Regional Airport Study

Mid-Point Summary Report

Study Goals, Forecasts, Scenarios, Results of Analysis

REGIONAL AIRPORT STUDY

Planning For The Future

May 2010

Prepared for the Regional Airport Planning Committee

by the

Metropolitan Transportation Commission

Bay Conservation and Development Commission

Association of Bay Area Governments

and

SH&E, an ICF International Company

Introduction 1
Public Workshops 1
Scope of the Study 2
Study Goals 5
Forecasts of Future Aviation Demand 5
Runway Capacity and Delays 10
Potential Solutions (Scenarios) 11
Results of Scenario Analysis 16
Results 32
Summary 36

INTRODUCTION

Airports are an integral part of the Bay Area transportation system and play a central role in meeting the travel and economic needs of the Bay Area's residents and businesses. Starting in 2008, the Metropolitan Transportation Commission (MTC), the Association of Bay Area Governments (ABAG), and the Bay Conservation and Development Commission (BCDC) launched the Regional Airport Study to assess when Bay Area airports will reach their respective capacities and what types of solutions will be most effective in addressing future capacity problems while responding to regional environmental and economic issues. Given the expense and environmental concerns associated with building new runways, potential solutions being considered in this effort focus on using the existing aviation resources more efficiently. The study also analyzes the potential future capacity benefits from new air traffic control technologies and the possibility of a future California high-speed rail system which could help relieve projected airport traffic loads. The study is intended to develop a regional consensus that can guide future planning decisions by the airports and Federal Aviation Administration (FAA).

The policy committee overseeing the study is the Regional Airport Planning Committee (RAPC), a joint committee of the three agencies above. In addition to representatives from each of the agencies, the committee includes representatives from the Bay Area Air Quality Management District, the Federal Aviation Administration, the three primary Bay Area airports [Metropolitan Oakland International Airport (OAK), San Francisco International Airport (SFO), and Norman Y. Mineta San Jose International Airport (SJC)], general aviation airports, and the Caltrans Division of Aeronautics, as well as representatives from Sacramento, Stockton, and Monterey airports outside the Bay Area region. The study also receives input from three technical advisory panels of experts—in the areas of forecasting, airport demand management strategies, and new air traffic control technologies—as well as from a task force of stakeholders representing various environmental, business, and community interest groups.

The study will be completed in the spring of 2011.

PUBLIC WORKSHOPS

Public workshops have been scheduled around the region to obtain input on the work that has been completed to date on the Regional Airport Study. The workshops will be held in South San Francisco (May 10), Fairfield (May 11), and Oakland (May 12). Topics that will be addressed at the workshops include:

- Study goals
- Forecasts of regional aviation demand
- Airport capacity and delay
- Potential strategies to address capacity problems
- Effectiveness of the various strategies in achieving the study goals

After receiving input from participants in the workshops, RAPC will recommend a consolidated list of strategies for further analysis, reflecting both technical merit and the potential for broader public support. The study will culminate in a Vision and Implementation Plan to be adopted by the three regional agencies.

SCOPE OF THE STUDY

The region's three primary commercial airports, OAK, SFO, and SJC, serve not only residents and visitors to the Bay Area but also air travelers from outside the region. As a result, the scope of the study includes airports in neighboring regions that border the Bay Area—Sacramento, Stockton, and Monterey—as new airline routes at these airports could potentially reduce flights at Bay Area airports. Secondary airports in the Bay Area are also considered in the study because some of these airports could have large enough local air passenger markets in the future to support air service to selected major travel destinations. These airports can also play a vital role by taking on a larger share of corporate aviation users, as these aircraft would otherwise add to the congestion on the runways of the primary airports.

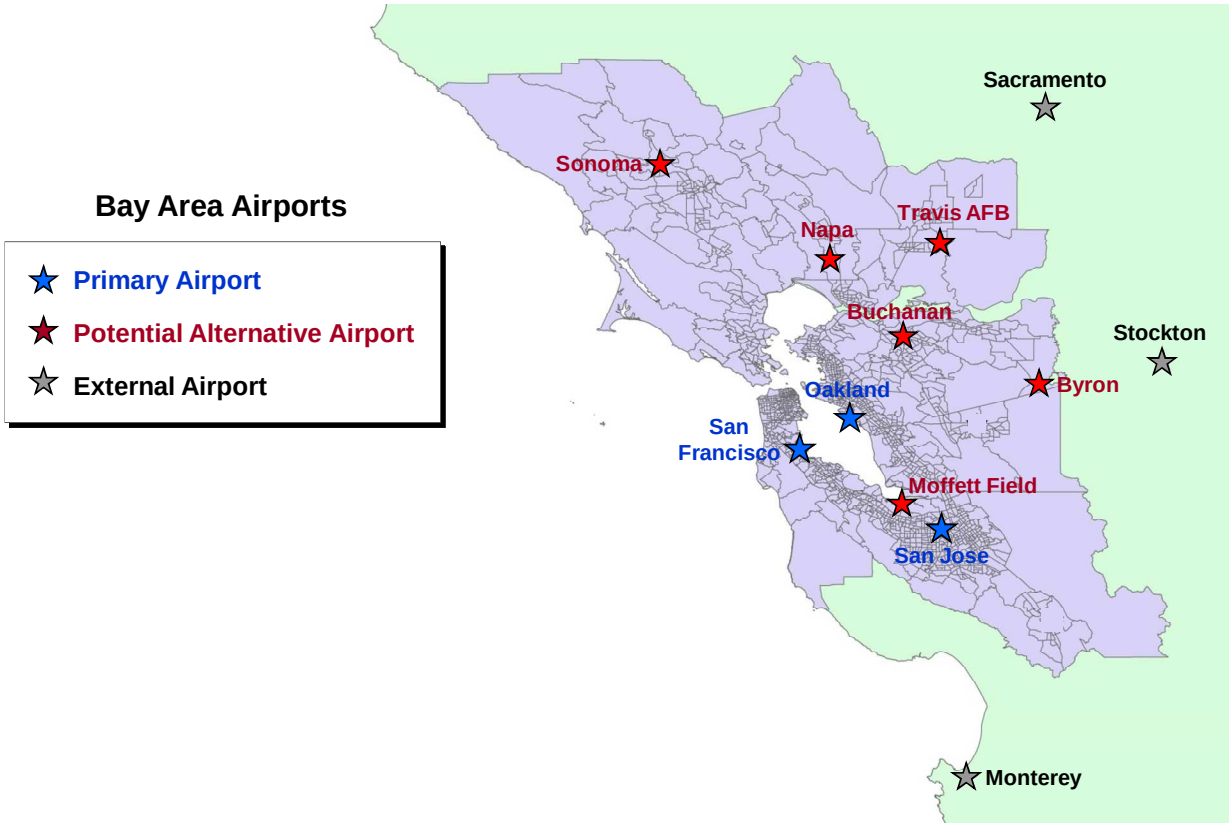
San Francisco International Airport (SFO) is the largest airport in the region and a hub for United Airlines. SFO provides a large variety of domestic service and all of the region's long-haul international flights. Recently, due to reduced weather delays, lower airport costs, and competitive factors, low-cost airlines have re-established a strong presence at SFO, effectively competing with low-cost services that used to be concentrated at the Oakland and, to a lesser extent, San Jose airports. San Francisco serves 68% of regional air passengers and 43% of regional air cargo shipments (based on 2009 operating statistics).

Metropolitan Oakland International Airport (OAK) has traditionally been the hub for low-cost carriers and a major air cargo center due to operations by FedEx and UPS. Recent economic conditions and airline service decisions have caused a reduction in scheduled passenger flights and a realignment of low cost airline service among the Bay Area's three primary airports. Oakland serves 17% of regional air passengers and 52% of air cargo (2009).

Norman Y. Mineta San Jose International Airport (SJC). Traffic at San Jose Airport has also been affected by the recent realignment of airline services in the Bay Area, but to a somewhat lesser extent than Oakland Airport. SJC does not currently offer any long-haul international flights, and air cargo facilities are limited due to space constraints. San Jose serves 15% of the regional air passengers and 6% of air cargo (2009).

General Aviation Airports. The region's many general aviation airports serve an important role by accommodating small planes that may otherwise use the larger air carrier airports. As the economy rebounds, more business jets are likely to fly into and out of the Bay Area, making these airports even more important as a means to relieve air traffic at the primary airports and improve the efficiency of the entire airport system.

Figure 1



ICF INTERNATIONAL SH&E an ICF International Company

1

STUDY GOALS

Future plans for the regional airport system, however it is ultimately developed, must address a wide range of issues, including how well the system serves its users, support for the Bay Area's economy, and the impacts of airport activity on the environment and on people who live near airports. As is often the case, there will be tradeoffs in the future between the various goals as some may be viewed as more important than others or direct conflicts may exist between goals. Seven goals have been established for the study:

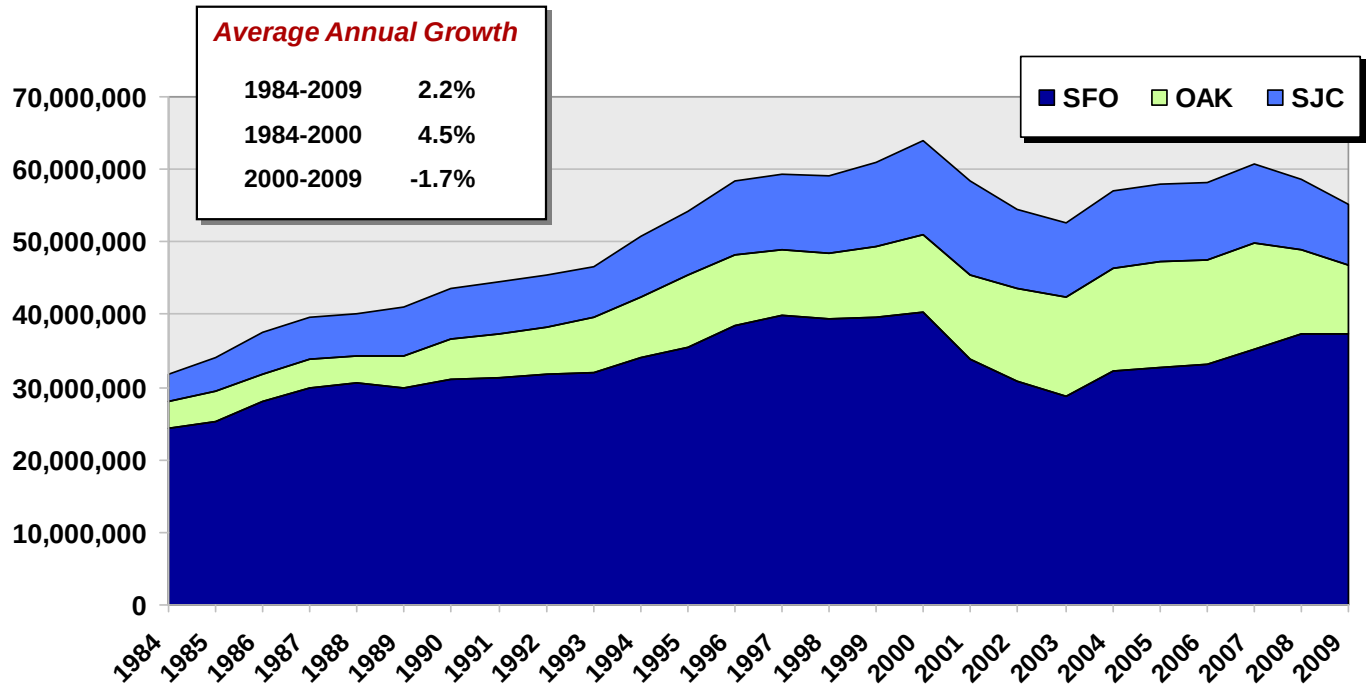
- Healthy Economy – Can the region serve future aviation demand and support a healthy economy?
- Reliable Runways – Can we reduce flight delays and passenger inconvenience?
- Good Passenger Service – Can we provide better service to the region's major air travel markets?
- Convenient Airports – Can we maintain or improve airport ground access times and costs?
- Climate Protection – Can we decrease greenhouse gas (GHG) emissions from aircraft and vehicle trips to and from airports?
- Clean Air – Can we decrease air pollution from aircraft and vehicle trips to and from airports?
- Livable Communities – Can we avoid increasing the regional population exposed to aircraft noise?

FORECASTS OF FUTURE AVIATION DEMAND

Most major improvements to the performance of the regional airport system will take years to plan and implement. Consequently the aviation forecasts must adopt a similar long-range time frame. The horizon year for this study is 2035, but forecasts have also been developed for an intermediate year, 2020. History shows that getting the forecasts "right" is a major challenge. Unanticipated events can have significant impacts on the forecasts. Some recent examples include changing economic conditions (such as the dot-com bust and the global financial crisis), the 9/11 terrorist attacks, airline bankruptcies and mergers, rising fuel costs, health epidemics in various parts of the world (e.g., SARS in Asia, swine flu in Mexico), and volcanic eruptions that cancelled flights in Europe. Also, over time the share of regional air passengers handled by the individual airports has risen and fallen as a result of airline decisions, which are currently made outside local or regional planning processes. As a result, not only is it difficult to predict the absolute growth in air passenger (and air cargo) levels, it is even more difficult to predict which airports will grow the fastest because of airline responses to changing market conditions. To provide better guidance for future forecast adjustments, this study will also develop a forecast tracking system to regularly check on the validity of the forecast assumptions and to enable the regional agencies to adjust the forecasts as necessary.

Figure 2 - Bay Area Airports Handled 55.1M Passengers in 2009 After Peaking at 64M in 2000

Bay Area Passengers by Airport
(Enplaned + Deplaned)



Source: ACI, and individual airport statistics.

2

Because of the inherent uncertainty in the forecasts, the study has produced a high, medium, and low forecast for air passenger and air cargo growth, with the major part of the analysis focusing on what the study team considers the most likely forecast—the medium, or Base Case forecast. The forecast range reflects different assumptions for Bay Area personal income growth, airline fares (which are affected by future fuel costs), and the economic outlook for the United States and abroad. In addition to the forecasts for air passengers and air cargo, the associated number of aircraft operations (or flights) is a critical piece of the analysis, since the number of future aircraft operations directly affects airport runway capacity, noise, and aircraft emissions.

Air Passengers: Under the Base Case forecast, total Bay Area air passengers would grow 67% from 60.6 million annual air passengers in 2007 to 101.3 million in 2035. The greatest growth in air passengers is forecast to occur at SFO as international flights increase and low-cost carriers continue to expand services there. OAK and SJC shares of domestic traffic are forecast to rebound from current levels to somewhere around where they were in 2007, and these airports are expected to receive additional trans-border services to and from Mexico and Canada. Airline passenger flights at the primary airports would grow more slowly than the number of air passengers, as aircraft size and load factors increase over time, resulting in a 32% overall increase in flights.

Air Cargo: Air cargo, which is closely tied to economic growth in the United States and abroad, is forecast to increase 92% in terms of weight. SFO's share would grow to 51% in direct relation to growth in international air cargo, while OAK's share would drop to 43%. A portion of the region's air cargo demand would be carried in the belly compartments of passenger aircraft and the rest would be carried in dedicated all-cargo aircraft. All-cargo flights would increase 94% at SFO (mostly international) and 26% at both OAK and SJC.

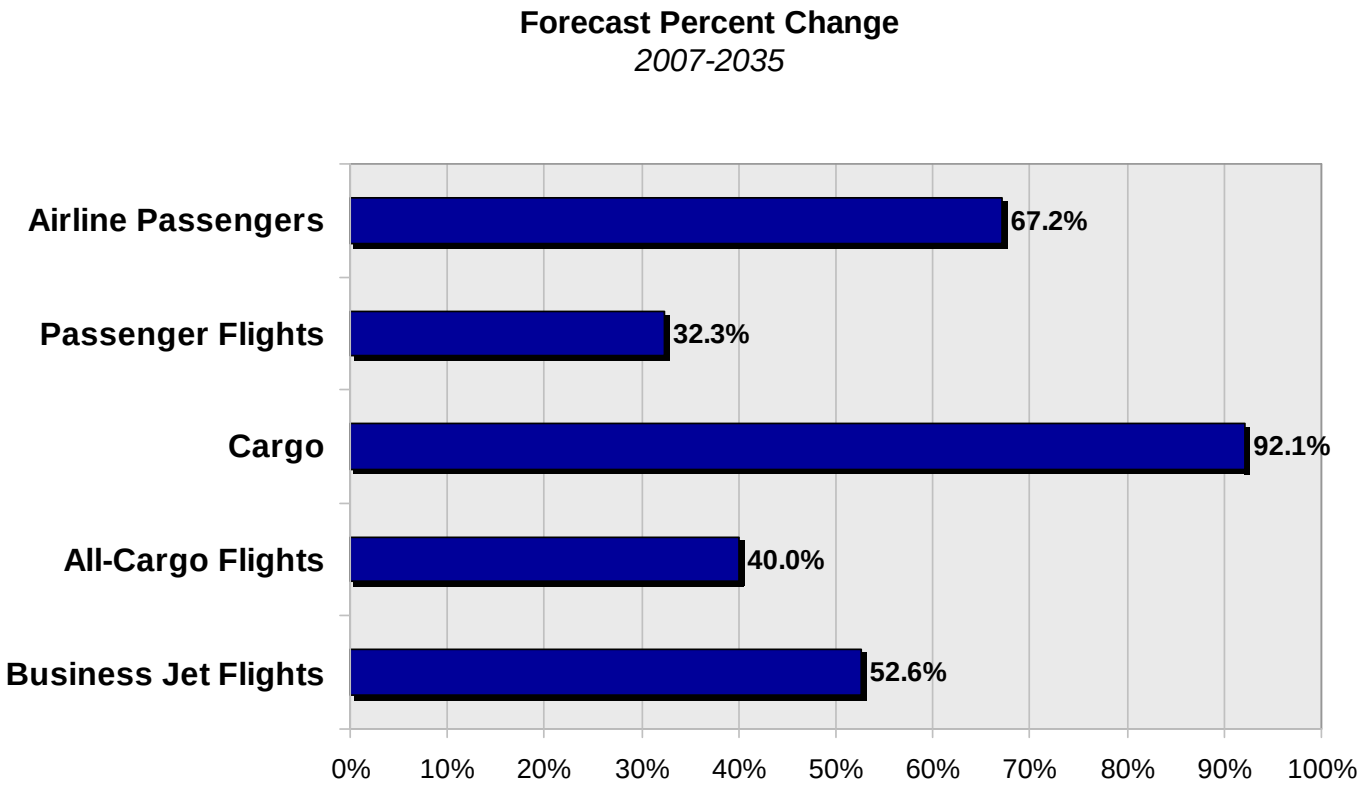
General Aviation/Business Jet: Business jet activity at the three primary airports is forecast to increase from today's levels by 56%. At SFO and SJC, these aircraft use the same runways as the airlines, but at OAK the main airline runway is only used for departing business jets to alleviate noise in nearby communities.

Air Traffic Trends and Projections	Forecast					
	Low		Base Case (Medium)		High	
		% Change		% Change		% Change
2007						
Passengers*			60.6			
Cargo**			1,426			
2020						
Passengers*	68.7	+13.3%	75.3	+24.3%	86.9	+43.3%
Cargo**	1,668	+17.0%	1,805	+26.6%	1,953	+37.0%
2035						
Passengers*	88.2	+45.6%	101.3	+67.2%	128.8	+112.5%
Cargo**	2,189	+53.5%	2,740	+92.1%	3,452	+142.1%

** Millions of annual passengers*

*** Thousands of tons*

Figure 3 - Forecast Growth in Bay Area Aviation Demand



ICF INTERNATIONAL SH&E an ICF International Company

3

Airport Forecast Ranges

As mentioned above, there is considerable volatility in the airport forecasts, related to how airlines serve these airports, when capacity limitations emerge and whether, for instance, a future high-speed rail (HSR) system is constructed in the California corridor. To provide some perspective on the different airport traffic levels that might result, based on these different conditions, the table below provides several examples of alternative airport forecasts. For example, if delays at SFO cannot be mitigated by new air traffic control (ATC) technologies; airlines might shift some of their flights to other airports. Also if an HSR system is developed, not only would overall traffic decline for all three airports, but the impact on each airport would vary as the number of air passengers diverted to HSR from each airport would differ. The table below illustrates how these different conditions would affect traffic at each airport compared to the 2035 Base Case.

	OAK	SFO	SJC	Total
Base Case				
Passengers*	20.7	64.3	16.3	101.3
Share (%)	20.4%	63.5%	16.1%	100%
Traffic Redistribution				
Passengers*	23.1	60.0	18.2	101.3
Share (%)	22.8%	59.3%	18%	100%
High-Speed Rail				
Passengers*	18.9	61.9	14.4	95.1
Share (%)	19.8%	65.1%	15.1%	100%

** Millions of annual passengers*

RUNWAY CAPACITY AND DELAYS

Central to the main purpose of this study are two key questions:

- What are the capacity limits of the Bay Area airports?
- When will they be reached?

Runway capacity problems are manifested in delayed and cancelled flights, which inconvenience air passengers and increase operating costs for the airlines. The most delay-prone airport in the Bay Area has historically been SFO, which has ranked in the top five most delay-prone airports in the country in seven of the last eleven years. The chief cause of these delays is the lack of runway capacity at SFO during foggy mornings and during stormy weather, when arrivals must use a single runway. One potential solution could come in the form of the FAA's next-generation air traffic management and control system (NexGen) which is discussed later; however, absent major technological enhancements to capacity, SFO could exceed its capacity as early as 2025. Neither OAK nor SJC is forecast in the Base Case to have runway capacity issues over the forecast time frame.

The capacity analysis is based on a model that calculates runway capacity and then feeds this information into another model along with a forecast of aircraft demand to estimate annual aircraft delays. In simple terms, runway capacity is the number of aircraft operations that can be handled by the airport's runways without producing unacceptable levels of delay (and assuming a particular combination of aircraft types using the runways). For SFO, the estimated capacity number is approximately 460,000 to 485,000 annual aircraft operations (an operation is a takeoff or landing), and at OAK the number is approximately 425,000 to 450,000 annual aircraft operations, including the North Field in the calculation. At SJC, the comparable number is over 500,000 annual aircraft operations, but this figure does not consider terminal or landside constraints, which are likely to be the limiting factor at the San Jose Airport. The table below shows the capacity in relation to forecast levels of operations, which include all passenger, cargo, and general aviation flights operating at the airport (in the case of OAK, capacity includes the North Field general aviation airport as well).

	San Francisco	Oakland	San Jose
Capacity	460,000–485,000	425,000–450,000	Over 500,000
2007 Flights	373,000	337,000	200,000
2020 Flights	431,000	301,000	203,000
2035 Flights	527,000	355,000	243,000

POTENTIAL SOLUTIONS (SCENARIOS)

Although adding new runways to existing airports or developing a new regional airport may need to be considered at some point in the future, the assumption in this study is that other methods can be found that will be effective in serving projected demand.

These potential non-runway solutions are called "scenarios." In addition to the two scenarios introduced above, which are a redistribution of flights among the three primary Bay Area airports and implementation of a high-speed rail system in the California corridor, four other scenarios have been included in the study as discussed below. With assistance from the technical advisory panels, each scenario has been defined so as to analyze the performance as an individual solution. Later in the study, these scenarios will be combined into higher-performing solutions based on both the technical analysis and public input. The six scenarios evaluated are described below.

1) Redistribution of Air Passengers Among the Three Primary Bay Area Airports

- Over 500,000 forecast flights at SFO in the 2035 Base Case would not be sustainable without major advances in air traffic control (ATC) technologies to manage delays (see ATC scenario below) and aggressive demand management approaches (also see Demand Management scenario below).

- This scenario assumes delays cannot be mitigated to acceptable levels, causing airlines to shift some of their flights from SFO to OAK and SJC in order to protect their market share and reduce costs. Depending on the pace of new ATC development, these natural shifts in traffic could start to occur around 2020 or even earlier if delays increase at a greater rate than forecast.

- Four million passengers are estimated to shift from SFO to OAK and SJC in 2035.

- SFO passenger shares decline from 64% to 59%, OAK shares increase from 20% to 23%, and SJC shares increase from 16% to 18%.

- Total aircraft operations at SFO decline by 7.1% and total regional operations increase by 0.3%.

2) New Airline Service at Secondary Airports in the Region

- RAPC staff conducted a comprehensive assessment of all the secondary airports in the region, including federal facilities such as Moffett Federal Airfield (operated by NASA) and Travis Air Force Base, using a matrix of evaluation factors.

- Out of this comprehensive review, several airports were identified as potential candidates for new or expanded airline service. Because SJC appears to have sufficient runway capacity to serve demand in 2035, no secondary airline service airports were considered for the South Bay region.

- Potential secondary airports identified were Charles M. Schulz-Sonoma County Airport (assuming services to additional cities not currently served), Travis Air Force Base (through a potential joint use arrangement with the military; this airport had feeder flights to SFO in the early 1970s), and Buchanan Field in Concord (which received limited airline service to some California airports in the past). This does not mean that other airports could not be considered; rather, these airports scored the highest in the initial evaluation based on project demand and available facilities and were therefore selected for this scenario analysis.

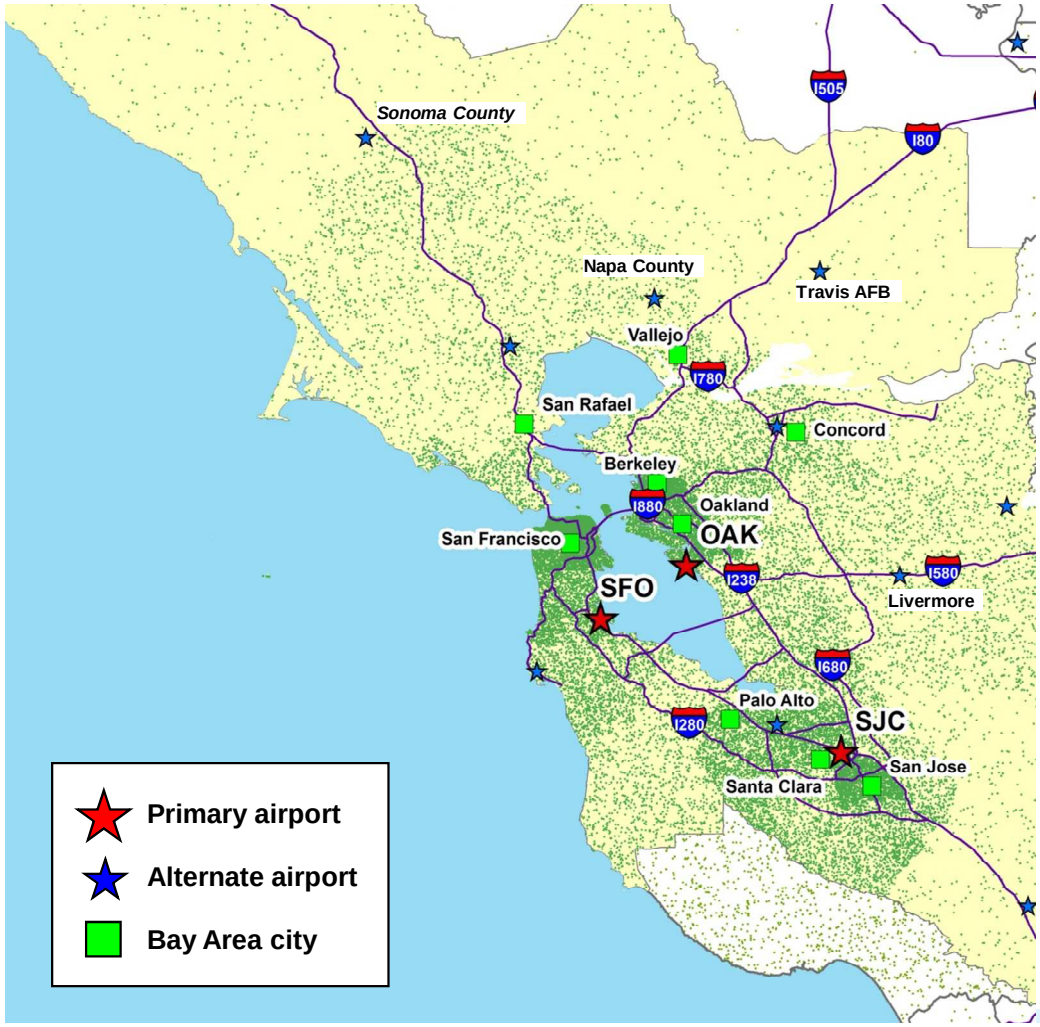
- Sufficient local air passenger demand would need to exist for airlines to be interested in establishing new service at secondary airports (see Figure 4).

- Based on estimated market demand in 2035, secondary airports would have service to five high-density short-haul markets (examples: Los Angeles, San Diego, Las Vegas, Portland, Seattle) and two major airline connecting hubs (examples: Denver, Phoenix, Salt Lake City).

- Together these three airports could shift 2.6 million passengers primarily from SFO and OAK and reduce commercial flights at the primary airports by 2.1%. Overall Bay Area aircraft operations would increase by 2.6% as smaller planes (e.g., 70-seat regional jets or turboprop aircraft) would be used for services at the secondary airports and would not produce a one-for-one reduction in flights at the larger primary airports.

- Some implementation issues with this scenario include airline interest in starting service at a new location (viability of market, fit with their business model, fleet availability, costs of operating a new station, etc.), community interest, potential need for subsidies in the initial years, and availability of gates/runway capacity at destination airports served from these secondary airports.

Figure 4 - Geographic Distribution of Current Bay Area Domestic Passengers



2006 Bay Area Domestic Passengers
One dot represents 1,000 passengers

Region	O&D Psgrs (000s) Dom.	O&D Psgrs (000s) Int'l.	% of Total Bay Area[1]
Nearby Counties			
Santa Cruz	815.1	81.9	1.9%
Monterey	718.9	103.0	1.7%
Sacramento	292.3	333.1	1.3%
San Joaquin	261.7	132.5	0.8%
Stanislaus	247.8	89.8	0.7%
Mendocino	150.1	7.8	0.3%
San Benito	71.1	13.6	0.2%
Lake	35.0	33.2	0.1%
Merced	58.8	0.5	0.1%
Yolo	5.3	0.5	0.0%
Other Regions			
Sierra	229.3	105.2	0.7%
Central Valley	119.5	26.6	0.3%
Northern CA	86.9	42.6	0.3%
Southern CA	95.2	7.2	0.2%
Central Coast	47.8	1.1	0.1%
Total	3,234.8	978.9	8.8%

1/ Share of Bay Area O&D passengers
Source: MTC surveys and SH&E analysis

4

3) New Airline Service at Airports Outside the Region

- About 9% of air passengers using the Bay Area airports are from neighboring regions and use the Bay Area airports because they can only get the flights they need at OAK, SFO, or SJC (also see Figure 4).

- The three external airports—Sacramento, Monterey, and Stockton—were evaluated to assess the ability of increased service levels at these airports to capture local passengers who currently bypass these airports and instead choose to fly from a Bay Area airport.

- Currently (May 2010) Sacramento Airport has 144 daily departures to 31 destinations, compared to Monterey Airport with 17 daily departures to 6 destinations, and Stockton Airport with 1 daily departure to Las Vegas.

- In this scenario, a number of new non-stop services were evaluated for each airport, resulting in an estimated diversion of 1.7 million air passengers from Bay Area airports in 2035.

- New airline service at the out-of-region airports would reduce flight activity at SFO and OAK by approximately 4,000 operations each. The most noteworthy diversion would occur at SJC, with a reduction of 7,500 annual aircraft operations due primarily to improved air services at Monterey.

- Total Bay Area airline passenger flights would be reduced 1.4%.

- This scenario is largely dependent on airline interest in developing new air service at these airports and on local marketing efforts.

4) High-Speed Rail

- A 220 mph high-speed rail (HSR) system for the California corridor is being planned, and partial funding has been secured from state and federal sources. The initial phase would be constructed between downtown San Francisco and Anaheim, serving air passengers who would normally fly to Los Angeles, Burbank, Orange County, and beyond to Ontario and San Diego (the ultimate destination for HSR).

- Over 100 trains per day would travel between the Bay Area and Southern California in 2035 with a travel time to Los Angeles of about 2.5 hours. The planned HSR alignment enters San Jose from the south and travels up the Peninsula to downtown San Francisco.

- California cities served by HSR include 5 of the top 15 domestic air passenger markets projected at 26% of all domestic passengers served from the three Bay Area airports (based on 2007 passenger statistics).

- Air passengers would be diverted to HSR by a combination of factors, such as frequent service, fares, reliability, and proximity to their final destination.

- The study uses the latest California High-Speed Rail Authority forecasts as a basis for the air passenger diversion estimates, resulting in an estimated 6 million air passengers switching from air to rail in 2035, or about 6% of regional air passengers.

- All three airports would experience some diversion, estimated at 2.9 million from SFO, 1.9 million from SJC and 1.8 million from OAK. Air passengers are diverted from OAK to HSR at a lower rate than from the other airports because of less convenient access to HSR from the Oakland area.

- Total passengers would be reduced 4.4% at SJC, 3.2% at OAK, and 1.5% at SFO, resulting in a decrease in aircraft operations Bay Area-wide of 2.5%.

- If airlines respond to the new HSR system by using smaller jet aircraft to maintain frequent service, the benefits for Bay Area runways could decrease.

- Some issues with this scenario include the operation date for the system, the competitiveness of HSR in terms of fares and travel times, whether the system will ultimately require some form of security similar to that required for airline passengers, and whether airlines would actually reduce flights or just substitute smaller aircraft to maintain frequency.

5) New Air Traffic Control Technologies (NexGen)

- Advancements in the FAA's air traffic control technologies using satellite-based navigation systems are expected to revolutionize the FAA's current outdated equipment and procedures for managing both the national airspace and the terminal airspace that surrounds each airport.

- Major elements that would affect airport capacity include reducing the spacing between aircraft landing and taking off at airports (controlled by wake vortex separation requirements), developing new departure and arrival routes to remove existing bottlenecks in the airspace, expanding the weather conditions in which pilots can essentially fly their planes as if they were operating in good weather, improving the sequencing of arriving aircraft to optimize arrival capacity, and improving navigation precision so that aircraft arrive over fixed points at specific times.

- These benefits require a host of new technologies all working together in an integrated fashion and doing so in a manner that would not compromise the safety of passengers; these safety issues would be addressed through the FAA's rigorous technology certification process.

- While these technologies will enhance capacity at all Bay Area airports, the major beneficiary would be SFO as these technologies could overcome some of the limitations imposed by weather patterns and the airport's closely spaced runways.

- Key components of NexGen that have been specifically considered in this scenario include reduced aircraft separation by monitoring the location and strength of wing-tip-generated wake turbulence and Cockpit Assisted Visual Systems (allowing the pilot to "see" other aircraft in bad weather with electronically assisted vision systems).

- An additional ATC improvement at SFO is expanded use of its Simultaneous Offset Instrument Approach (SOIA) during morning fog conditions. And at OAK it has been assumed that the glide slope Antenna at one end of the main air carrier runway would be relocated to improve capacity in bad weather.

- Implementation issues for NexGen technologies include the availability of funding, the lengthy stakeholder review and acceptance process (by pilots, controllers, the FAA, etc.), the lengthy FAA certification process, and finally, the ability and willingness of the airlines to pay for the technologies and install them in their aircraft. Thus, it is difficult to predict exactly when these technologies will be available for use.

6) Demand Management

- The FAA and the airports have certain tools they can use to "manage" demand, meaning to influence the number of flights at an airport.

- Traditionally the FAA has limited the number of flights at highly congested airports by imposing slot controls. Recently the FAA has moved to allow certain congested airports to enact landing fees that are partly based on the level of congestion at the airport rather than based solely on the landing weight of aircraft.

- Under the Base Case forecasts, only SFO is highly congested; therefore, this scenario focuses on SFO's delay problem with emphasis on reducing the number of small aircraft, which includes 50- to 70-seat regional jets and 30-seat turboprops (both are used to feed passengers from smaller cities into SFO where they transfer to longer-distance domestic or international flights) and general aviation aircraft.

- The main components of the SFO demand management strategy are:

  – Using buses instead of small aircraft for short-distance flights from Sacramento, Monterey, and Modesto.

  – Shifting some flights out of the beginning and end of the 8 a.m. to 2 p.m. peak period of the day, which can coincide with morning fog conditions and create delays.

  – "Upgauging" the size of aircraft serving SFO in 2035 to a minimum of 100 seats.

  – Limiting the number of small business jets allowed to operate in the peak period by establishing a reservation system for landings.

- Together, these efforts could eliminate an average of nine flights per hour over the critical 8 a.m. to 2 p.m. period, which would help with some of the delays encountered during morning fog conditions; however, this estimated reduction in flights would not be sufficient to help in the worst weather when arriving aircraft must use a single runway.

RESULTS OF SCENARIO ANALYSIS

Having established a set of goals for the study, each scenario was evaluated against the goals established for the study. To quantify the results, one or more performance measures were defined for each goal. These measures allow changes in performance to be assessed over time (how does performance change between 2007 and 2035?) as well as how the scenarios perform in relation to each other (how does scenario 1 compare to scenario 2 in 2035?). The results of this work are explained below in greater detail and are based on the 2035 Base Case forecasts.

Healthy Economy – Can the region serve future aviation demand and support a healthy economy?

Performance Measure: The degree to which each scenario has adequate capacity to serve projected aviation demand is also a measure of support for the regional Bay Area economy. Delay is used again as the main metric, and each scenario is assigned a qualitative rating of high, medium, or low.

Comments: The degree to which Bay Area airports can handle demand affects the economy in that there are real costs to passengers, businesses, and airlines when flights are delayed or cancelled. Chronic delays at SFO between 1998 and 2000 negatively affected the scheduling of business meetings, the region's ability to book conventions, and tourism.

Results:

- This goal is largely focused on SFO, which is forecast to have a significant delay problem in 2035. Scenarios that effectively address delays receive higher rankings.
- ATC produces the greatest reduction in aircraft delays (57%) and thus provides high support for the economy.
- Traffic Redistribution, HSR, and Demand Management reduce delay by 18–30% and provide medium support for the economy.
- Internal Airports and External Airports reduce delay by less than 10% and provide low support for the economy.

Figure 5 – Healthy Economy

Scenario	2035 SFO Avg Aircraft Delay (minutes)	Healthy Economy Rating
Baseline	21	Low
Redistribution	15	Medium
Internal Regional Airports	19	Low
External Regional Airports	21	Low
High-Speed Rail	17	Medium
New ATC Technologies	10	High
Demand Management	17	Medium

ICF INTERNATIONAL SH&E an ICF International Company

7

Reliable Runways – Can we reduce flight delays and passenger inconvenience?

Performance Measure 1: Average annual aircraft delay.

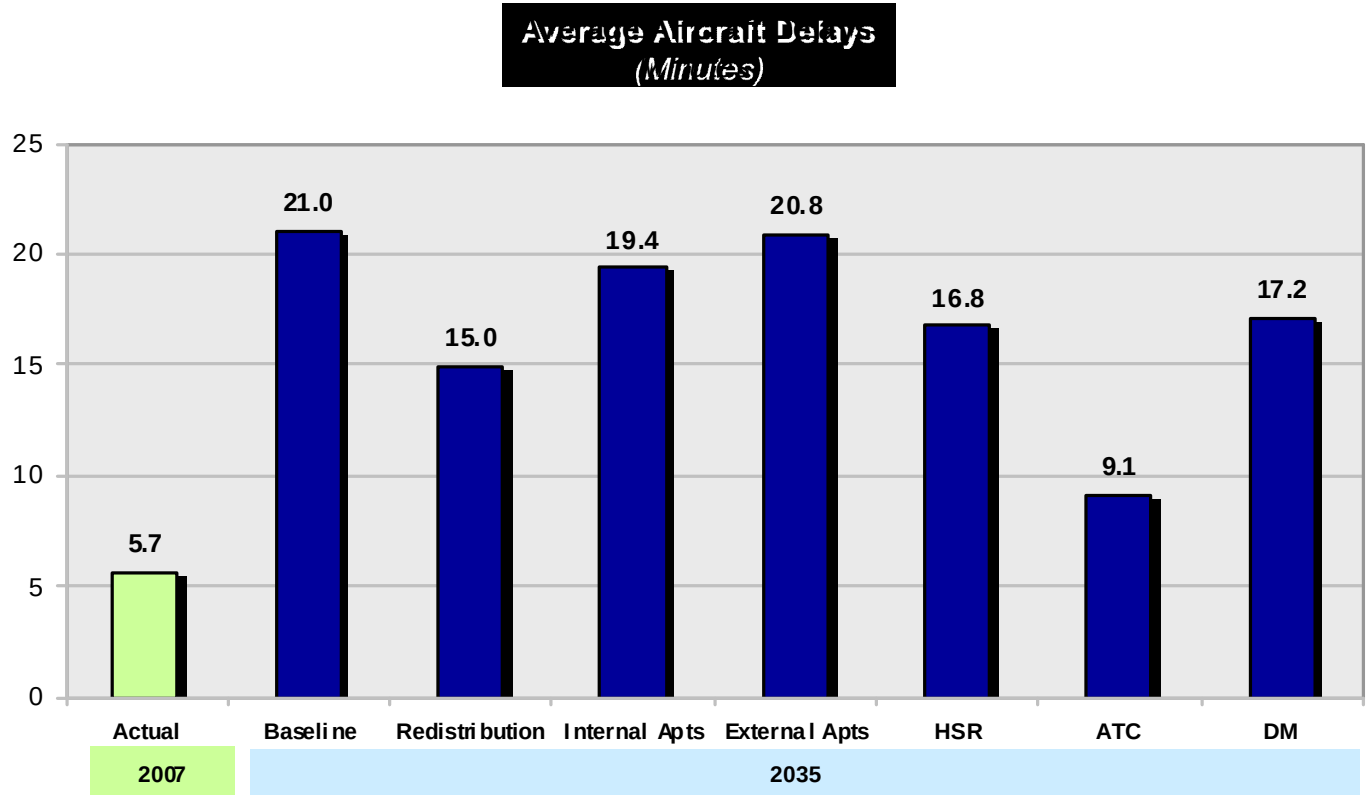
Performance Measure 2: Average annual aircraft delay during the 3 consecutive hours with the highest delay.

Comments: Runway capacity and delay models were used to determine the average aircraft delay (total delay minutes divided by total annual aircraft operations) for each scenario. Delays vary by scenario based on the number of aircraft takeoffs and landings, fleet mix (i.e., the specific types of aircraft using the airport), airport runway configuration and operating procedures, and frequency of good and bad weather. For the purposes of this analysis, the acceptable level of average annual aircraft delay was defined to be 12 to 15 minutes. A second performance measure was also used, this time reflecting average delays over the busiest 3 hours of the day. This measure was used as a proxy for the worst conditions passengers would experience in terms of schedule disruptions. Here the threshold was set at 20 minutes, based on some anecdotal information from different metrics used by the FAA.

Results:

- SFO continues to be the most delay-prone Bay Area airport in 2035. For all scenarios, average annual aircraft delays at OAK are less than 5.0 minutes, and SJC's delays are less than 1.0 minute.

Figure 6 – Reliable Runways



5

- Under the Base Case, SFO delays increase from acceptable levels today (5.7 minutes) to unacceptable levels in 2035 (21.0 minutes) due to the forecast increase in aircraft operations and capacity constraints imposed by SFO's runway configuration in poor weather.

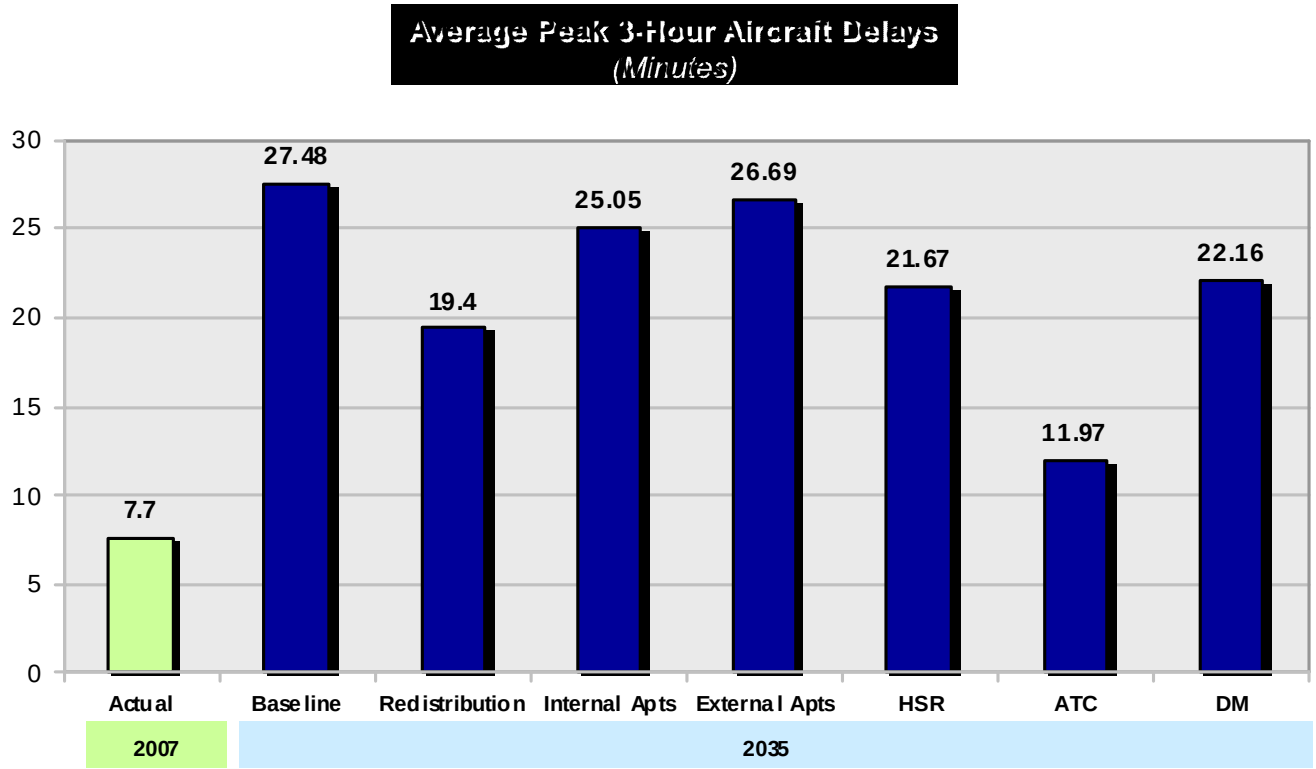
- ATC is the best scenario in that it mostly solves SFO's runway problem (reducing average delay to 9.0 minutes), but this scenario is based on a very optimistic view of what NexGen can deliver and when these technologies will be available (as mentioned above, many important issues remain to be addressed).

- Redistribution of traffic among the three airports is next best (15.0 minutes) followed by HSR (16.8 minutes).

- Demand Management will help, but doesn't address the really bad weather problems at SFO (17.2 minutes).

- Similar scenario rankings were obtained for the second performance measure, where the 3 hours with the most delay are measured.

Figure 7 – Reliable Runways



6

Good Passenger Service – Can we provide better service to the region's major air travel markets?

Performance Measure: Flights per capita (specifically, annual departures per 10,000 population) in the top 15 domestic markets.

Comment: This goal measures how many flights Bay Area residents would have available in 2035 to the most highly traveled domestic destinations. The top 15 destinations represent 62% of all domestic air passengers. The HSR scenario is somewhat unique as trains provide service to the major California destinations, so the trains have been counted as flights.

Results:

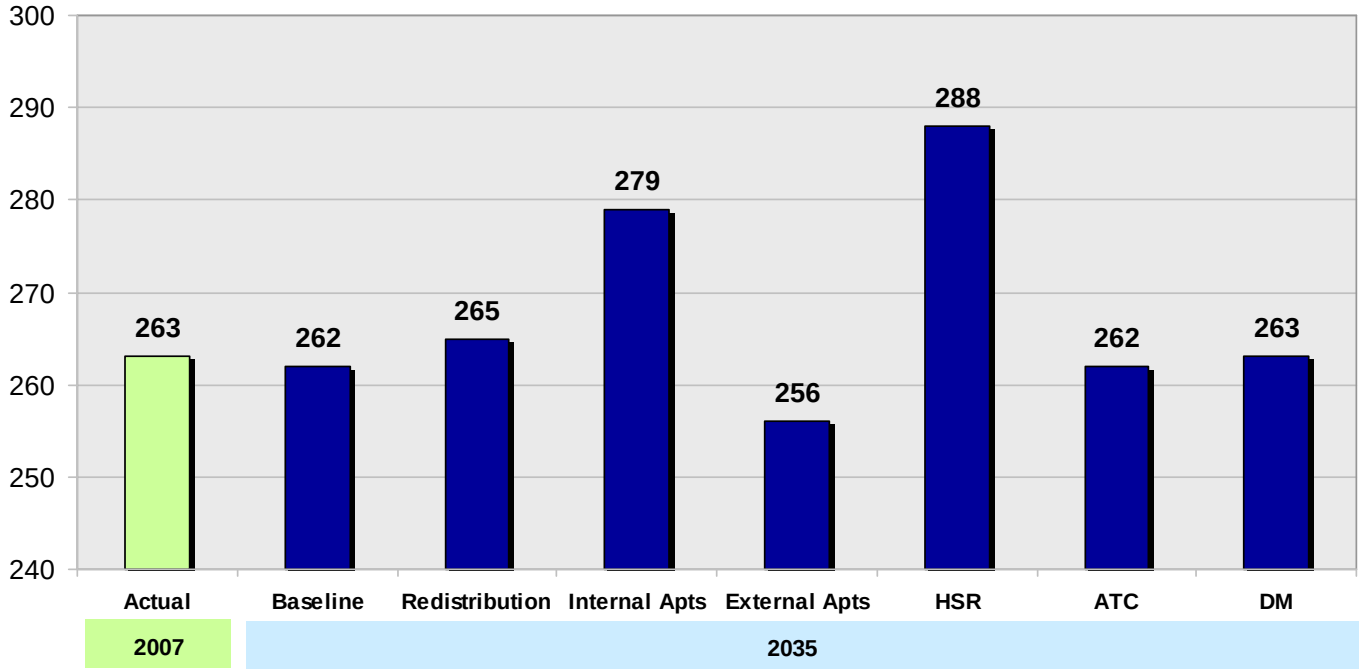
- The best scenario is HSR (288) due to the frequency of train service. (There are also flight reductions at the Bay Area airports as a result of air passengers switching to rail, but these are more than offset by the high level of train service.)

- The next best scenario is Internal Airports (279), due to added flight frequencies by small aircraft at Sonoma, Travis AFB, and Buchanan, followed by Traffic Redistribution (265).

- Compared to 2007 (263 departures per 10,000 population), the baseline, ATC, and Demand Management all produce about the same number of flights per capita (262–263).

Figure 8 – Good Passenger Service

Service in Top 15 O&D Markets
(Annual Departures per 10,000 Population)



Note: HSR Scenario counts train frequencies as flights.
2035 population based on ABAG's 2007 projections.

8

Convenient Airports – Can we maintain or improve airport ground access times and costs?

Performance Measure: Average time and cost to airports for air passengers traveling to airports.

Comments: This performance measure addresses the time and cost expended by air passengers in getting to the airports. Some air passengers will not be able to use the closest airport because it may not provide the desired flights. The analysis includes trips by all modes of airport access—personal car, taxi, rental car, shuttle, bus, mass transit, etc. The geographic location of air passengers in the region is forecast separately and is input to this measure (see Figure 4). The average airport travel time experienced by air passengers is projected to increase from about 49 minutes in 2007 to between 50 and 51 minutes in 2035 (a 3–5% increase). This increase is mainly due to projected regional growth which results in more congestion on the major highways, which are also the primary access routes to the airports.

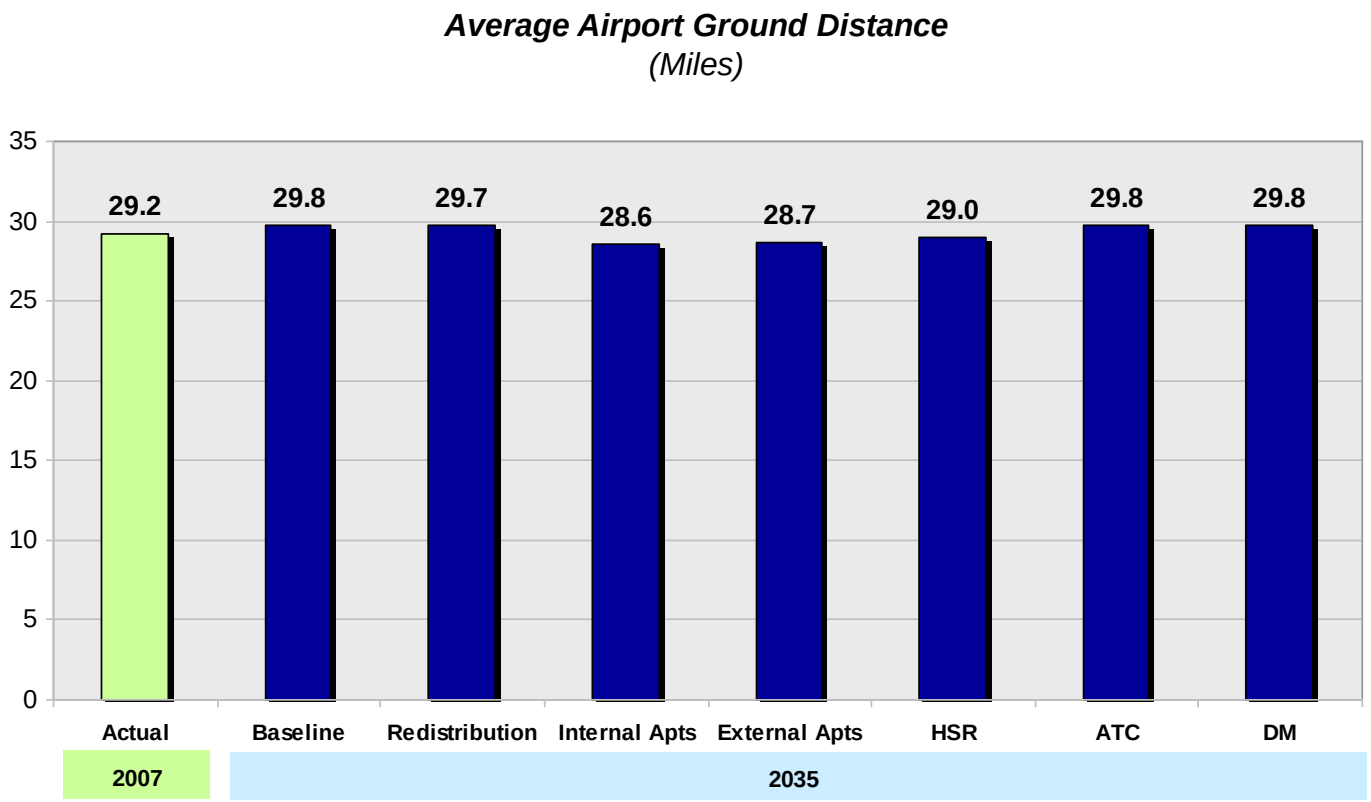
Results:

- Traffic Redistribution has the lowest average access distance and travel time as more flights at OAK and SJC are provided nearer to where people live and work.

- Internal Airports is next best for the same reason, but there are fewer passengers that would benefit from shorter ground access trips.

- External Airports looks good as well, because many long distance trips from outside the region are eliminated as these trips are converted to shorter trips to one of the airports outside the region. The major benefits of this scenario are environmental (reduced emissions and greenhouse gases), but average times and costs for Bay Area air passengers do not change significantly in this scenario compared to the Base Case.

Figure 9 – Convenient Airports



Note: Access costs include highway and transit costs.

Climate Protection – Can we decrease greenhouse gas (GHGs) emissions from aircraft and vehicle trips to and from airports?

Performance Measure: Daily tons of carbon dioxide (CO_2) produced by planes and air passenger vehicles.

Comment: Despite the continuing introduction of more fuel-efficient aircraft, CO_2 (the primary GHG analyzed in this study) is projected to increase. SFO's commercial airline fleet is estimated to be about 5% more fuel-efficient in 2035 compared to 2007. This small improvement is due to some significant improvements in the overall fuel efficiency of the airline fleet that have already happened as well as the retirement of many older fuel-inefficient aircraft that were no longer profitable to operate when airline fuel costs spiked in 2008. In contrast, air passenger vehicles used for airport travel will become markedly more fuel-efficient, as new federal fuel economy standards take effect and older vehicles are retired. It is worth noting that implementation of the FAA's NexGen technologies could provide significant GHG reductions for aircraft operating in the national airspace, and these reductions are not captured in this analysis. Between 2007 and 2035, daily CO_2 would increase about 53%, including both aircraft and airport ground travel. Of this amount about 83% of greenhouse gases will come from aircraft and 17% from air passenger vehicles. While California has set ambitious targets to reduce GHGs emissions (40% below 1990 levels in 2035), new reductions in GHGs from aircraft will most likely be negotiated at the international level.

Results:

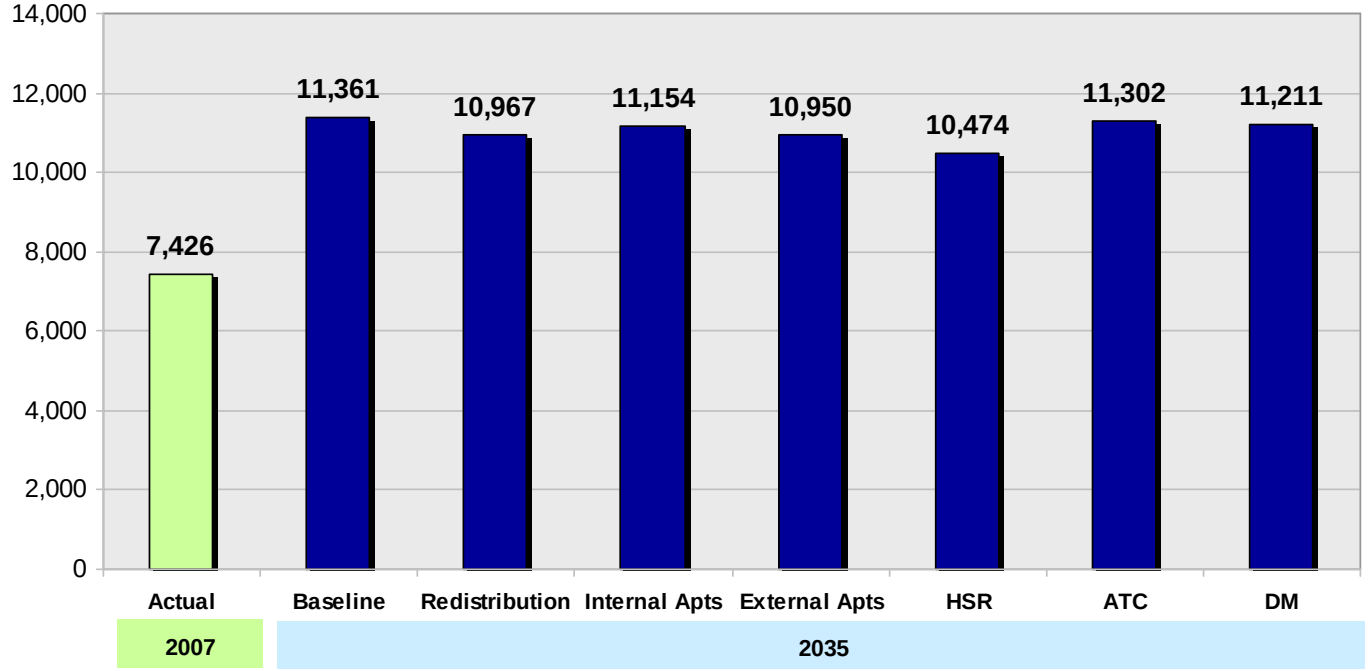
- HSR is the best scenario due to the reduction it produces in total Bay Area flights, followed by Traffic Redistribution.

- While emissions from HSR trains themselves are not included in the totals (the GHG estimates only address reductions in the numbers of flights), HSR produces fewer GHGs on a per passenger mile basis when compared to aircraft and will result in even lower GHGs in the future as more renewable energy sources are used for generating electricity in California.

- External Airports almost matches Traffic Redistribution, but mainly transfers aircraft GHG emissions outside the Bay Area as new flights are added to serve local air passengers at Sacramento, Stockton, and Monterey airports. There would, however, be a reduction in emissions from shorter ground access trips.)

Figure 10 – Climate Protection

Green House Gas Emissions
(Daily Metric Tons of CO2)



Notes: Includes emissions from aircraft and airport ground access vehicles.
Internal Airports Scenario includes emissions from new air services at alternative airports.
External Airports Scenario excludes emissions from service development at airports outside the region.
HSR Scenario excludes emissions for rail service, but a sensitivity analysis was performed.

ICF INTERNATIONAL SH&E an ICF International Company

11

Clean Air – Can we decrease air pollution from aircraft and vehicle trips to and from airports?

Performance Measure: Daily tons of hydrocarbons (HC) and nitrogen oxides (NOx) produced by planes and air passenger vehicles.

Comments: Emissions of HC and NOx combine to form smog, and HC emissions also include some toxic air contaminants. Aircraft emissions have been calculated for all phases of flight below the mixing layer of 2,300 feet. Aircraft emissions are projected to increase 49–66%, depending on the scenario, due largely to growth in aircraft operations (there will be some reduction in aircraft emissions in 2035 due to provision of electric power to planes at all gates). In contrast to aircraft emissions, air passenger vehicle emissions will actually decrease between 2007 and 2035 as state-mandated emission controls and the turnover of the vehicle fleet produce fairly dramatic reductions in pollutants (2.8 metric tons per day in 2007 decreased to 0.7 tons in 2035). Air passenger vehicle emissions will constitute 3% of total emissions in 2035.

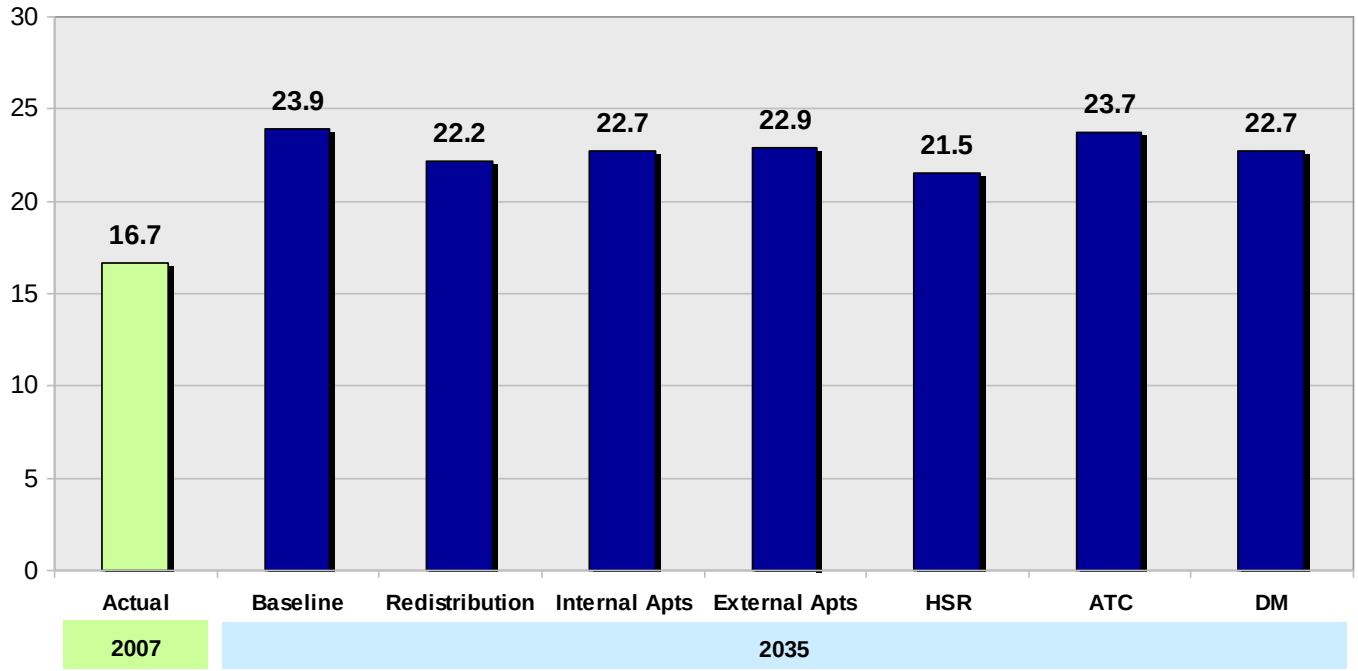
- Similar to the GHG analysis above, HSR shows the lowest emissions (21.6 metric tons per day), followed again by Traffic Redistribution (22.3 metric tons per day).

- Internal Airports and Demand Management are tied for third. With the Internal Airport scenario, airlines use smaller aircraft with lower emissions than the aircraft they replace at the primary airports, thus providing a slight emission benefit.

- ATC does not produce much in the way of emissions reductions as the number of operations does not change from the Base Case; however, there is a slight benefit that accrues related to a reduction in taxiing delays.

Figure 11 – Clean Air

NOx plus HC Emissions
(Daily Metric Tons)



Note: Includes emissions from aircraft and airport ground access vehicles.
Internal Airports scenario includes emissions from new air services at alternative airports.
External Airports scenario excludes emissions from service development at airports outside the region.
HSR Scenario excludes emissions for rail service.

ICF INTERNATIONAL SH&E an ICF International Company

12

Livable Communities – Can we avoid increasing the regional population exposed to aircraft noise?

Performance Measure 1. Regional population inside the 65 CNEL contour.

Performance Measure 2. Regional population inside the 55 CNEL contour.

Comments: Noise levels around airports are expressed in CNEL (Community Noise Equivalent Levels) and, consistent with state noise standards, the 65 CNEL contour line is used to demarcate areas where there is a potential noise problem for people living near airports. The 55 CNEL contour is larger area-wise (but lower noise level) and encompasses a significantly larger population; the population within this contour was evaluated as well because of the history of airport noise complaints which show that many complaints originate outside the 65 CNEL contour. The size and shape of future noise contours are based on the number of aircraft operations, the noise characteristics of aircraft using the airport, the split in operations between the day, evening, and nighttime periods, and the use of various airport arrival and departure flight tracks. The analysis tool used in this study provides a simplified approach to determining changes in the noise footprint at each airport without running complex airport noise models which are more precise. While the airline fleet as a whole became much quieter in the 1990s as airlines upgraded to Stage 3 aircraft to comply with the FAA's mandate to phase out louder Stage 2 aircraft by January 1, 2000 (causing noise contours around many airports to shrink), similar improvements in the noise intensity of the commercial airline fleet are not evident in the decades ahead. The latest Stage 4 noise requirements only prevent the creation of new aircraft types that would be much noisier than most existing Stage 3 aircraft. Many newer aircraft in the current airline fleet would also meet the Stage 4 noise requirements for newly manufactured aircraft. Thus, with growing operations and limited reductions in the noise intensity of the airline fleet, noise exposure increases over the forecast period.

Also affecting the performance measure for this goal would be any increase in the underlying population inside the 55/65 CNEL noise contours between 2007 and 2035. Some future population increases may in fact occur if new regional initiatives to encourage more sustainable and transit-friendly Bay Area growth patterns are successful. This possibility illustrates some of the difficult policy issues that arise with airport planning.

Results

- All scenarios show increases in population for the 55 and 65 CNEL noise contours from 2007 to 2035. There is about a 7% difference in population (3,700 people region-wide for the 65 CNEL and 28,000 for the 55 CNEL) between the scenario with the highest and lowest noise impact.

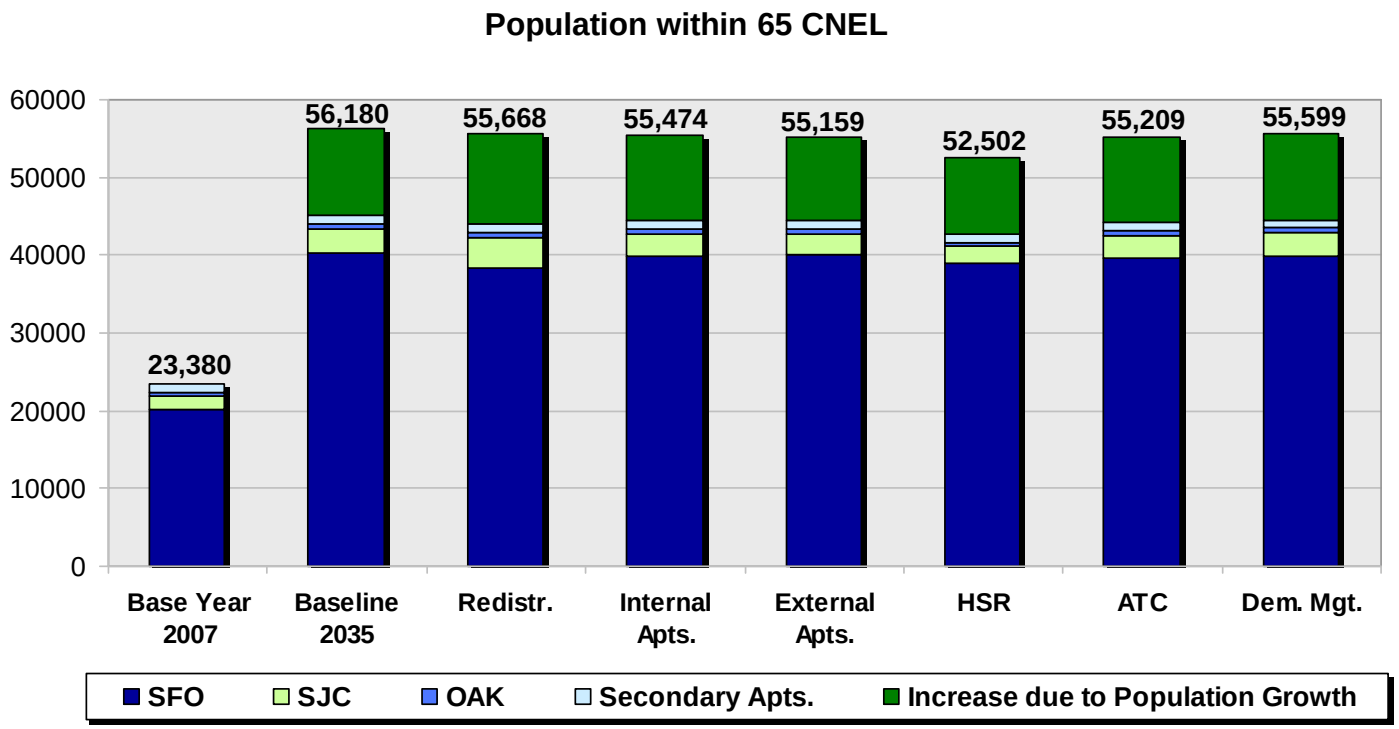
- Most of the increases in population occur around SFO, and most of this increase is the result of the projected increase in aircraft flights. About 66% of the increased population in the Base Case (65 CNEL contour) is due to more flights and 34% is due to more population inside the contour.

- HSR is the best scenario in terms of noise-exposed population, as it produces the fewest aircraft operations in 2035, followed by External Airports.

- Other points that are important to bear in mind when considering these results: (1) many homes in the forecast contours have already received noise insulation through airport- and FAA-sponsored programs, (2) any homes sold near airports would be subject to

airport noise disclosure requirements under current California real estate law, and (3) any new residences constructed inside the 65 CNEL would likely be required to have noise insulation and may also be required to grant a noise easement to the airport. Also because 2007 was used as a baseline, operations had already decreased at OAK and SJC from historic levels, such that the 2007 base year noise contours would be smaller than in prior years and would result in a larger percentage increase in population over the forecast years.

Figure 12 – Livable Communities

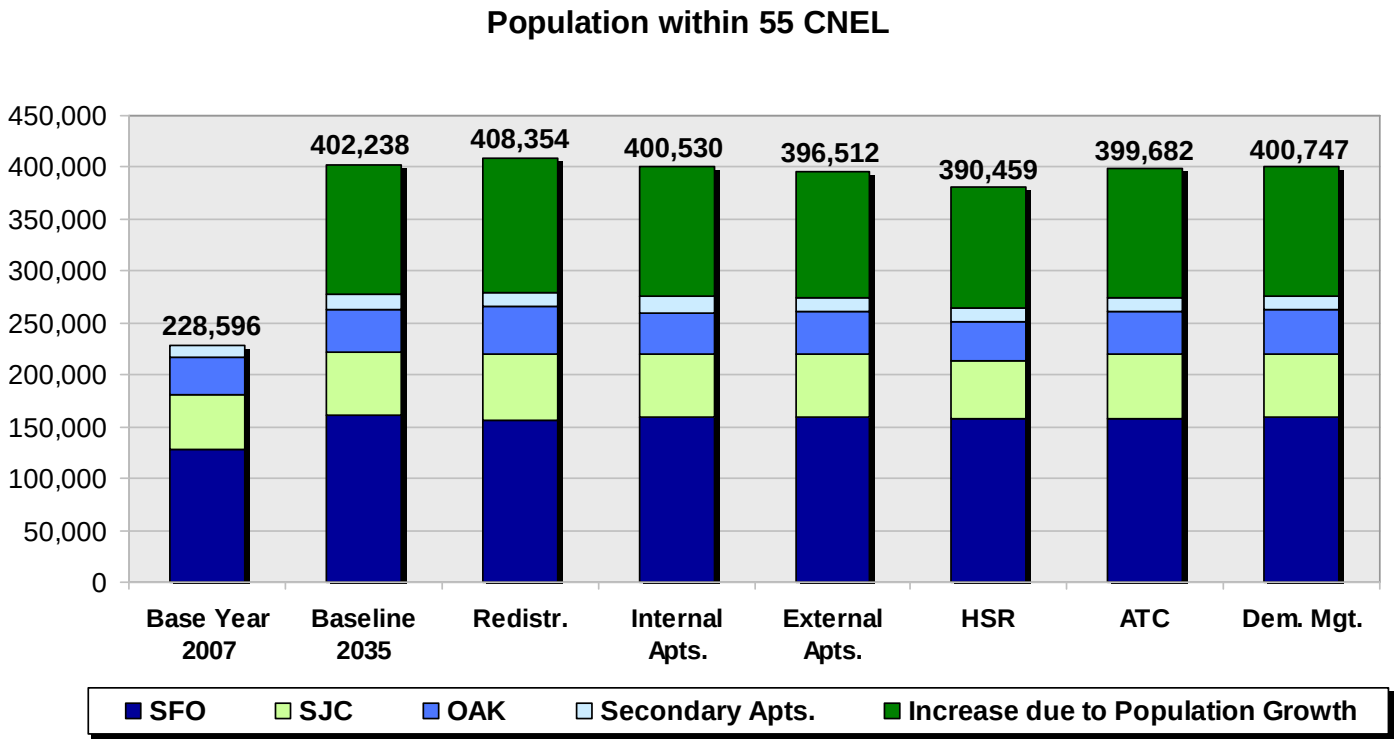


Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Internal Airports includes increases in 65 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports include Sonoma County Airport, Buchanan Air Field, and Travis AFB.
Some residences in forecast 2035 contours have already been soundproofed.

ICF INTERNATIONAL SH&E an ICF International Company

0

Figure 13 – Livable Communities



Notes: Change in population from 2007 Base year to 2035 Baseline results from forecast growth in aircraft operations.
Internal Airports includes increases in 55 CNEL populations at alternative airports due to diversion from primary airports.
Secondary airports include Sonoma County Airport, Buchanan Air Field, and Travis AFB.
Some residences in forecast 2035 contours have already been soundproofed.

ICF INTERNATIONAL SH&E an ICF International Company

1

SUMMARY

- The baseline scenario (unconstrained) is not the optimal situation from the perspective of many of the goals that were tested.

- ATC is the only scenario that effectively allows SFO to reduce aircraft delays to acceptable levels, but this scenario assumes an optimal set of new ATC technologies. Other issues include the timing of when these technologies will be in place and the airlines' ability to pay for them and install them in their aircraft. While ATC does not appear to have major environmental benefits within the airspace evaluated, it would have environmental benefits on a national scale. Also, ATC would enable use of Continuous Descent Approaches into airports, where the glide path of landing aircraft is optimized for fuel, emissions, and noise. This aspect will be evaluated further in the next portions of the study.

- High Speed Rail performs well for all the environmental goals, and for the amount of passenger service it provides. It is not quite as effective as Traffic Redistribution in lowering delays at SFO.

- Traffic Redistribution generally performs well under the various study goals, but does not match HSR, which is the most effective strategy for many of the goals. Traffic Redistribution could be more effective if additional traffic could be shifted to OAK and SJC airports, but OAK could then reach its runway capacity sooner.

- Demand Management is somewhat of a middle-of-the-road scenario, as it is neither the best nor worst for most goals. It does not reduce flights sufficiently to help at SFO during very bad weather, but it would help reduce flights to a level closer to SFO's capacity during summer fog conditions.

- Internal Airports, using secondary Bay Area airports for new airline service, does not produce meaningful delay reduction at SFO, but it does provide more flight choices for Bay Area residents and reduces airport travel distance, time, and costs for many residents. It does not offer significant additional environmental benefit, but it is not the worst scenario either.

- Finally, External Airports produces little in the way of delay reduction at SFO, but it does provide more flight choices for people living outside the Bay Area, thus reducing aircraft operations at Bay Area airports. Environmentally, the scenario does well, but in reality it creates additional emissions outside the region which may be equal to or greater than the emissions reduced within the Bay Area. Clearly the reduced airport ground access travel distance is a plus on the environmental side, as residents outside the Bay Area use their local airports for more of their flight needs.

Figure 14 – Summary of Screening Results

	Goal:						
Scenario	Economy	Reliable Runways	Good Service	Convenient Airports	Climate Protection	Clean Air	Livable Communities
Baseline	⊘	⊘			⊘	⊘	⊘
Redistribution				~	~	~	~
Internal Airports				~	~	~	~
External Airports	●	●	●	~	~	~	~
High-Speed Rail			◉	~	◉	◉	◉
ATC Technologies	◉	◉		~	~	~	~
Demand Mgmt				~	~	~	~

Notes:

Reliable Runways based on Average Aircraft Delays
Liveable Communities based on 65 CNEL Population
Climate Protection and Clean Air are for aircraft impacts only (excludes ground access vehicle impacts)

Legend:

- ◉ **Most Effective**
- ● **Least Effective**
- ⊘ **Baseline is Least Effective**
- ☑ **Baseline is Most Effective**
- ~ **Similar Results**

ICF INTERNATIONAL SH&E an ICF International Company

15