's pollutants.

Table 6: Sacramento Airport (SMF) and Regional Emissions (tons per year)

Pollutant	**Aircraft**	**GSE**	**Ground Access**	**SMF Total**	**Air Basin Total**	***SMF % Contribution***
CO	166	380	3569	4115	714305	*0.57%*
NO_X	314	42	381	737	97090	*0.75%*
PM	13	1	9	23	86140	*0.02%*

SOURCE: Humphries, Jim, More Air Quality Requirements for Airport. Presented at San Diego Air Quality Symposium, Feb. 16-17, 2000.

The criteria air pollutants in the CAA related to air transportation include carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide, sulfur dioxide, lead and ground level ozone (volatile organic compounds (VOCs) also known as hydrocarbons and oxides of nitrogen (NO_x)). Table 7 and Figure 2 outline the contributors of each pollutant at San Francisco International Airport. The major air pollutants produced at airports and their sources are as follows:

- Carbon Monoxide (CO): Originates from incomplete combustion in idling aircraft engines, ground vehicle operation, heating plants. Peaks in colder months of the year.
- Nitrogen Oxides (NO_x): Product of high temperature combination of nitrogen and oxygen; in aircraft engines and other internal combustion sources.
- Particulate Matter (PM): liquid and solid particles from various sources such as ash, soot, smoke, fumes and dust form combustion and erosion processes.
- Hydrocarbons/VOCs: methane, alkenes, aldehydes, ketones, terpenes from fuelling activities and incomplete combustion processes.
- Ozone (O_3): A secondary product from reactions with VOCs, NO_x and sunlight.

Table 7: Air Pollutant Emissions Estimates (tons/year) for San Francisco International Airport (1996 Emissions Inventory)

	CO	**VOCs**	**NO_x**	**SO_x**	**PM**
Aircraft	2455	520	2305	99	N/A
Autos/Taxis	5568	608	683	10	995
Shuttles/Vans	220	32	57	0	39
Heavy Trucks	104	16	88	3	24
Buses	179	42	263	6	72
Motorcycles	34	7	4	0	3
Ground Support Equipment	233	46	352	9	19
Fuel Storage and Handling	0	146	0	0	0
Maintenance Facility	62	195	258	3	35
Building Energy Use	30	1	49	1	3
TOTAL	**8885**	**1613**	**4059**	**131**	**1190**

SOURCE: Federal Aviation Administration, *Airport Master Plan Improvements, San Francisco International Airpor*t, Final Environmental Assessment, Volume 1, - Documentation, Burlingame, California, October 1998, Tables 4.53 and 4.59.

Figure 2. Sources of Emissions at SFO (1996)

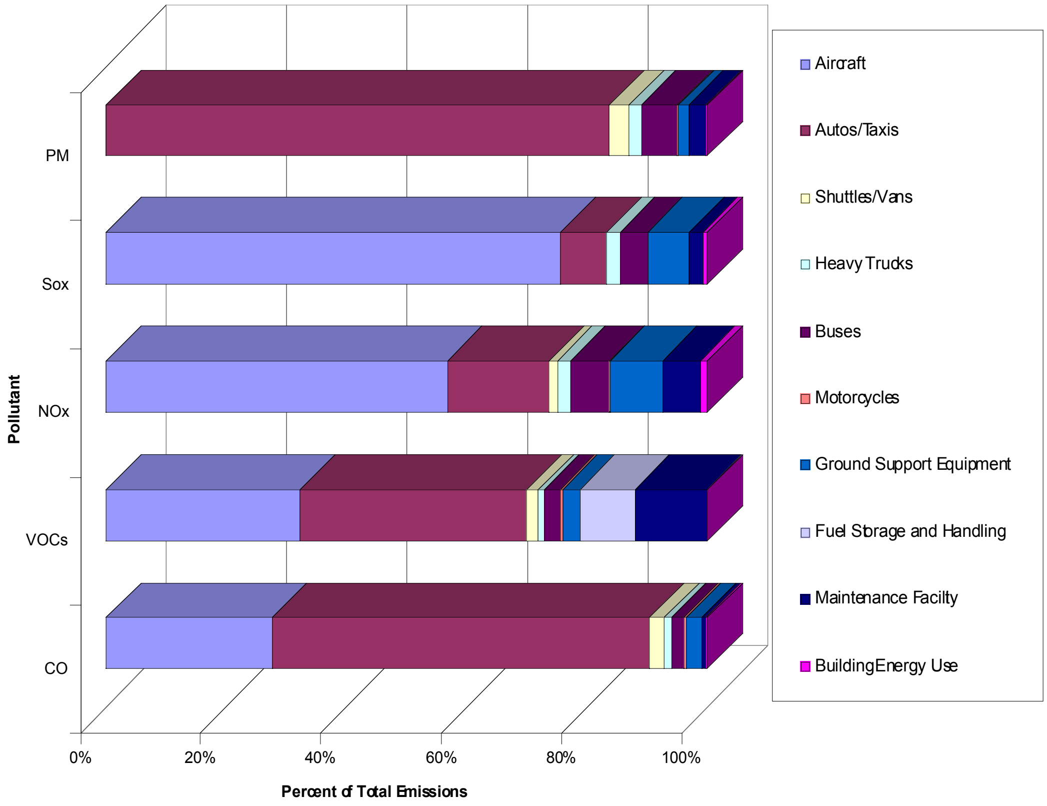


Table 8 shows the emissions inventory used for the San Francisco Bay Area 1999 Ozone Attainment Plan, part of the California SIP. The inventory for aircraft was based on aircraft types and activity data specific to each airport in the region. The California Air Resources Board and EPA provided the emission factors and methodologies used for the compilation of these emissions. Ozone is the only criteria pollutant for which the Bay Area is in nonattainment of the NAAQS.

Table 8: Bay Area 1999 Ozone Attainment Plan Emission Planning Inventory

AIRCRAFT	VOC (tons/year)	NO_x (tons/year)
Commercial Aircraft	1306.7	6205
General Aviation	321.2	73
Military Aircraft	2157.15	1587.75
Agricultural Aircraft	-------	---------
Airport Ground Support Equipment	58.4	171.55

SOURCE: Bay Area Air Quality Management District San Francisco Ozone Attainment Plan for the 1-Hour National Ozone Standard, June 1999.

Although the NAAQS set limits for total emissions, aircraft emission limits have been set by the International Civil Aeronautics Organization (ICAO). The levels set by ICAO may be too high to achieve emission reduction objectives set in SIPs via aircraft emissions. Rather, airport emission reductions depend on measures such as alternately fueled ground service vehicles and voluntary agreements between the airport and AQMDs to achieve emission reductions. In the South Coast AQMD (Los Angeles area), five airports are collaborating with the EPA and Air Transport Association in the South Coast Consultation Process to decrease aircraft emissions. Although the desired reduction may not be achieved, communication between those interested in airport activities and those interested in air quality has commenced. Increased communication will lead to more integrated air quality and airport planning in the future.

Emissions Modeling for Aircraft and Airports

Predicted emissions in a conformity analysis are based on emissions modeling procedures determined by the EPA and USDOT. Since 1983, airport/air base models have used the Emission and Dispersion Modeling System (EDMS), a software package designed by the FAA to model air quality at civilian airports and military bases. There is a chance that conformity determinations are not valid due to their dependence on models. It is also possible to modify certain growth factors or assumptions in the conformity analysis to achieve de minimis levels. However, in the case of growth factors and other modeling, assumptions must be consistent across all documents and processes. Additionally, these assumptions are subject to public and EPA scrutiny.

EDMS

Since its original release, several software and database enhancements have been made to EDMS in response to the needs of the air quality analysis community and regulation changes. In 1997 a significantly re-engineered model, EDMS Version 3.0 was released. The most recent version EDMS 3.22, released in November 2000, has improved accuracy and has corrected errors of the earlier versions.

EDMS calculates emissions from vehicles visiting the airport, in addition to aircraft, ground service equipment and stationary emissions sources, such as power plants and incinerators. EDMS models dispersion of these emissions within the vicinity of the airport. EDMS is not necessarily used for all air quality modeling applications. For example, the Bay Area AQMD (BAAQMD) uses published emissions factors to calculate air transportation related emissions, not EDMS. However, EDMS is the required method of emissions calculations for the conformity process.

There are many concerns with the EDMS model. A study by Joel Solden and Vadim Kogen demonstrated that emissions factors for aircraft, GSE and mobile sources were often overestimated by EDMS. Some EDMS emissions factors were five or more times what were actually observed at airports. Table 9 shows selected results from their study. In the case of aircraft CO emissions, EDMS' yearly estimate was almost nine times the amount actually measured by sampling the air at relevant locations. Unreliable emissions factors augmented by uncertainty regarding which emissions to include in conformity analysis complicates the conformity process.[13]

Table 9: Total Aircraft and GSE Annual Emission Rates Based on Actual Data and EDMS Default Values

	CO (tons/year)		**HC (tons/year)**		**NO_x (tons/year)**	
	EDMS Default	**Actual values**	**EDMS Default**	**Actual values**	**EDMS Default**	**Actual values**
Aircraft	114	25	12	3	184	157
GSE/AGE/APU	154	6	4	1	15	7
Total	**268**	**31**	**16**	**3**	**199**	**163**

SOURCE: Solden, J. and Kogen, V. "Airports and Air Quality, Observations from Case Studies" TRB 80th Annual Meeting, Washington D.C.

Challenges and Limitations in Emissions Modeling

Emission modeling for airports is complex since most of the emission sources are mobile, and their activity and emissions characteristics vary considerably with diurnal, weekly, seasonal, and weather related factors. Additionally, emissions dispersion for aircraft requires three-dimensional analysis. Some of the shortcomings of current modeling methods include crude air quality modeling tools, limited knowledge about the interaction of pollutants, limited or outdated origin and destination information, and limited information on demand changes. The models prescribed by the EPA and USDOT also ignore land use and induced demand effects.

Thorough modeling of changes in airport emissions must take into account several factors. The first of these is the mode split. Increased capacity at an airport may shift travelers from rail or car to airplane on routes like the California corridor. Modeling must also account for changes in vehicle traffic to and from the airport. Increased capacity can draw passengers from other airports, which could significantly increase VMT (vehicle miles of travel) to the airport. Alternately, increased capacity could reduce regional VMT by attracting traffic that would otherwise utilize a more distant airport. According to Humphries, this has been studied by consultants, but the dispersal of demand across airports is difficult to quantify, and more difficult to translate into emissions numbers. The Los Angeles World Airports (LAWA) multi-airport system may be successful in eliminating some ground travel, but the quantification of this is unclear.

Another area of uncertainty in airport emissions modeling is which aircraft emissions are taken into account. Currently, emissions to approximately 3,000 feet, or the mixing height, are considered. The mixing height varies with the altitude, climate and terrain around an airport. Also included are emissions during the taxi, take-off roll and climb for departing aircraft and descent and taxi for landing aircraft. Little is known about the effects of emissions above the mixing height (the stratosphere), and they are not included in air quality analyses.

Emissions from Ground Service Vehicles, Auxiliary Power Units

Ground service equipment (GSE) and auxiliary power units (APU) can contribute significantly to airport emissions. Emissions from GSE can also be highly variable based on the layout of the airport and the type of fuel used. GSE using internal combustion engines have much higher emissions than electric GSE, despite the latter necessitating energy produced at a power plant. A power plant can be very energy efficient and can meet strict environmental standards depending on its location and emission controls used.

Alternatives to internal combustion engines (gasoline and diesel) include compressed natural gas, liquefied natural gas, liquefied petroleum gas and electricity. GSE that are specifically designed and manufactured to use alternative fuel perform better than those that were converted to use alternative fuels. Purchasing electric GSE also requires the purchase of an electric charging station. However, tax credits at the federal or state level may be available for the purchase of electric vehicles.

It is possible for an airport to quantify the emissions and cost savings associated with the use of alternative fuels and electricity in place of gasoline and diesel for GSE. Emissions calculations for GSE are based on average rated brake horsepower (BHP) of the engine, load factor, annual hours of use, and emissions index for each pollutant specific to engine size in grams per BHP-hr. For electric GSE, this differs: it is based on emissions of each pollutant produced, megawatt hours of electricity used, and emissions index in pounds per megawatt hour of electricity consumed.

For example, the emissions calculations for a diesel baggage tug with a 78 HP engine used for 1,021 hours in a year results in 1,062.20 lb. NO_x. An electric baggage tug creates only 18.6 lb. NOx. The emissions from electric GSE are created by the generation of the electricity it utilizes, not the GSE's operation. Cost calculations show that the electric baggage tug would cost $742.58/yr more to operate than its diesel counterpart, implying a cost of $1,424/ton reduction in NO_x emissions.[14]

Auxiliary Power Units (APU) are small turbine engines in each aircraft that supply power to aircraft until the main engines are started. APUs burn jet fuel and are a major source of emissions in the vicinity of airports. Some airports have begun to install 400 Hz power produced at a power plant and encourage airlines to minimize unnecessary use of APUs. Electrifying gates to curb APU usage is a common strategy among airport operators to reduce aircraft emissions.

Emissions from Ground Transportation

As was seen from Table 7, at SFO in 1996, on-road vehicles contributed far more to CO emissions than aircraft did and somewhat more VOCs than aircraft. Emissions from vehicles visiting the airport (autos, taxis, vans, buses, etc.) are usually only counted after the vehicles enter the airport property. Emissions outside this area are generally accounted for in the TIP. The TIP, which must take into account growth in emissions, must also conform with the NAAQS through transportation conformity. In advance of the conformity and NEPA processes, the airport should meet with the local AQMD to determine if all ground transportation related emission increases of the airport property have been accounted for in the SIP. If they have not, they must be added to either the TIP or the airport emissions.

Airport employees, airport visitors, ground transportation providers, and the transportation of people and goods between airport facilities produce on-road mobile emissions at an airport. Since employee trips occur daily, it is especially effective to curb the emissions from these trips. Airport employees follow irregular work schedules that are not always amenable to transit. Most airports offer free parking for airport employees, making it especially difficult to reduce auto usage.

Estimating the emissions from on-road traffic is difficult. At Sacramento airport, on-road mobile sources emissions data was developed using empirical measurements (hoses), regression (passenger numbers to vehicle trips) and bulk vehicle counts (rental cars, employees, etc.). Emissions factors were based on the EPA MOBILE model, but the INFAC model can also be used. Over time, it is predicted that ground transportation emissions will decrease as older, more polluting vehicles are replaced and as demand management and mitigation measures take effect.[15]

The mitigation measures that an airport uses are specific to the environment and policies of the airport. Some mitigation measures that have been utilized historically at airports worldwide include:

Measures affecting employees:

- Variable shifts for employees, including work at home
- Rideshare/carpool incentives for employees
- Transit incentives for employees
- Alternative mode incentives for employees
- End employee parking subsidy or offer cash-out

Measures also affecting airport visitors/passengers:

- Increase long-term parking rates
- Passenger vehicle idle time limits
- Passenger and employee satellite parking (long-term and short-term) with shuttle bus service
- Taxi and bus idle time limits

Measures also affecting ground transportation/cargo/service vehicles:

- Idle restrictions for delivery, service and commercial vehicles
- Circulation management for on-call vans and shuttles
- Restrict airport shuttle bus use, pool buses
- Alternative fuels for airport shuttle buses
- Electric shuttles
- Alternative fuels for delivery, service and commercial vehicles
- Alternative fuels for taxis and rental cars
- Extend rail service to airport or shuttle bus service from rail to airport
- Congestion relief via road construction projects.

SOURCE: Gosling, Geoffrey D., Airport Ground Transportation Strategies to Address Air Quality Impacts. Year 2000 Air Quality Symposium, San Diego, Feb. 16-17 2000.

The success of any of the above measures depends greatly on its usage. For example, high occupancy vehicles, such as vans, require high occupancy rates to compensate for their increased emissions. Shared modes and transit may produce fewer emissions per passenger, but these are not effective strategies if the passengers switch to those modes from other low emissions modes instead of from single occupancy vehicles. Strategies such as rail links to airports may decrease emissions in the vicinity of the airport, but those emissions may simply shift to the passenger's local rail terminal. Given that 80% of the emissions from a motor vehicle trip occur during the cold start, a rail strategy may not improve region-wide emissions. To investigate the effectiveness of these measures, the entire passenger trip must be accounted for.

Alternately fueled on-road vehicles, like alternately fueled ground service vehicles, require a financial investment and incentives for operators. This is a viable option for vehicles that do not leave the airport property and can refuel easily, such as shuttle buses. Some airports have been able to acquire grants to fund the vehicle changes, but such funding is not easy to attain. Los Angeles International Airport (LAX) has been aggressive in its implementation of alternately fueled vehicles. The airport has 130 alternately fueled vehicles including 27 liquefied gas-fueled transit buses with 16 on order and 49 compressed natural gas construction and maintenance vehicles. The airport's goal is to have 50 percent of the LAX fleet operating on alternate fuels.[16]

Improving the flow of vehicles circulating through the airport can reduce emissions from idling. However, the result may also be the increased use of auto to drop off and pick up passengers or circulating instead of parking a vehicle. Mode choice to the airport depends both on the parking facilities and quality of circulation. In the interest of reducing emissions, short-term parking is favorable to extended idling. Airport operators can encourage this by providing the first thirty or sixty minutes of parking for free. Pricing parking to decrease emissions may just encourage circulation instead of actually decreasing the number of vehicles accessing the airport. It is a complicated and delicate mode choice scenario.

Emissions from Aircraft

The significant emissions from aircraft are hydrocarbons, CO and NO_x. Hydrocarbon and carbon monoxide emissions are the result of incomplete combustion at lower aircraft power settings. These power settings are used for descent, idling and taxiing. Emissions of NO_x occur when the aircraft engine temperature is highest, during take-off and to a lesser degree during cruise. Over the last twenty years, hydrocarbon and CO reductions have been achieved, but at the expense of NO_x emissions because the technology for fuel efficiency also causes higher operating temperatures. Typically, airports represent only 2-4% of a region's total NO_x emissions.[17] Table 10 shows the growth in the contribution of aircraft emissions to the total region. This is clearly a smaller number than the entire airport's contribution.

Table 10: Aircraft Component of Total Regional Emissions, 1990 and 2010.

	Year	% VOC	% NO_x	% SO_2
Atlanta	1990	0.7	2.1	0.1
	2010	2.5	8.1	1.9
Boston	1990	0.2	0.6	<0.1
	2010	0.7	2.3	0.7
Charlotte	1990	1.2	2.3	0.1
	2010	5.1	7.6	0.6
Chicago	1990	0.3	1.1	0.1
	2010	0.7	3.4	0.1
Houston	1990	0.1	0.5	0.1
	2010	0.3	1.9	0.1
Los Angeles	1990	0.3	0.9	0.4
	2010	0.9	2.4	0.6
New York	1990	0.3	0.9	0.1
	2010	1.7	3.3	0.4
Philadelphia	1990	0.1	0.4	<0.1
	2010	0.2	1.8	0.1
Phoenix	1990	0.2	0.9	0.7
	2010	0.4	1.8	0.9
Washington, D.C.	1990	0.3	0.9	<0.1
	2010	0.8	3.7	0.4

SOURCE: US EPA Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft

Regulation of Aircraft Emissions

Under Section 231 of the CAA, the EPA has the authority to regulate aircraft emissions in the United States. Section 231(a)(2) of the Clean Air Act authorizes the EPA administrator, from time to time, to revisit emissions standards for aircraft engine emissions "which in his judgement causes, or contributes to air pollution which may…endanger the public health or welfare".[18] As a result, several rulemakings have been performed to regulate the emissions of aircraft and aircraft engines, including both commercial and general aviation aircraft.

The EPA has worked with the FAA and ICAO to develop international aircraft emissions standards. However, ICAO member countries are not mandated to adopt ICAO standards. Countries wishing to not adopt ICAO standards must simply communicate that to the ICAO.

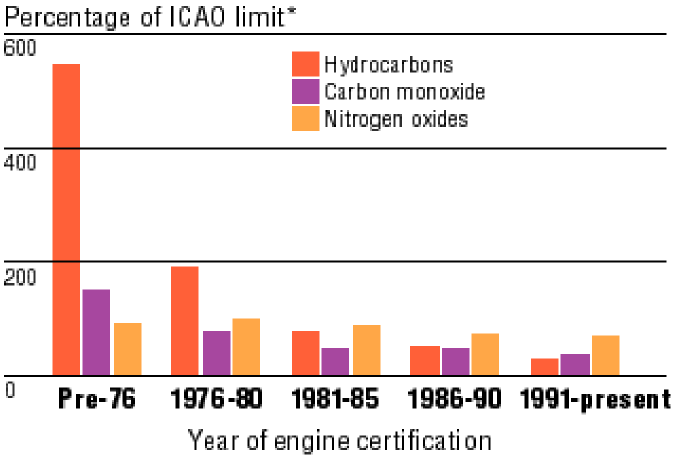
Technology and Aircraft Emissions

Unlike automobile emissions, technology can not be expected to produce significant decreases in aircraft emissions in the short term. The current growth in air travel far outpaces technological advancements in aircraft engines. Although growth in air travel is estimated to slow to 5% per year, the best estimates of technological advances show only a 3% reduction in aircraft emissions.[19] This disparity makes it unlikely that total aircraft emissions can be held constant, let alone reduced. Figure 3 shows the progress of decreases in aircraft emissions.

Current technological advances are in the area of propulsion, aerodynamics, materials, and design. Unlike other transportation modes, the possibilities of using alternate non-petroleum based fuels in the near future are virtually non-existent. Airlines have an economic incentive to reduce the usage of expensive airline fuel. While fuel costs as percentage of an airline's total cost have decreased from over 40%, it is still approximately 15% today. With profit margins around 5%, even small fuel efficiency improvements have an enormous impact on an airline's bottom line.[20]

Due to the expensive nature of aircraft, turnover in aircraft fleet is slow, and it takes many years for engine improvements to have their full effect.

Figure 3: Aircraft Engine Emissions
SOURCE: The Boeing Company (http://www.boeing.com/commercial/value/evreducemis_7.html)



* New international standards for gaseous emissions became effective in 1996.

Impact of Delay at Airports

The 1978 deregulation of the airport industry and the subsequent development of the hub-and-spoke system have caused growing delays at airports nationwide. Delays and congestion at airports have a significant influence on emissions from aircraft. In 1996, airports in thirty-two cities are estimated to have experienced 20,000 hours of aircraft delays. The estimated value of this delay in wasted time and fuel is $5 billion.[21] The environmental impact of the delay is enormous, since hydrocarbon and CO emissions are greatest during taxi and idle. An aircraft pollutes several hundred times more hydrocarbons while it is idling than it does during normal operations.[22]

Improvements in the airfield can produce large emissions reductions. Some options to reduce idle and taxi time include centrally located/multiple terminals, additional runways, high-speed turnouts, and gates closer to runways. Success of these strategies also depends on the demand-side response.

Emissions per Passenger

Emissions per passenger per trip are decreasing due to fuel efficiencies, however the actual emissions vary greatly between aircraft and engine types, load factors and seating arrangements within aircraft. Load factors are increasing, reaching levels around

70% and expected to increase in the future. As load factors increase, emissions per passenger decrease. However, efficiencies improving the seat-miles per gallon are unlikely to exceed the growth in air travel in the near future, leading to a net increase in aircraft emissions.[23]

Another factor in aircraft emissions per seat-mile is flight length. Short flights are far more fuel consuming per seat-mile than longer routes. Up to one-third of the total fuel consumption during a short (30-minute) flight is during the LTO Cycle, whereas that fraction decreases to one-eighth for medium and long-distance routes.

As shown in Figure 4, for longer length flights, aircraft may be more fuel-efficient than other modes. However, the disproportionate emissions of short flights support the use of other modes for short trips, such as car or train. Data comparing the fuel efficiency of aviation vis-à-vis other modes also show lower fuel consumption for automobiles than other modes, as shown in Table 11.

Figure 4: Passenger-Miles per Gallon for Various Modes

SOURCE: The Boeing Company (http://www.boeing.com/commercial/value/evmoreff_5.html)

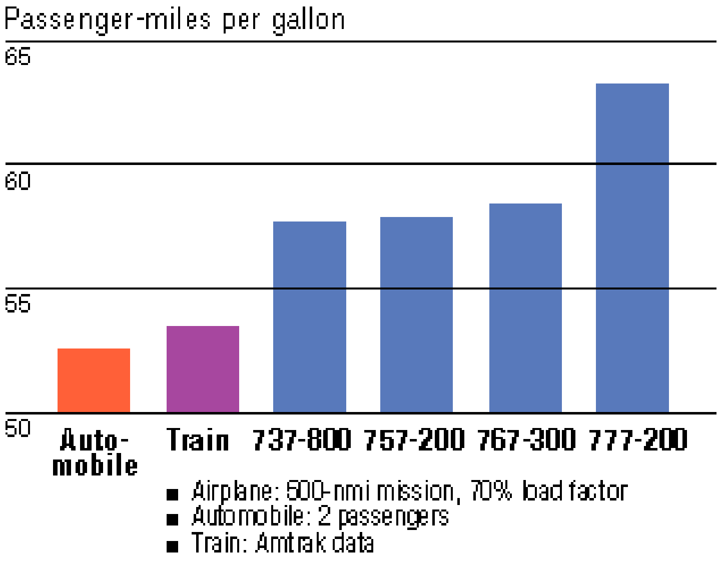


Table 11: Fuel Efficiency Comparison of Aircraft and Automobile

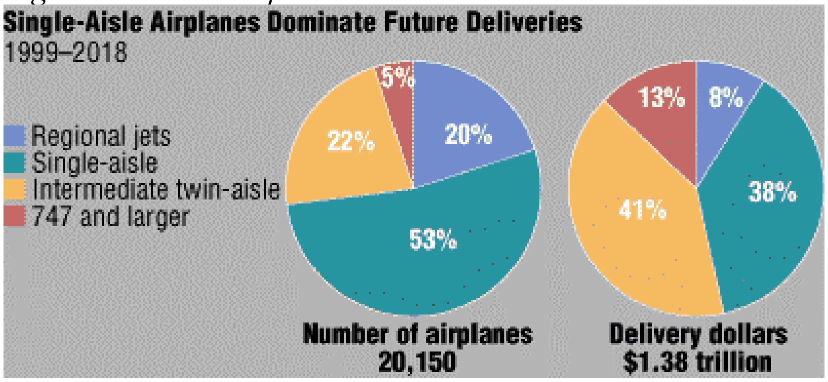
Aircraft:	**Type of engine**	**Fuel (kg)**	**Seat capacity**	**Fuel per passenger (kg) per hour**
Gulfstream IV	Mixed Turbofan	4536	13	348.92
B707-320B	Turbofan	13421	141	95.18
MD11	Turbofan	22518	250	90.07
B737-200	Mixed Flow Turbofan	6804	95	71.62
B747-400 RR	Mixed Turbofan	29952	420	71.31
B737-100	Mixed Flow Turbofan	5841	85	68.72
MD82	Mixed Flow Turbofan	7762	156	49.75
B737-500	High Bypass Turbofan	5270	108	48.8
Airbus A330-300	High Bypass Turbofan	15833	335	47.26
Airbus A321 (IAE)	Turbofan	6653	185	35.96
B777-300 (all eco. class)	Turbofan	19361	550	35.2
Automobile	**(distance of 770 km)**	**55**	**3**	**18.3**

SOURCE: The Environmental Organisation, Copenhagen. "Emissions Report". (http://www2.ios.com/~beck/reportuk.htm)

Aside from flight length and load factors, seating arrangements can impact emissions performance. For example, a one class (all economy) B777-300 can accommodate 550 seats. The same aircraft, designed with three classes, can only carry 328 passengers. This translates into a 33% increase in emissions per seat.[24] Airline revenues and marketing emphasizing comfort are obstacles to the most fuel-efficient seating arrangements.

As congestion at airports increases, airlines are expected to make use of Next-generation Large Aircraft ("NLAs"). These larger aircraft do not necessarily have a positive effect on emissions per passenger, especially if an inefficient cabin arrangement is chosen. However, larger aircraft make better use of the airfield, reducing runway congestion and idle time. Additionally, NLAs will generally fly longer flights, which are more fuel-efficient. Despite the anticipated demand for NLAs, the majority of current and expected airline aircraft orders are for smaller, single-aisle aircraft, as shown in figure 5.

Figure 5: Future Airplane Deliveries



SOURCE: The Boeing Company, *Current Market Outlook*, 1999. (http://www.boeing.com/commercial/cmo/4wa07.html#verylarge)

Policies to Reduce Aircraft Emissions

There are several changes that aircraft operators can make to reduce emissions. However, all are subject to the safety of passengers. These include minimizing the use of reverse thrust, single-engine taxi, and shutting off main engines while idling. These strategies must be implemented by the airlines, while it is the airport operator that is responsible for reduced emissions. As an example of effectiveness, Delta Airlines' implementation of single-engine taxiing at its Atlanta hub led to a $5.9 million reduction in fuel costs in 1995 alone, as well as a proportional reduction in emissions. Some aircraft are unable to perform single-engine taxi and on capable aircraft, crews must be trained in the technique. Additionally, some experts believe single-engine taxi is unsafe in some conditions as it may cause the aircraft to veer to one side.[25] Another consideration for reduced emissions is to use tugs to push back aircraft from gates instead of using the aircraft's main engines to power back.

Another policy to reduce aircraft emissions at airports is emissions-based landing fees. This has been implemented in European cities such as Zurich, Geneva, and several Swedish airports. The premise of emissions-based landing fees is that the most polluting aircraft are penalized (as a percentage of the landing fee), while the least polluting aircraft pay no penalty. At Zurich airport, the policy has led to development of low emission engine technology, operational changes by airlines, and expedited fleet turnover. Legal issues have hindered the widespread implementation of this type of policy, although the policy was upheld in courts in Switzerland.[26] Without such a policy, airport operators have little or no control over what size aircraft airlines choose to use. Airlines will generally choose the fleet mix that will maximize their revenue per passenger-mile, not produce the least emissions.

Aviation fuel prices also impact aircraft emissions. It is expected that significantly higher fuel prices would create a greater incentive to retire obsolete aircraft and reduce the demand for air travel via higher ticket prices. Additionally, high fuel prices would justify the development and purchase of more expensive fuel economy technology.

4. Conclusions

General Conformity in Context

Airports have a small effect on air quality, but air quality concerns, through the general conformity process, can have a large effect on airports. While to date conformity for most airport projects has been established by the de minimis approach, major expansions that many consider necessary to accommodate future traffic growth will likely require more extensive conformity assessment. It is essential that airports, the FAA, and air quality agencies learn to negotiate the conformity process so as both to avoid unnecessary bottlenecks and further the aims of the Clean Air Act and its amendments.

General conformity is a recent step in a decades-long policy evolution. The 1969 National Environmental Policy Act (NEPA) created a regulatory tool to ensure that the environmental impact of any development projects was being considered. However, NEPA did not provide thresholds to determine if the environmental impact of a project was excessive and prevent the project. Additionally, NEPA was a project-based regulation, not accounting for the area-wide or cumulative air quality effects of projects.[27] NEPA began the process of internalizing air quality concerns into agency plans, but the NEPA process and programming were not tied until the CAAA. Each revision of the Clean Air Act attempted to tie air quality and development projects more closely. The 1994 general conformity rule extends this to sectors, including aviation that had previously escaped significant pressure to reduce emissions.

General conformity is no more or less reasonable then the Clean Air Act itself. If air quality is to be attained through ambient standards, and if attaining these standards is a national priority, then it makes perfect sense for the air quality impacts of federal actions to be carefully scrutinized. The general conformity requirements for airports are a straightforward application of this basic principle.

Many in the airport community believe that general conformity singles out airports and burdens airport projects excessively in light of their small contribution to regional emissions. It is therefore important to see the conformity requirements in their proper context. Air quality agencies have very limited authority to regulate activities at airports. They cannot set emissions caps, regulate aircraft engines, or mandate operational changes. For these reasons, environmentalists, in stark contrast to airport officials, have claimed that airports have “slipped through a crack” in the air quality regulatory system. In particular, they note that aircraft can be regulated neither as stationary sources nor as mobile ones. The general conformity process has thus become the de facto instrument for regulating airport emissions. Since the players are beyond regulatory reach, policy has focused on the stage.

In the long run, this approach should be critically examined. Much of the opposition and resistance to new airport projects derive from the fact that it is only at the project approval stage that outside agencies have significant leverage on airport activities. Operations cannot be capped, but operational capacity can be. Access to stage 3 aircraft cannot

short run, the focus must be on general conformity itself. Perhaps the most urgent reform to this process as it applies to airports is to permit the “banking” or emission reduction actions so that their impacts may be counted as mitigations in future projects. Under the present system, airports have an incentive to postpone these actions so that they can be used to meet conformity requirements. This is obviously perverse, but there are significant challenges to devising an appropriate remedy.

The concept of banking leads naturally to the concept of airport-level emissions budgets. By treating an individual airport as a single emissions source, any emissions reductions it achieves naturally rebound to its benefit. If the budget is developed accurately, then emissions reductions outside the context of a project will create a surplus in the emissions budget that can then be used to cover extra project-related emissions. The challenge, of course, is to develop budgets that are at once realistic, compatible with air quality goals, and agreeable to other airports, and other sources of emissions, within the region.

However the emissions budget is specified, the integrity of the conformity process hinges upon its realism. If baseline emissions are over budget, then, in most cases, the only feasible way for a project to attain conformity is to meet de minimis emissions targets. If these targets have to be met, they almost always will be met, one way or the other. The resulting “structure of deceit” will make the conformity process a Kabuki dance rather than a meaningful process for maintaining air quality.

Research Needs

Additionally, there are great opportunities for research that can facilitate airports in overcoming the general conformity hurdle. Such opportunities exist for every phase of the process, from assessing the direct and indirect impacts of airport projects on emissions and air quality, to identifying appropriate mitigations and offsets.

One promising area of research is the design of quick response methods for estimating the direct and indirect impacts of airport projects. Such methods would enable these impacts to be assessed and fed back into the project design process. They would allow mitigations to be built into the project during its early stages. In addition to its obvious technical advantages, this would permit airports to use de minimis criteria in lieu of the zero-impact ones that take effect when mitigation is added subsequent to the impact determination.

The same concept might be extended to air quality impact analyses. When the additional emissions estimated to result from a project exceeds de minimis levels, it is important to determine whether the emissions will result in additional or more severe violations of air quality standards. While a full scale analysis may be required to fully answer this question, there may be simpler methods that can be used to predict, with a reasonable level of confidence, what that answer will be, and identify strategies (other than emissions reductions) for reducing the impact of a project.

A fundamental challenge in emissions assessment is how to manage the inherent uncertainty concerning the impacts of a project. Airport projects may trigger a chain of adaptations and economic responses that are only dimly understood, while at the same time the regulatory process seems to demand perfect knowledge about them. It is not realistic to expect each individual conformity assessment to undertake the in-depth analyses that would be required to trace out all its potential emissions impacts. A more fruitful approach is to establish, through research, some general parametric relationships as well as some uncertainty bounds around them. These can then be applied to individual projects to distinguish impacts that can be safely ignored or addressed cursorily from those that require extensive study.

In considering these various impacts it is important to recognize that many may be more benign than they initially appear. For example, there is a widespread view that conformity assessments should consider the potential for airport projects to lead to higher levels of traffic at the airport. Obviously, if this occurs, there will be more emissions generated on the airport property and from vehicles accessing the airport. But that is not the whole story. The increased activity at the airport in question may displace other activities, including traffic at other airports, and travel by other modes. There may even be significant "person-day" effects: if there is more travel outside the region, then the effective population within the region will be decreased, with attendant reductions in vehicular travel, power consumption, and other emissions-generating activities. Conversely, if the additional airport activity includes more visits to the region, there may be a countervailing, though different, set of emissions increases associated with the added tourism. Such impacts are clearly difficult to pin down, and may be trivial compared to the more obvious ones, but these are some of the research directions in which the with/without, direct plus indirect, thinking of general conformity takes us.

While efforts to increase the operational capacity of airport runway systems continue, there is increasing realization that runways are not always the most important capacity constraint. At some airports, it may instead be the curbside, and at others, the access road system. At still other airports, the key constraint may be none of the above, but rather the emissions that can be tolerated in light of the Clean Air Act and the many other activities that generate air pollution. Technological, operational, and institutional innovations can permit more airport activity to be squeezed out of a given level of emissions. The general conformity process has, for better or worse, become the prime forcer of this squeezing process. Research and reform are needed for this arrangement to succeed.

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Appendix A: The Transportation Conformity Process

The Clean Air Act of 1970 requires that states meet National Ambient Air Quality Standards (NAAQS) for various “criteria” pollutants. Areas that do not meet the NAAQS for one or more pollutants (nonattainment areas) must make provisions to decrease their emissions in a State Implementation Plan (SIP). The Clean Air Act (CAA) requires that any transportation projects in nonattainment areas using FHWA/FTA funds or sponsored by recipients of FHWA/FTA funds must be in “conformity” with the SIP. This is also true in maintenance areas, areas that recently achieved NAAQS. It is the responsibility of the Metropolitan Planning Organizations (MPOs) and state and local transportation agencies to assure that transportation plans coordinate with the SIP. The determination of conformity is the responsibility of the MPO and then confirmed by the FHWA and FTA in consultation with the EPA.

In 1990, the Clean Air Act Amendments (CAAA) were passed. The CAAA determined that states must reduce their emissions, net of growth, across all sources. In creating a SIP, planners first develop an emissions “budget”, a ceiling on emissions from transportation plan and TIP activities. If the MPO can not show that transportation projects in the Regional Transportation Plan (a twenty year time horizon) and the Transportation Improvement Plan (a three to five year horizon) conform with the SIP**, the CAAA authorizes the government to withhold funding for the project(s).** Conformance with the SIP exists if emissions are reduced, emissions are small with compared to the Air Quality Management District (AQMD) emissions, the emissions budget is not exceeded, the NAAQS are determined not to be violated and/or the project is included in the local TIP. Specifically, the transportation plans, programs and projects cannot create new NAAQS violations, increase the frequency or severity of existing NAAQS violation or delay attainment of the NAAQS.

After a non-conformity determination, the government withholds the funding until either the project is altered to meet the conformity test or else the SIP emissions budget is modified to compensate for the increased emissions through another measure. Exceptions to the prohibition include projects that have no effect on air quality ("exempt projects") and those that are grandfathered in.

The conformity process is conducted concurrently with the Environmental Impact Statement (EIS) outlined in the National Environmental Protection Act of 1969 (NEPA) and the Environmental Impact Review (EIR) outlined in the California Environmental Quality Act of 1970. The NEPA process requires examining the environmental impact of alternatives to the proposed project, including the impact of not completing any project ("build/no-build test"). Integrating the emissions analysis required by NEPA that required for conformity may lead to smoother and more effective planning and implementation.

Transportation Control Measures (TCMs), projects that improve air quality in nonattainment areas are funded though the Congestion Mitigation and Air Quality Program (CMAQ) outlined in ISTEA. There are sixteen TCMs outlined in CAA that must be considered for inclusion in the SIP. These sixteen TCMs include projects such as improved public transit, traffic flow improvements and control of extended idling of vehicles. It is important to note that no activities in the TIP can interfere with the implementation of TCMs in the SIP.

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[2] Federal Clean Air Act Amendments of 1990, section 176(c).

[3] Interview with Jim Humphries, SMF March 14, 2000.

[4] Descriptions of exempt activities are described in U.S. EPA General Conformity Rule 51.583 (c) (1,2,3,4) (d) (e) (f).

[5] The grandfather clause is described in U.S. EPA General Conformity Rule Section 51.850 (c) (1 & 2).

[6] U.S. EPA General Conformity Rule Described in section 51.858 (a) (1,2,3 &4).

[7] U.S. EPA General Conformity Rule Section 51.852 (definitions).

[8] U.S. EPA General Conformity Rule Section 51.860.

[9] U.S. EPA General Conformity Rule Section 51.858 (a) (5) (iv).

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