Supplement to Planning Advisory Committee Meeting #3

Focus Topic: Aviation Demand Forecasts

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Slides Updated from PAC Meeting #3

Based Aircraft Slides

- Current Base Aircraft (#19)
- Based Registration Location (#20)
- Based Aircraft Forecast (#22)
- Based Aircraft Fleet Mix (#23)

Operations Slides

- Hillsboro Itinerant GA Operations Forecast (#27)
- Hillsboro Local GA Operations Forecast (#28)
- Hillsboro Total Operations Forecast Summary (#31)
- Airport Peak Activity (#32)
- Operations and Based Aircraft Forecast Summary (#33)
- Fleet Mix Operations (#34)

Forecast Considerations

Questions to Answer

- What is the purpose of preparing forecasts?
- What types of forecasts are prepared?
- What are the drivers and trends of aviation demand?
- How does the FAA determine that forecasts are reasonable for long term planning?
- How will forecasts be used to guide decisions about future development?
- What happens if significant deviations develop between the forecast and actual numbers in the future?

Forecast Purpose and Process

- Forecasts: Basis for effective decision making in airport planning.
- Projections: Determine need for new or expanded facilities based upon demand.
- 20-Year forecast for master plans: 2016 (base year), 2021, 2026, 2036 (FAA)
- Forecast elements for Hillsboro Airport: Based Aircraft and Operations
- Approach: Multiple forecasts ⟶ planning envelope ⟶ selected forecast.
- Methods: Trend-line analysis, regression analysis, market share analysis, etc.
  - FAA: Keep it simple
- Requires both analytical and judgmental processes.
- Compare total based aircraft and total operations to the FAA Terminal Area Forecast (TAF) for consistency:
  - Within 10% in 5-year
  - Within 15% in 10-year
- FAA to review and approve the forecasts.

Forecast Categories

Based Aircraft

- Total Based Aircraft
- Based Aircraft Fleet Mix

Operations

- General Aviation (Itinerant and Local)
- Air Taxi (Itinerant)
- Military (Itinerant and Local)
- Peaking Characteristics
  - Peak Month
  - Design Day
  - Busy Day
  - Design Hour

Operations Fleet Mix

- Single Engine Piston
- Multi-engine Piston
- Turboprop
- Jet
- Helicopters

Critical Design Aircraft

- Leads to applicable design standards for runway, taxiways, etc.

FAA Forecast Process

7 Standard Steps in the Forecast Process

- Identify Aviation Activity Measures
- Review Previous Airport Forecasts
- Gather Data
- Select Forecast Methods
- Apply Forecast Methods and Evaluate Results
- Summarize and Document Results
- Compare Forecast Results with FAA's TAF

Forecast Inputs and Methods

INPUTS

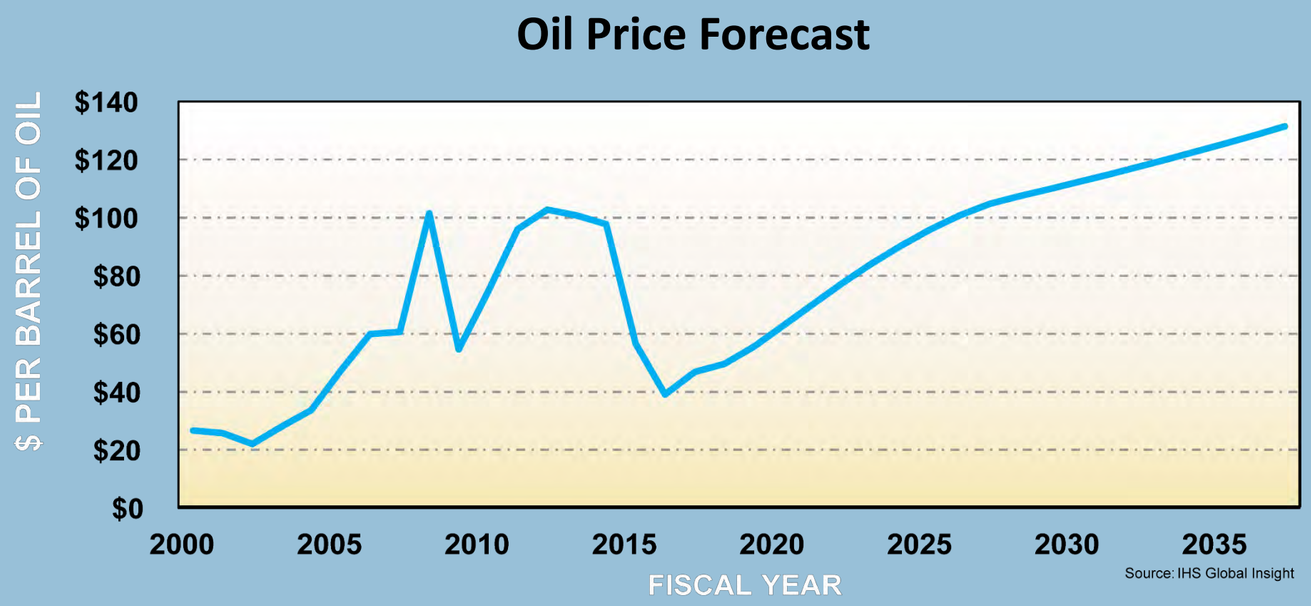
- FAA's annual aerospace forecasts 2017-2037
  - Active general aviation aircraft
  - General aviation operations
  - Active pilots
  - Hours flown
- Socioeconomic data
  - Population, employment, income, etc.
- Aircraft ownership
  - Area registered aircraft
- Historical trends
  - HIO operations
  - HIO based aircraft

METHODS

- Trend Line: "Fit" a projection line over historical data and extend into the future.
- Regression: Dependent (aviation demand) and Independent variables (socioeconomic).
- Market Share Analysis: Extend the % share of a known ratio.
- Growth Rate Analysis: Apply a known historical growth rate to aviation elements.

Economic Assumptions

- Forecasts rely on four key assumptions about future economic conditions that may affect aviation activity.

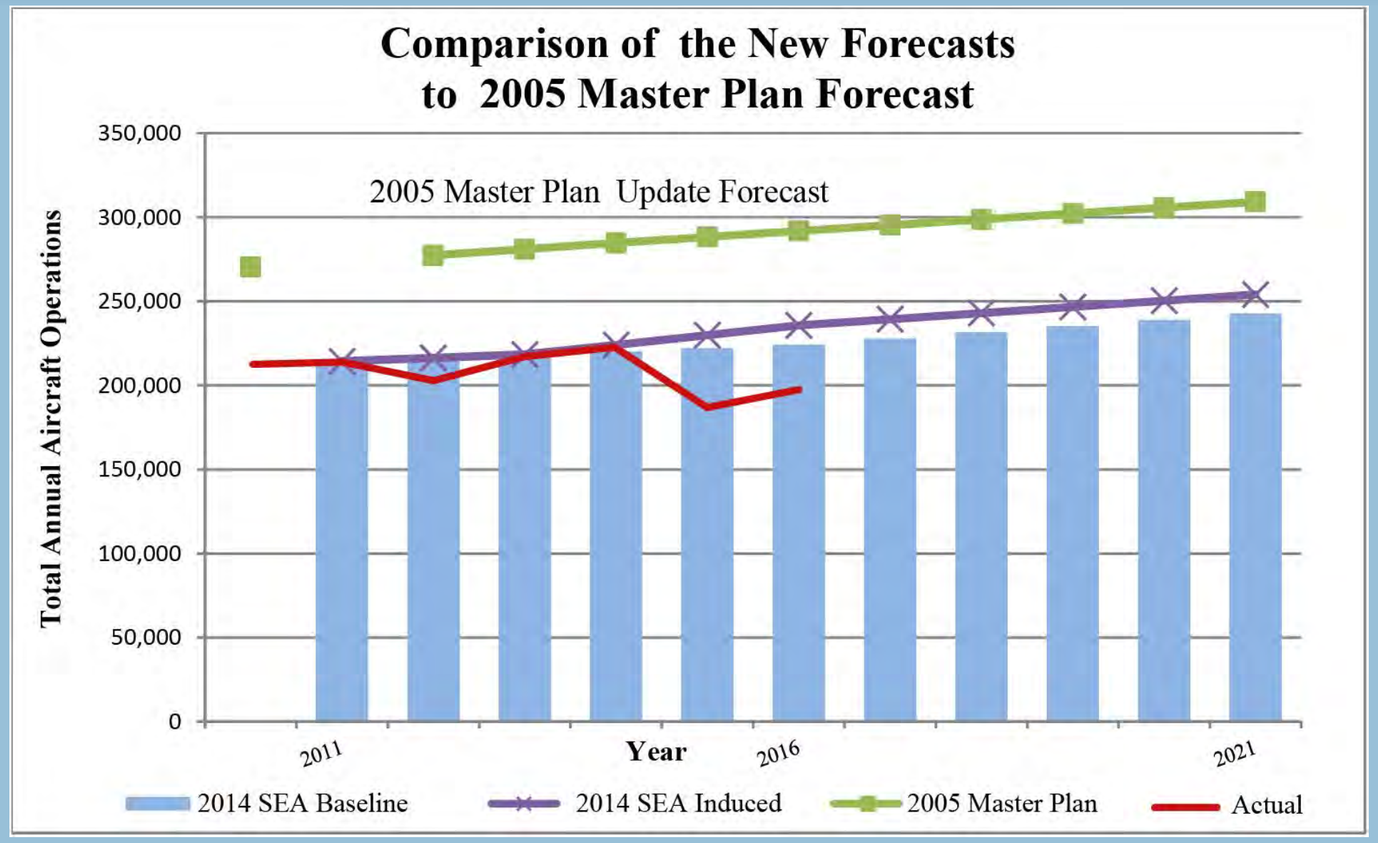


- U.S. GDP through 2037: 2.1% annually
- Oil Prices:
  - $39 per barrel in 2016
  - $47 per barrel in 2017
  - $101 per barrel in 2026
  - $131 per barrel in 2037
- Portland Metro socioeconomic measures will trend as forecast.
- FAA aviation measures will trend as forecast.

Previous Forecasts Considered

- 2005 Master Plan
- 2010 Environmental Assessment
- 2014 Supplemental Environmental Assessment (2011 baseline)

- Previous forecasts inform development of new forecasts.
- FAA recommends updating forecasts and airport planning document every 7-10 years or when there have been significant changes in the local or national aviation industry.



Source: SEA - Supplemental Environmental Assessment (Feb. 2014). Actual added.

Historic and Forecast Socioeconomic Data

Year	Population[2]	Employment (Non-farm)[2]	Households[2]	Income (PCPI)[3]
2000	1,927,881	973,230	746,625	$37,407
2010	2,226,009	968,830	857,379	$39,087
2011[1]	2,248,834	993,756	865,041	$40,178
2012[1]	2,271,894	1,019,323	872,771	$41,366
2013[1]	2,295,190	1,045,548	880,571	$40,921
2014[1]	2,318,725	1,072,448	888,440	$41,973
2015	2,342,501	1,100,040	896,379	$42,658
2016[1]	2,376,813	1,124,544	912,674	$43,266
CAGR 2000-2016	**1.32%**	**0.91%**	**1.26%**	**0.91%**
2020	2,519,163	1,228,140	980,872	$45,679
2025	2,671,777	1,311,570	1,055,978	$48,733
2030	2,814,058	1,399,790	1,125,755	$51,560
2035	2,937,885	1,484,460	1,187,311	$54,046
2040	3,052,078	1,571,290	1,244,034	$56,459
CAGR 2016-2040	**1.05%**	**1.40%**	**1.30%**	**1.12%**

[1]Interpolated figures for population, employment, and households

[2]*Metro Research Center (2014 update)*

[3]Woods & Poole Economics

CAGR: Compound Annual Growth Rate

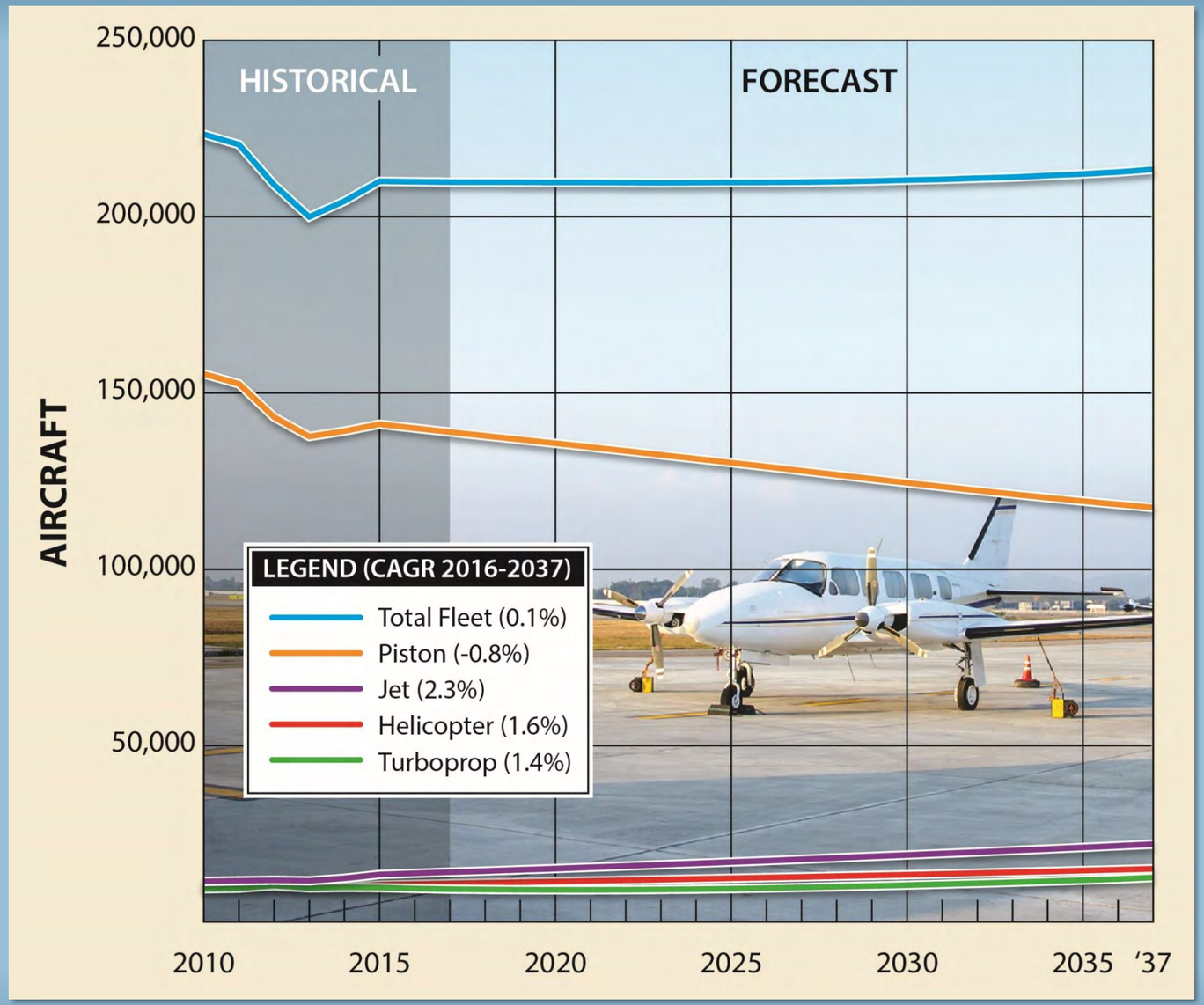
PCPI: Per Capita Personal Income

FAA Aviation Industry Forecasts

FAA prepares long range forecasts which are updated annually. The following five slides present relevant forecast trends used in this forecast as projected by FAA:

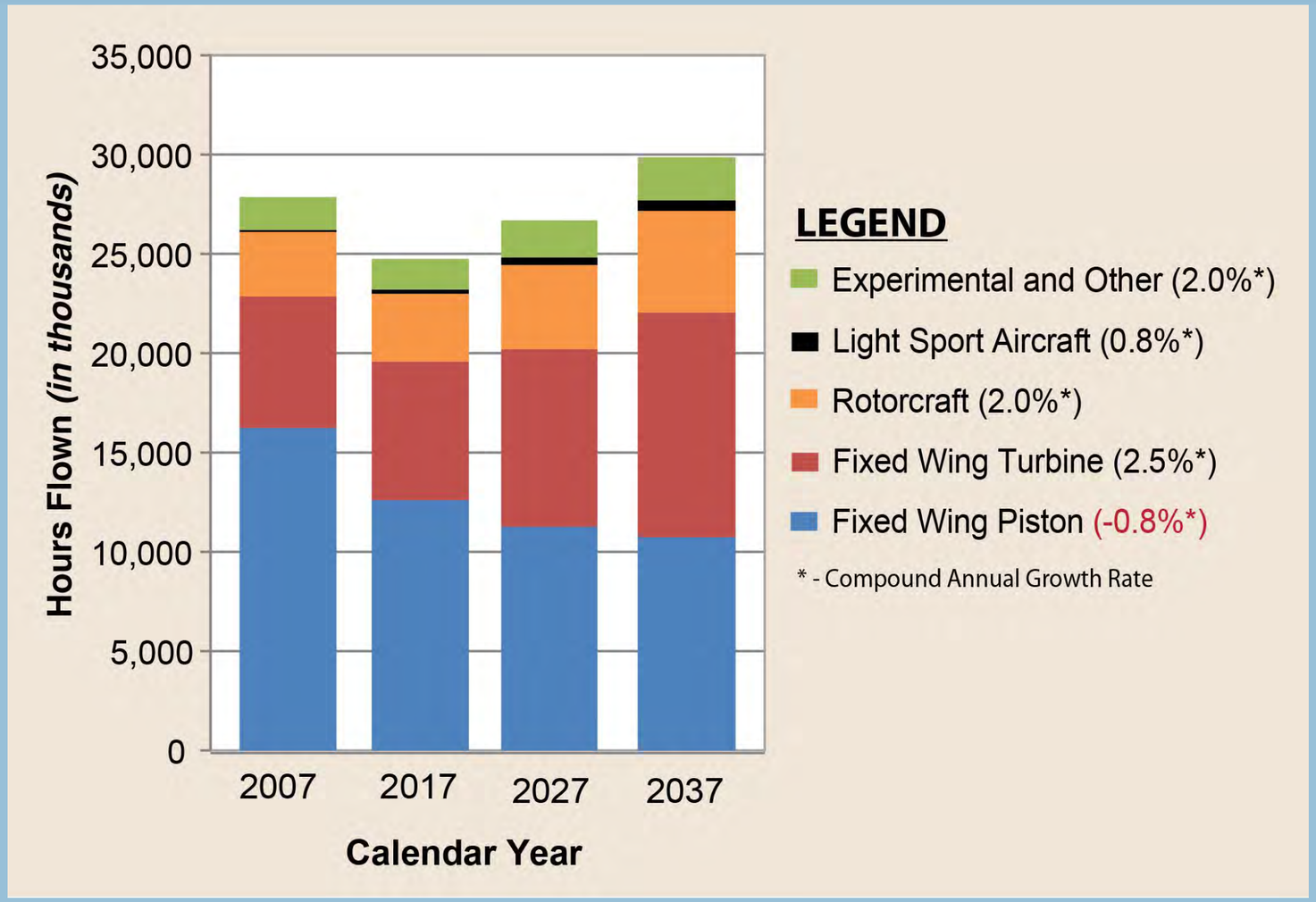
- U.S. General Aviation Forecast
- U.S. General Aviation Hours Flown
- U.S. Pilots by Type of Certificate Held
- U.S. General Aviation Operations Forecast
- U.S. Air Taxi Operations Forecast

U.S. General Aviation Aircraft Forecast (FAA)



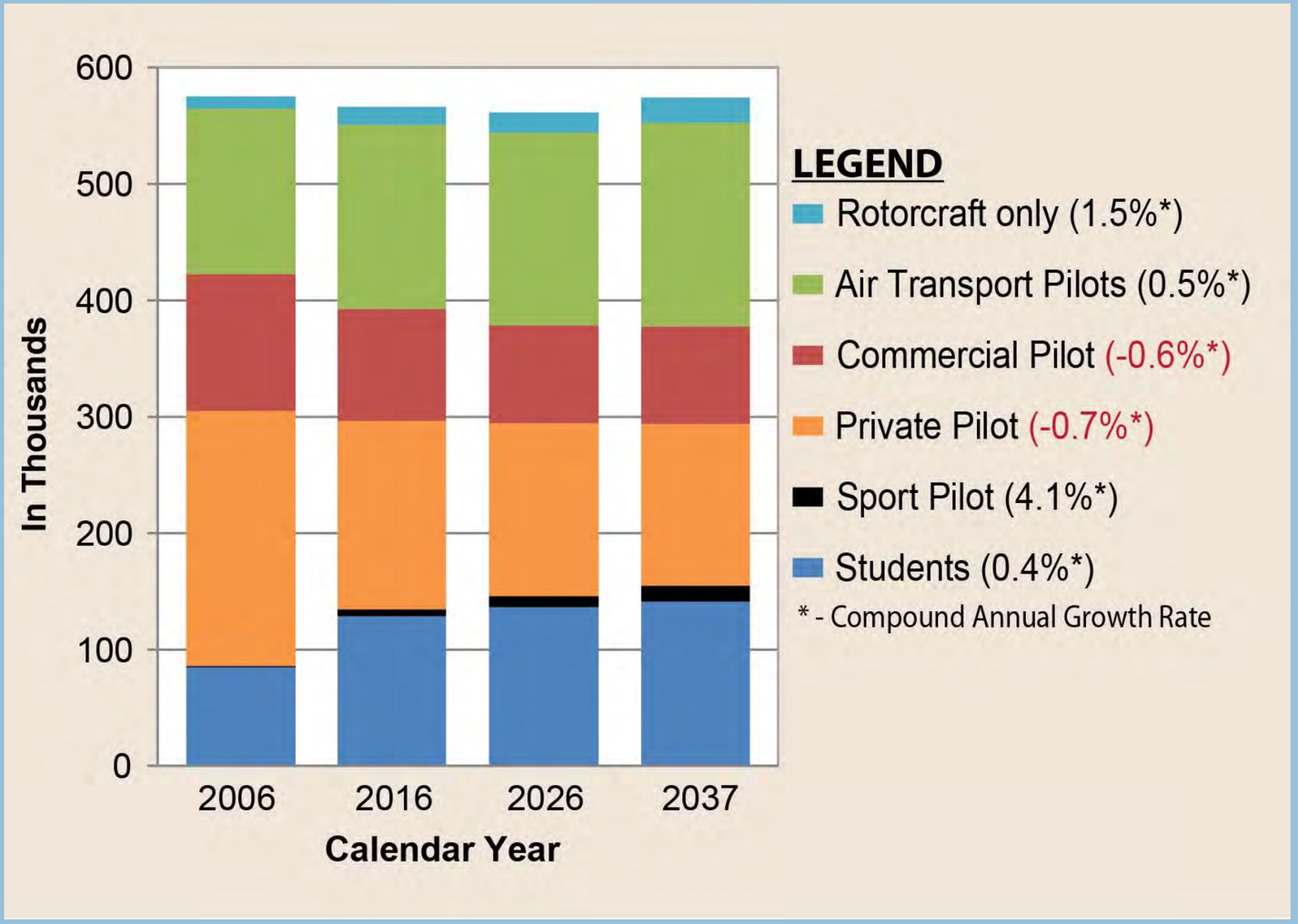
- 2010-2013 FAA re-registration removed many inactive aircraft
- 2014 first increase since 2008
- 210,000 active aircraft in 2015 was an increase of 2.8% over 2014
- Pistons forecast to decline (-0.08%).
- Turboprops to decline through 2022 then return to growth (1.4%)
- Jets increasing 3.1% from 2010-2016 and forecast to increase 2.3% annually through 2037
- Helicopters to increase 1.6% annually
- Total turbine: 1.9% annually
- Total fleet: 0.1% annually

U.S. General Aviation Hours Flown Forecast (FAA)



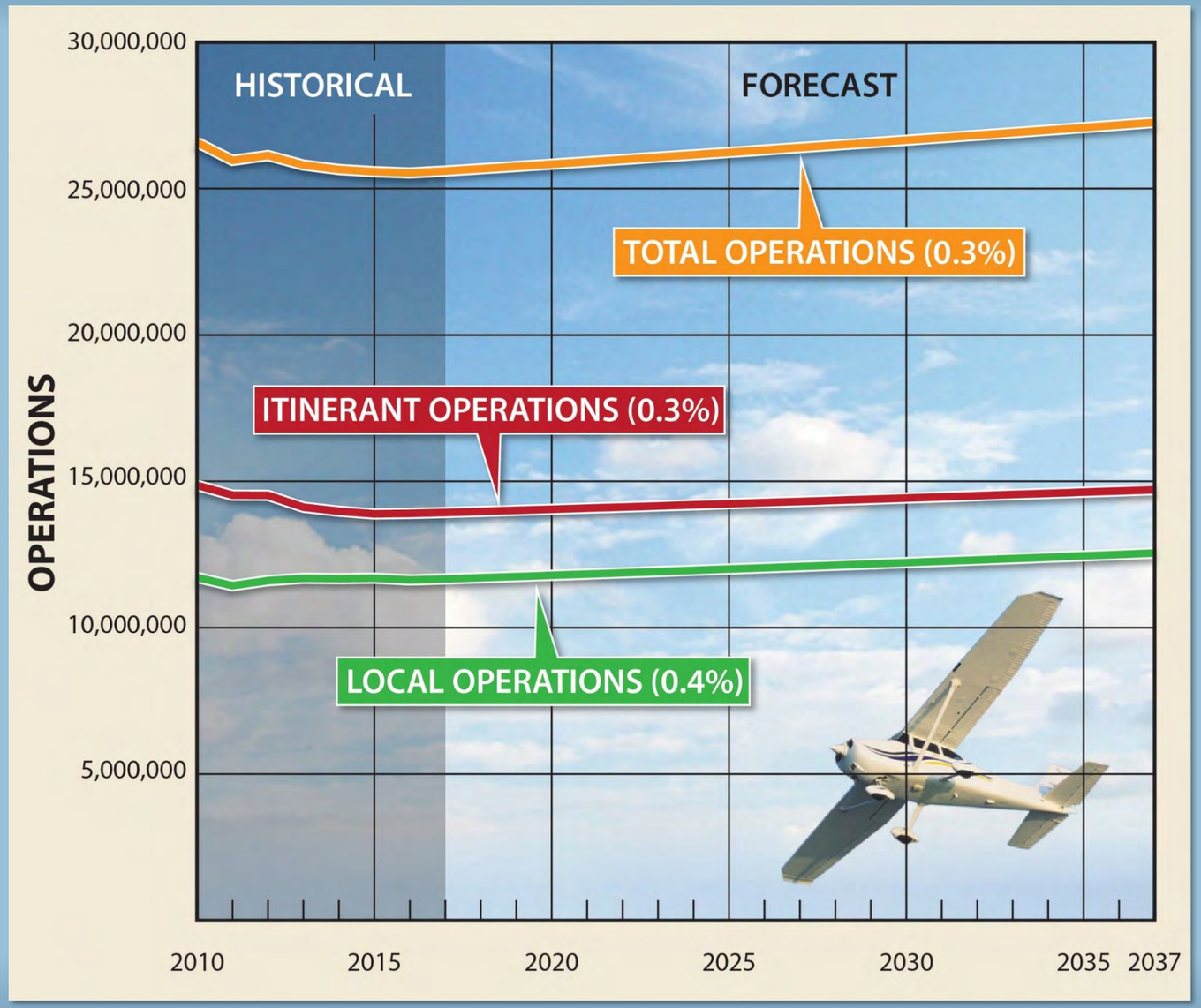
- **Total hours flown: 0.9% annually as newer aircraft fly more hours.**
- Turbine: 2.5 % annually, more than offsetting losses by piston aircraft. Jet portion growing at 3.0% annually due to fleet growth and higher utilization rates.
- Helicopters: 2% annually.

U.S. Pilots by Type of Certificate Forecast (FAA)



- **Total pilots forecast to grow 0.1% annually.**
- 584,000 certified pilots in 2016
- Private pilot decrease primarily due to cost.
- 2010 regulatory rule increased the term of a student certificate from 36 to 60 months.
- 2013 regulatory rule that second in command have an ATP certificate not just a commercial pilot certificate which required 1,500 more hours.

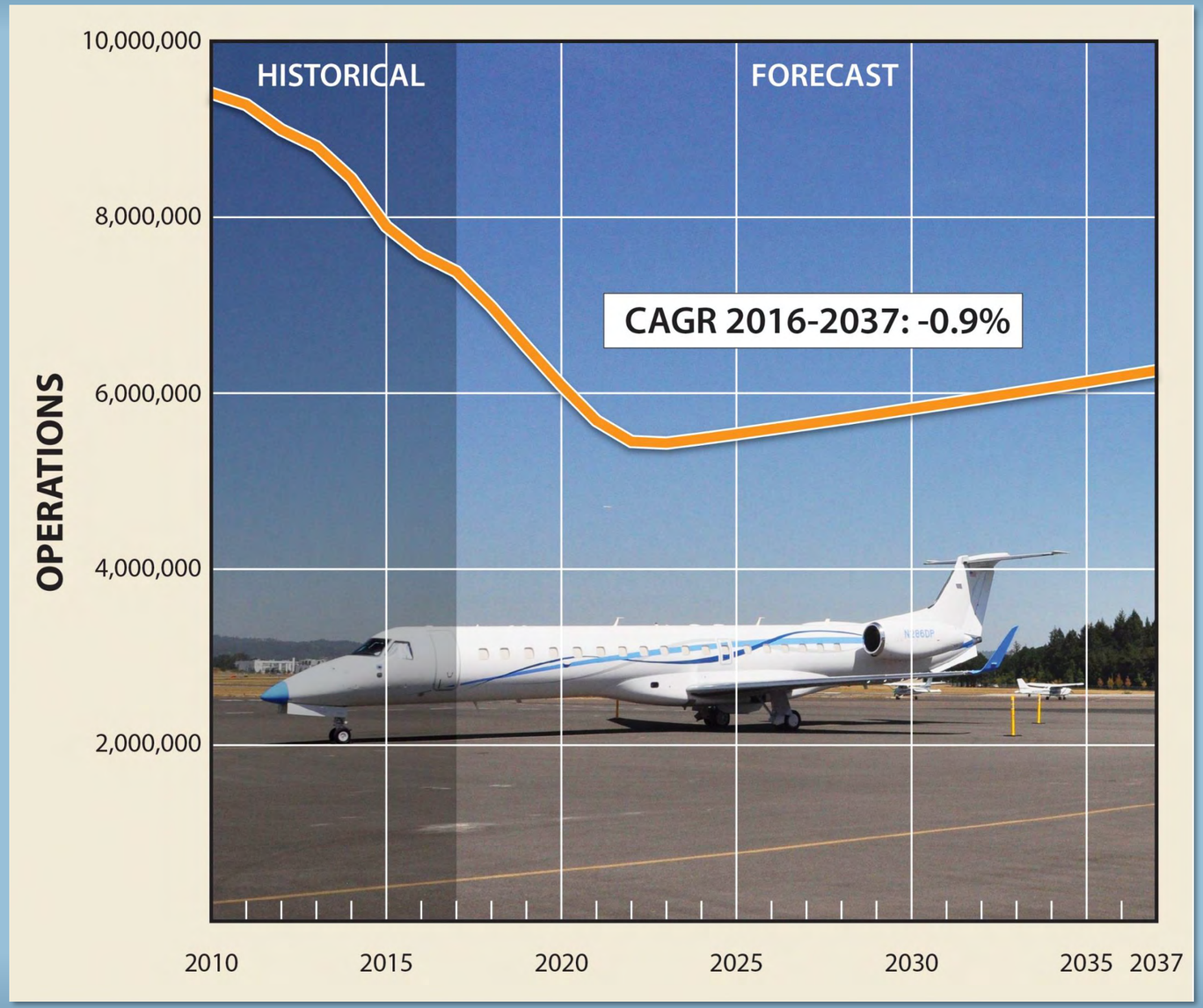
U.S. General Aviation Operations Forecast (FAA)



- **Total GA Operations: 0.3% annually.**
- GA operations account for 51% of all aircraft operations.
- Turbine increases more than offset decline in piston operations.

Forecast Inputs

U.S. Air Taxi Operations Forecast (FAA)



- Aircraft with less than 60 seats.
- Includes: Air cargo, air ambulance, fractionals, some charters.
- Decline primarily due to regional airline fleet transition to higher seating capacity.
- Corporate shuttle operations are counted as air taxi at Hillsboro.

Forecast Inputs

Questions About Forecast Inputs and Methods?

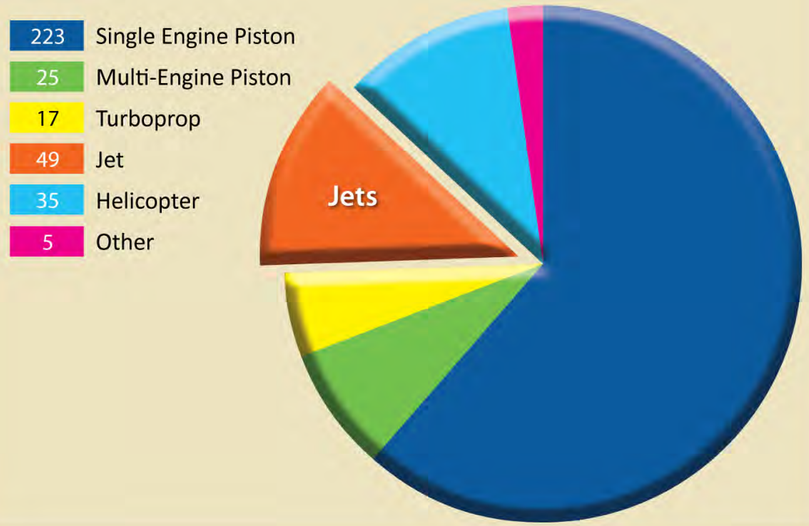
Based Aircraft Forecast

- Establish a baseline number and fleet mix.
- Examine aircraft ownership in the region and project registered aircraft into future plan years.
- Use registered aircraft projection as an input to based aircraft forecast.
- The based aircraft forecast helps to determine facility requirements such as hangar and apron needs and applicable design standards.

Current Based Aircraft (Baseline)

Aircraft Type	Number of Aircaft
Single Engine Piston	**223**
Multi-Engine Piston	**25**
Turboprop	**17**
Jet	**49**
Helicopter	35
Other	**5**
Total	**354**
Source: Oregon Department of Aviation	

BASED AIRCRAFT FLEET MIX - 2017

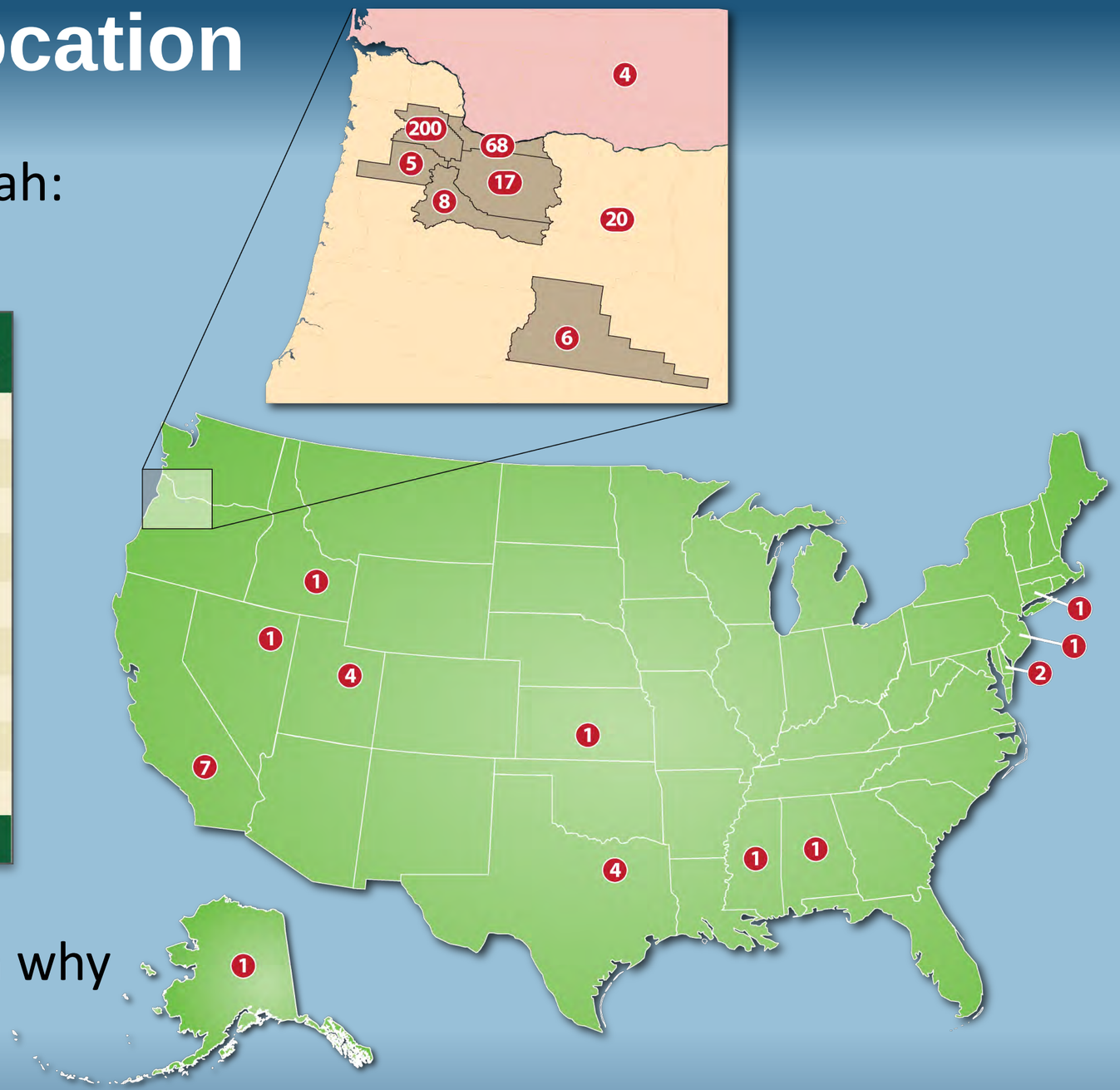


- 354 aircraft based at Hillsboro.
- 49 jets including most large business jets types in the national fleet.
- Jets have the highest economic impact.
- Jets have the greatest impact on airport design standards.
- Airport maintains design standards triggered by large business jets.

Based Registration Location

- Washington, Clackamas, Multnomah: 81% of based aircraft.

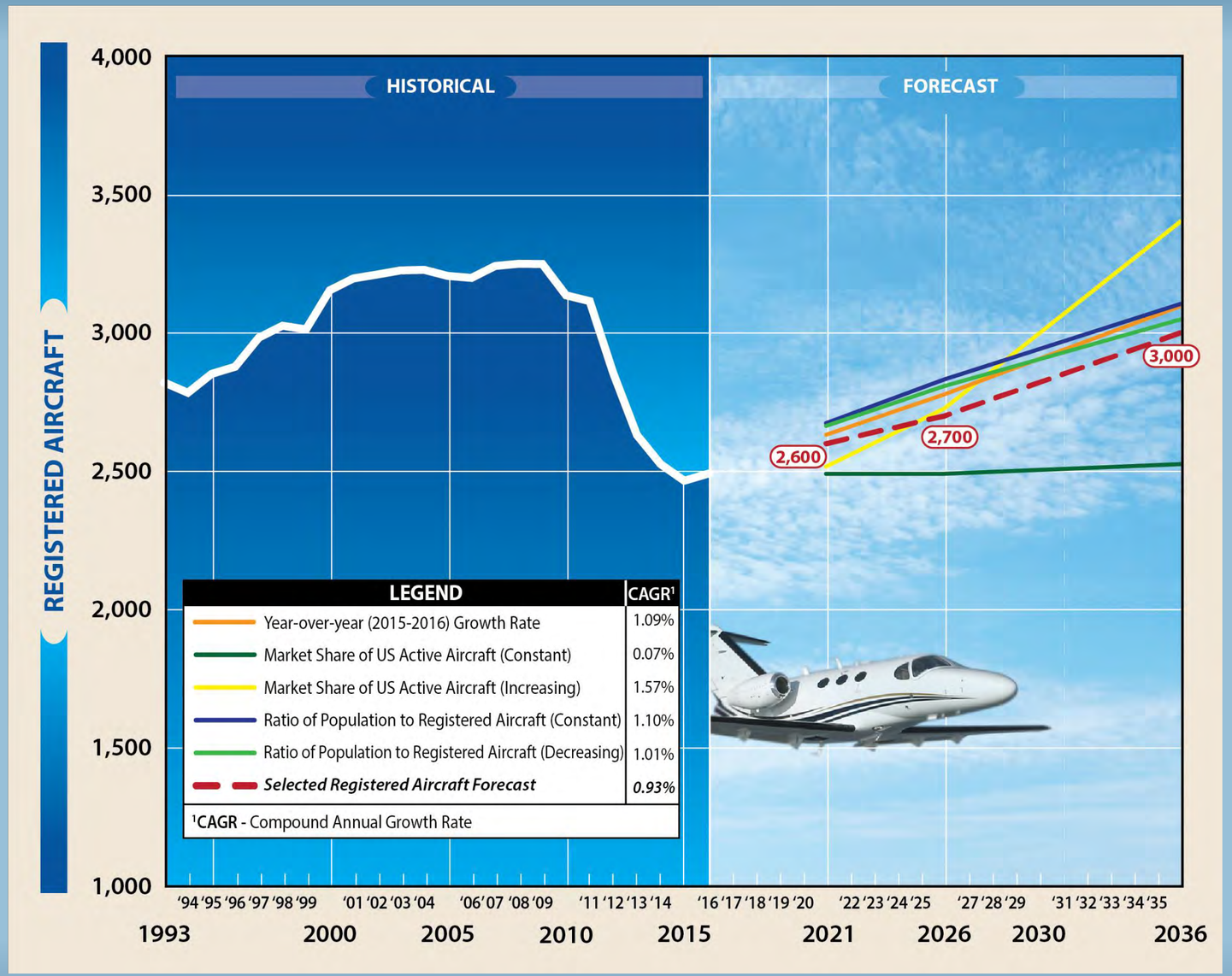
LOCATION	NUMBER OF AIRCRAFT	PERCENT
Washington County	200	56.5
Multnomah Couty	68	19.2
Clackamas County	17	4.8
Marion County	8	2.3
Deschutes County	6	1.7
Yamhill County	5	1.4
Other Oregon	20	5.6
Other WA State	4	1.1
Out of state (1 Foreign)	26	7.3
Total Based Aircraft	**354**	



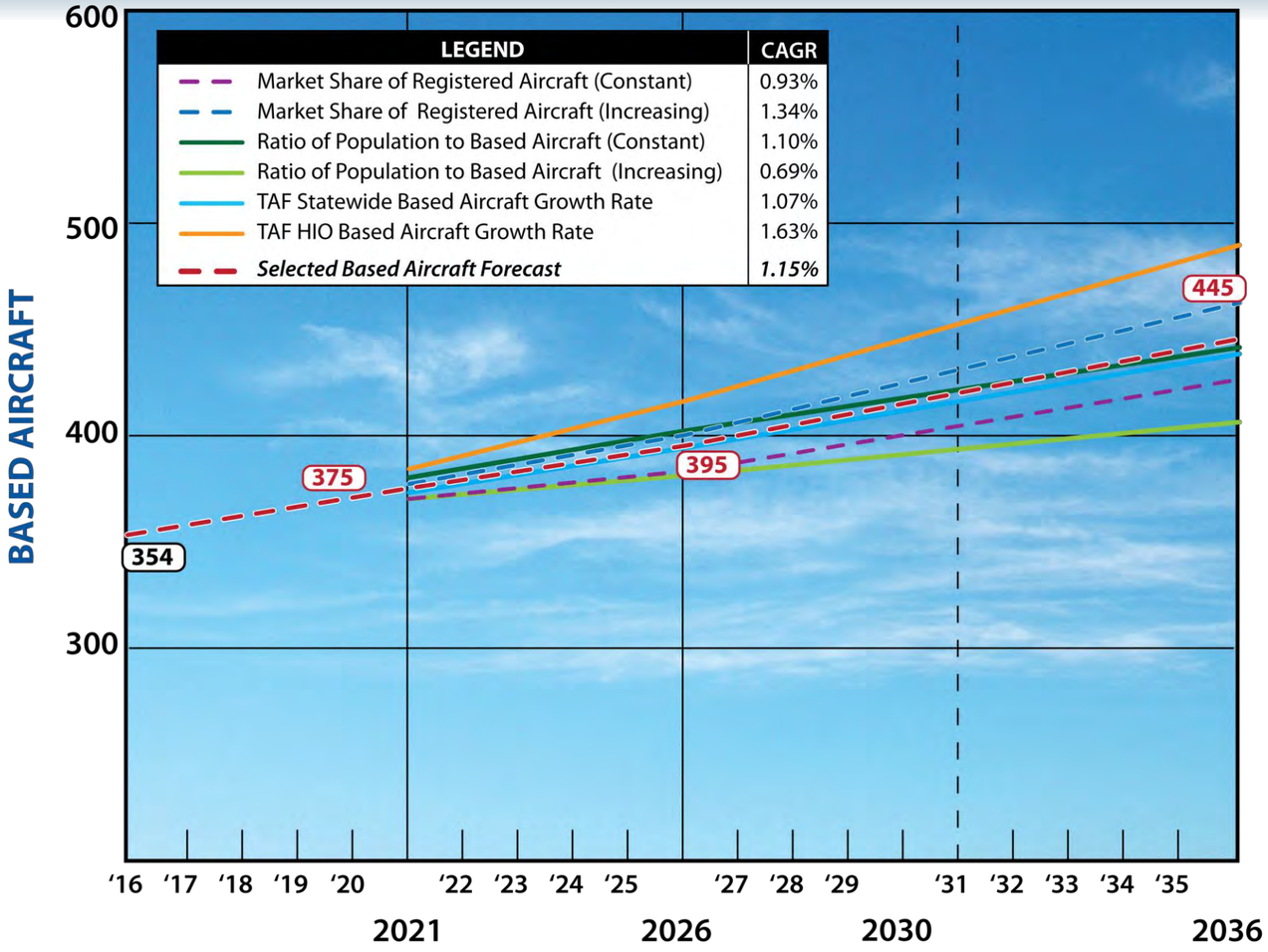
- Proximity is typically the #1 reason why someone chooses an airport.

Area Registered Aircraft Forecast

- Washington, Clackamas, Multnomah, Yamhill combined.
- Modest but steadily increasing trend until the 2007-2009 recession.
- Industry observers believe we have bottomed out (Kipplinger).
- Five (5) forecasts represent the planning envelope.
- Selected forecast is an approximate average (no obvious outliers).
- 507 new registered aircraft over next 20 years.
- Growth Rate in 4-county Area = 0.93%



Based Aircraft Forecast

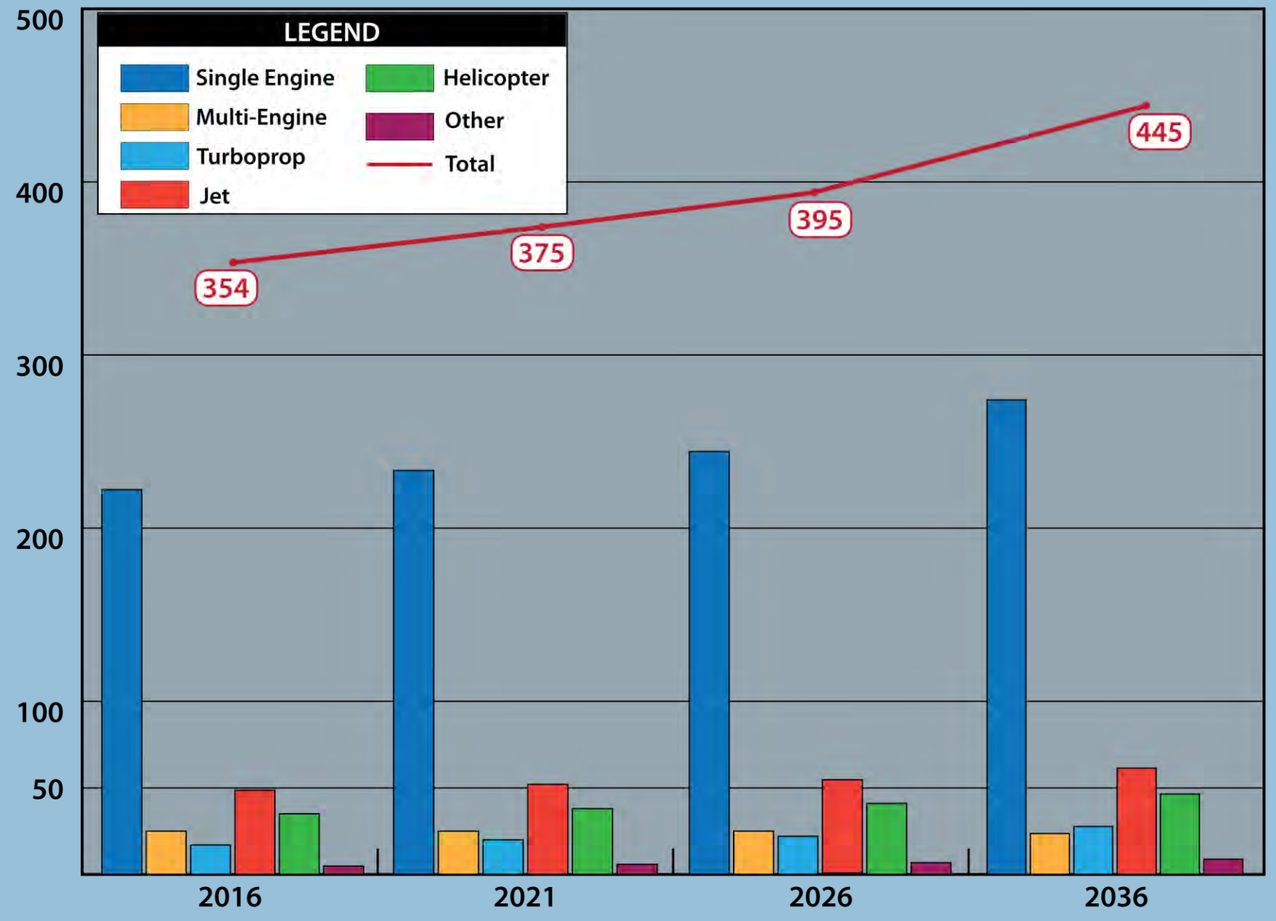


- Six forecasts form the planning envelope.
- Two based on registered aircraft forecast.
- Two based on population ratio.
- State TAF growth rate (1.07%).
- HIO TAF growth rate (1.62%).
- Selected is an approximate average.
- 91 new based aircraft over the next 20 years.
- Growth Rate = 1.15%

TAF: Terminal Area Forecast (FAA)

Based Aircraft Fleet Mix

- Piston aircraft to continue to dominate the based fleet
- Multi-engine piston aircraft to hold steady
- Modest growth in turboprops and jets
- Larger aircraft need more planned space for hangars and aprons



Based Aircraft Forecast

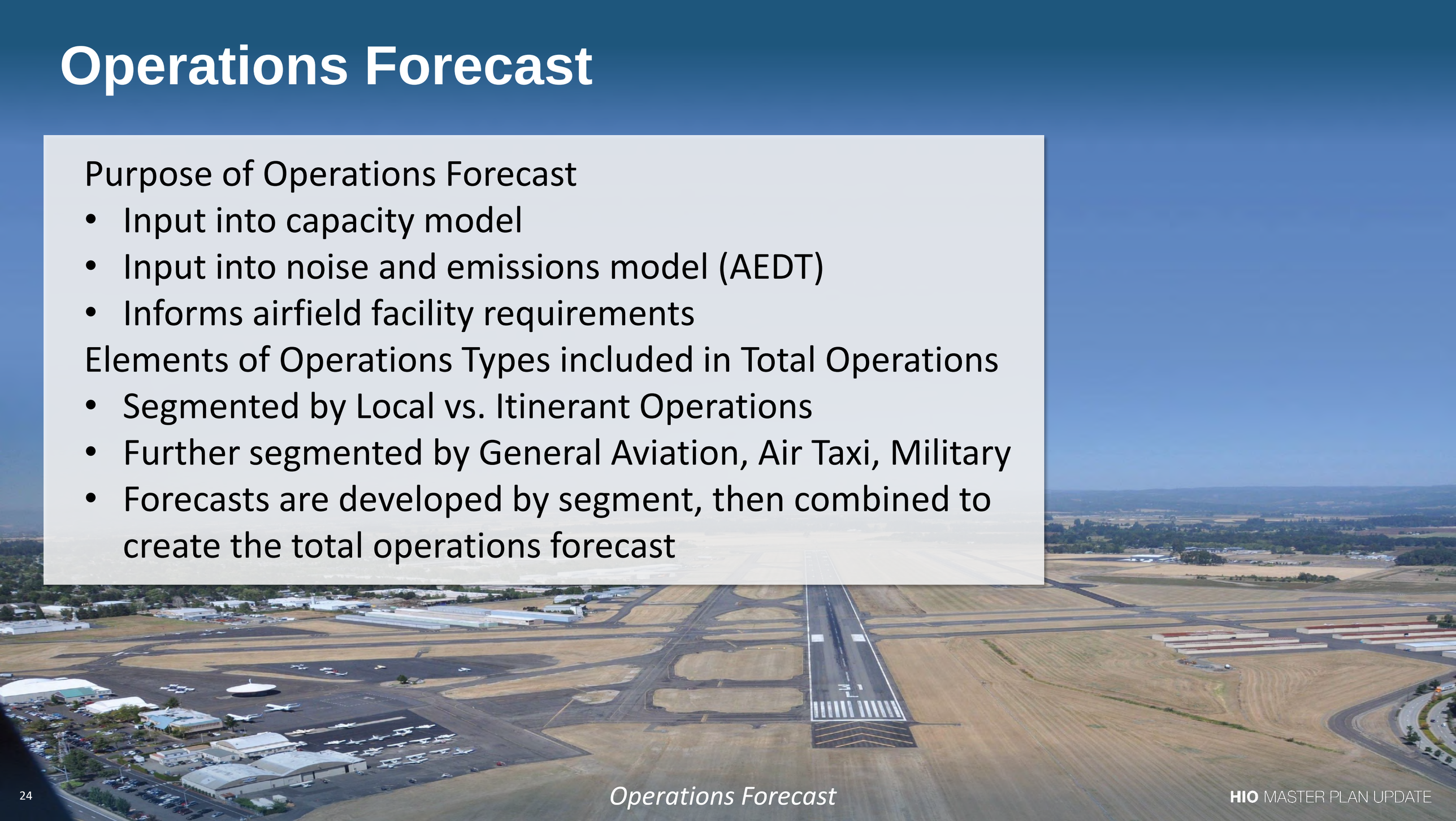
Operations Forecast

Purpose of Operations Forecast

- Input into capacity model
- Input into noise and emissions model (AEDT)
- Informs airfield facility requirements

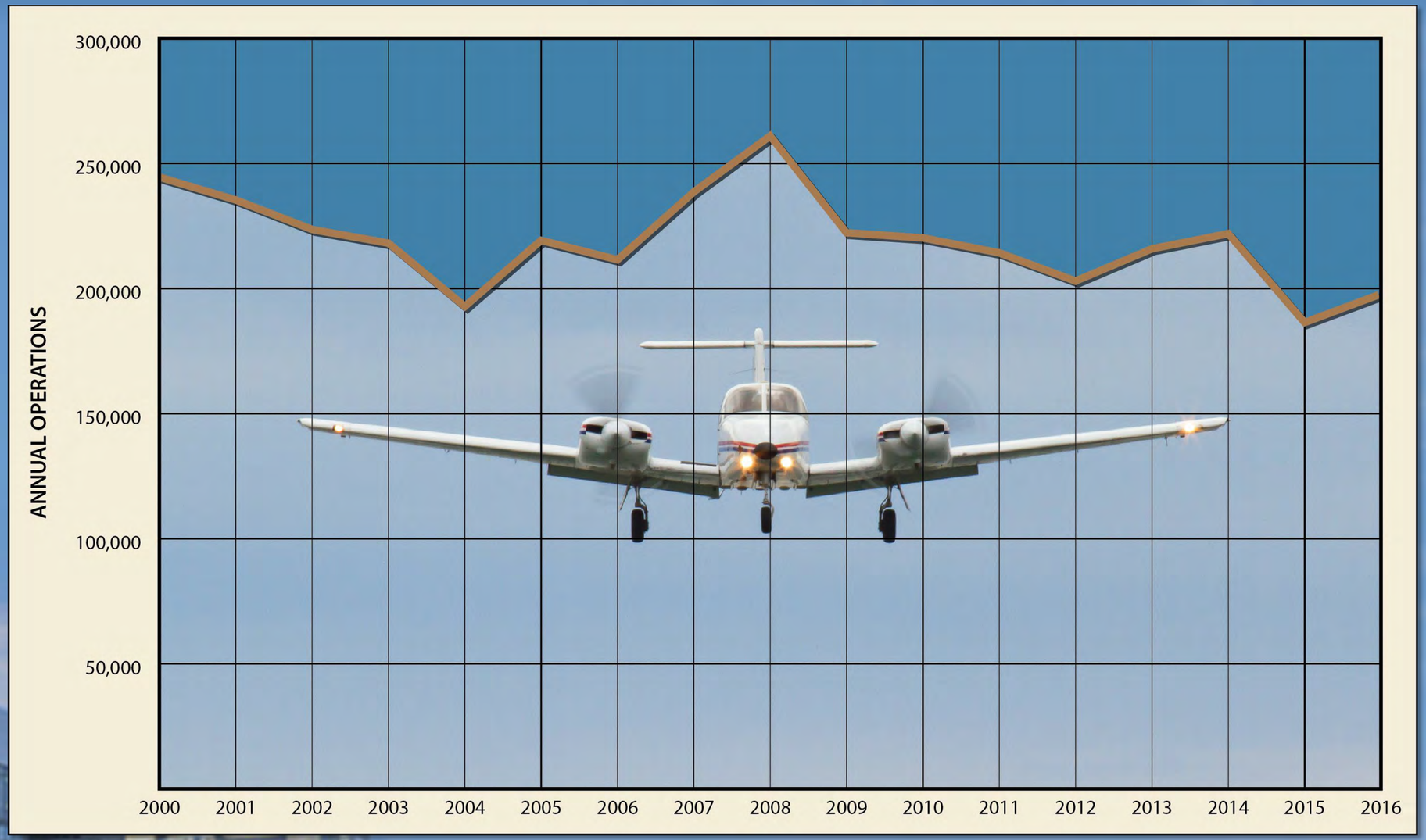
Elements of Operations Types included in Total Operations

- Segmented by Local vs. Itinerant Operations
- Further segmented by General Aviation, Air Taxi, Military
- Forecasts are developed by segment, then combined to create the total operations forecast



Historical Operations at Hillsboro

Year	Total
2000	244,511
2001	235,383
2002	223,589
2003	218,118
2004	192,833
2005	219,227
2006	211,493
2007	238,605
2008	260,957
2009	222,271
2010	220,213
2011	214,243
2012	202,967
2013	215,861
2014	221,932
2015	186,402
2016	197,763



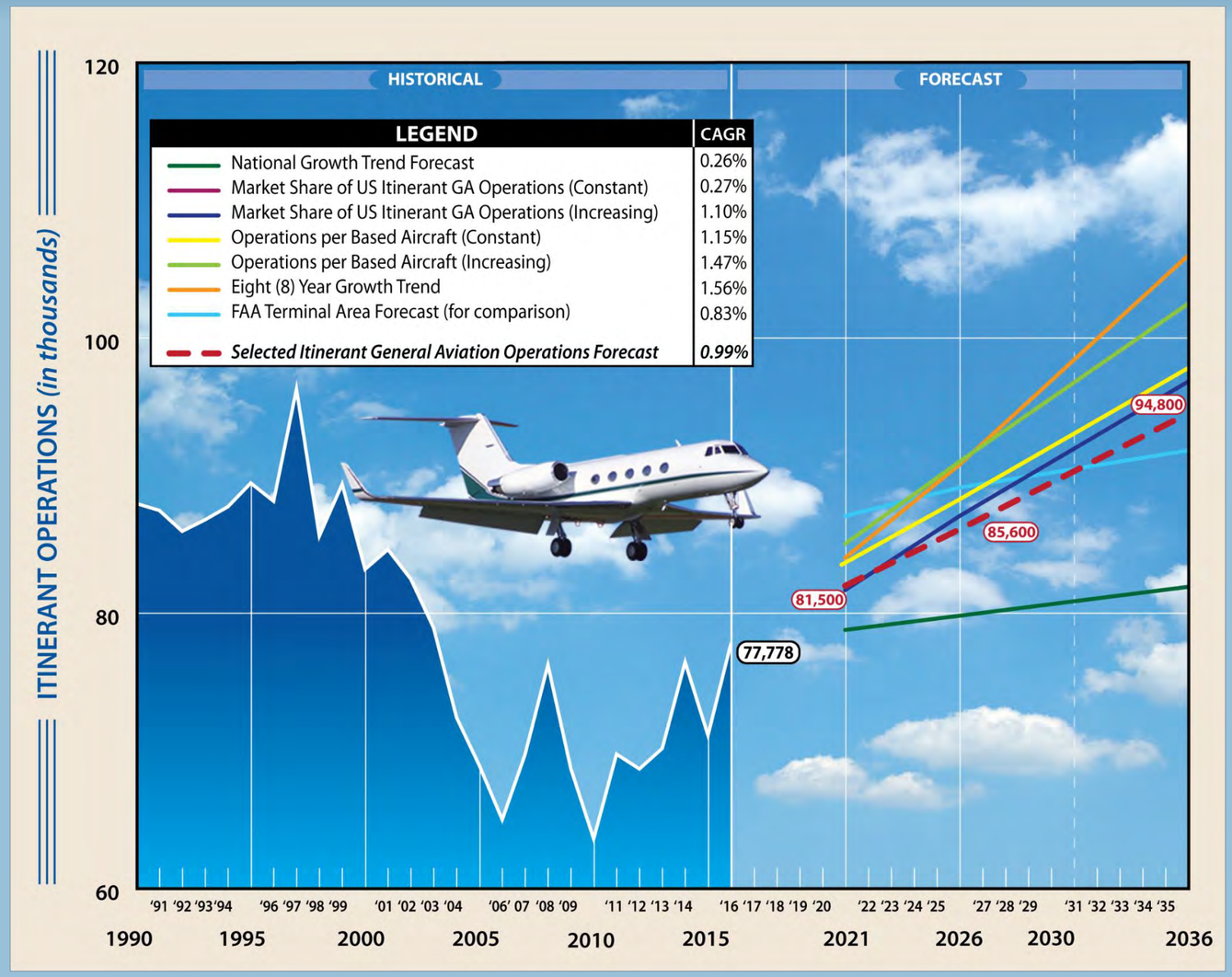
Historic Operations by Type at Hillsboro

Date	Itinerant					Local			Total Ops
	Air Carrier	Air Taxi	GA	MIL	Total	GA	MIL	Total	
2000	0	7,230	83,201	1,103	91,534	151,645	1,332	152,977	244,511
2001	12	7,931	84,639	873	93,455	141,880	48	141,928	235,383
2002	6	9,078	82,493	426	92,003	131,495	91	131,586	223,589
2003	0	9,386	78,942	450	88,778	129,141	199	129,340	218,118
2004	0	8,287	72,444	834	81,565	111,250	18	111,268	192,833
2005	0	9,689	68,940	227	78,856	140,311	60	140,371	219,227
2006	0	8,773	65,008	262	74,043	137,421	29	137,450	211,493
2007	3	6,571	69,755	219	76,548	162,032	25	162,057	238,605
2008	0	7,615	76,256	268	84,139	176,791	27	176,818	260,957
2009	0	5,749	68,724	295	74,768	147,478	25	147,503	222,271
2010	0	5,738	63,619	176	69,533	149,579	1,101	150,680	220,213
2011	4	6,235	69,770	330	76,339	137,822	82	137,904	214,243
2012	16	6,283	68,696	383	75,378	127,555	34	127,589	202,967
2013	5	3,884	70,187	376	74,452	141,387	22	141,409	215,861
2014	14	4,322	76,453	236	81,025	140,889	18	140,907	221,932
2015	35	4,405	71,144	367	75,951	110,446	5	110,451	186,402
2016	12	4,352	77,778	268	82,410	115,332	21	115,353	197,763

Hillsboro control tower counts (6:00 a.m. – 10:00 p.m.)

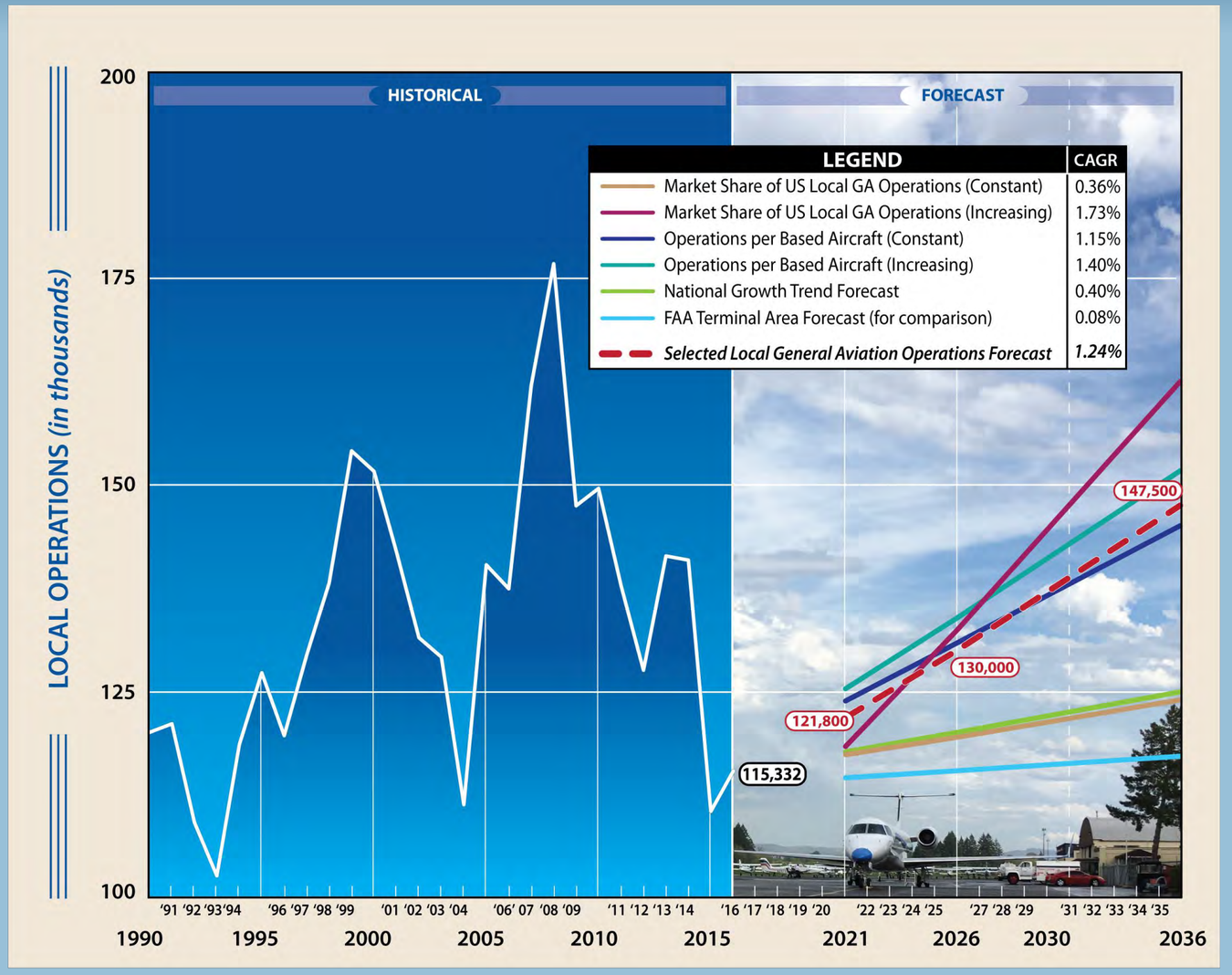
Hillsboro Itinerant GA Operations Forecast

- Six forecasts form the planning envelope.
- Two based on FAA forecast of US itinerant operations.
- Two based on operations per based aircraft.
- One based on the 8-year growth trend.
- Selected is an approximate average.
- Growth Rate = 0.99%



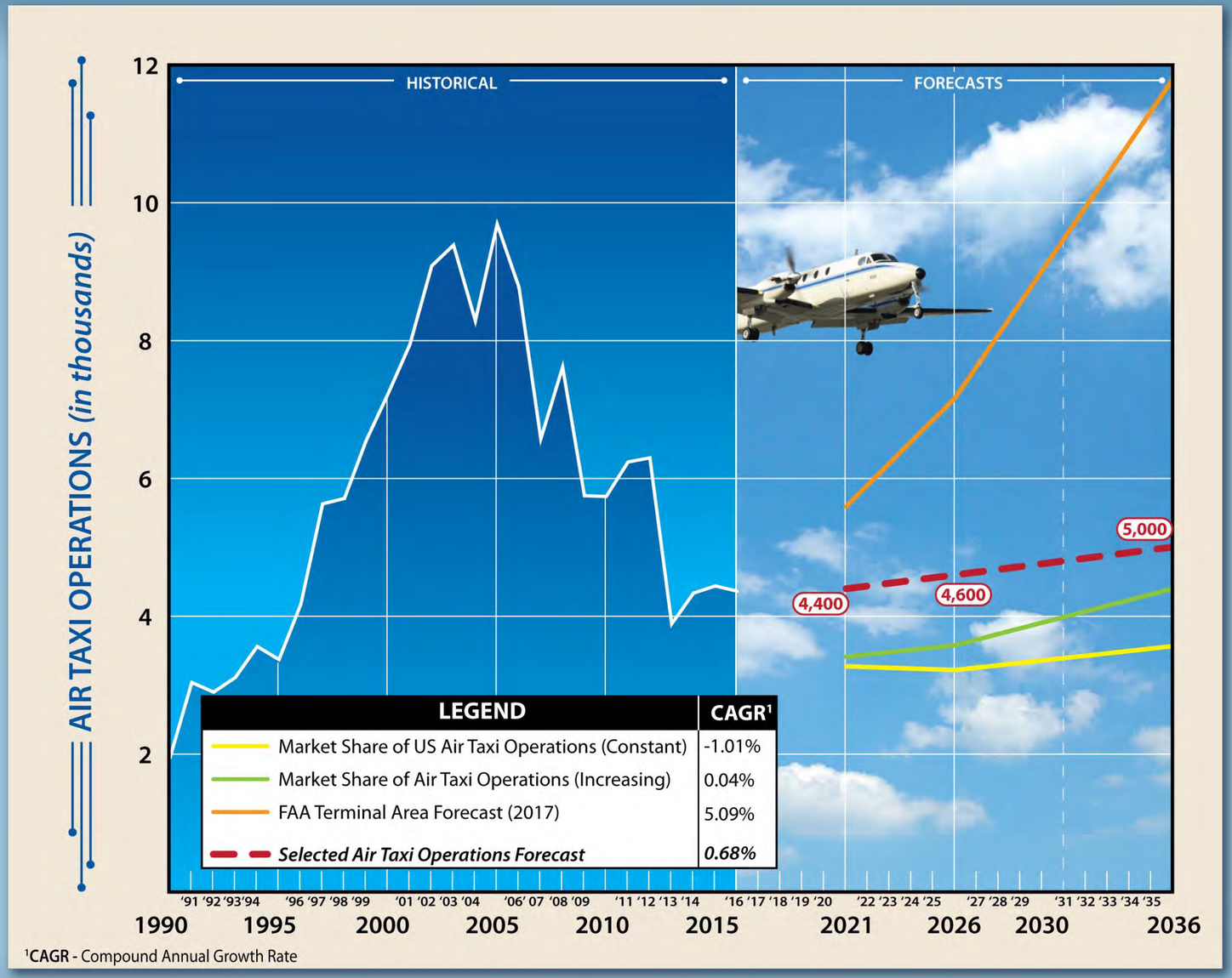
Hillsboro Local GA Operations Forecasts

- Five forecasts form the planning envelop.
- Two based on FAA forecast of US local operations.
- Two based on operations per based aircraft.
- One based on FAA national growth trend.
- Selected: As a training and reliever airport, our judgement is to reflect an increasing share of US local operations.
- Growth Rate = 1.24%



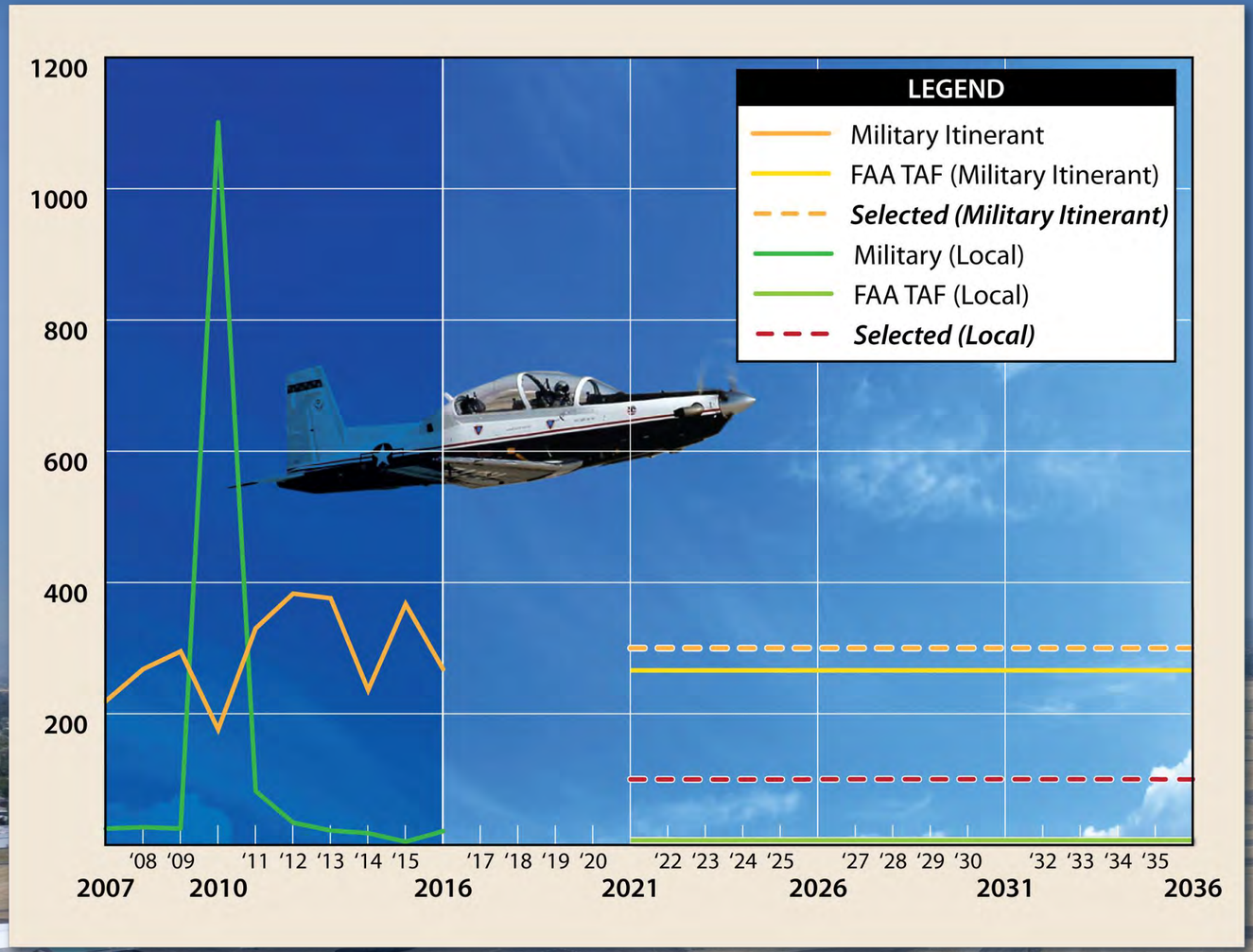
Hillsboro Air Taxi Operations Forecast

- Air taxi: Corporate shuttles, air ambulance, fractionals, and other “for-hire” activity.
- Corporate shuttle accounts for an average of 2,900 annual operations and no change is anticipated.
- Hillsboro facilities are well suited for air taxi activity.
- Selected forecast includes corporate shuttle and a modest growth in “other air taxi”.
- Growth Rate = 0.68%



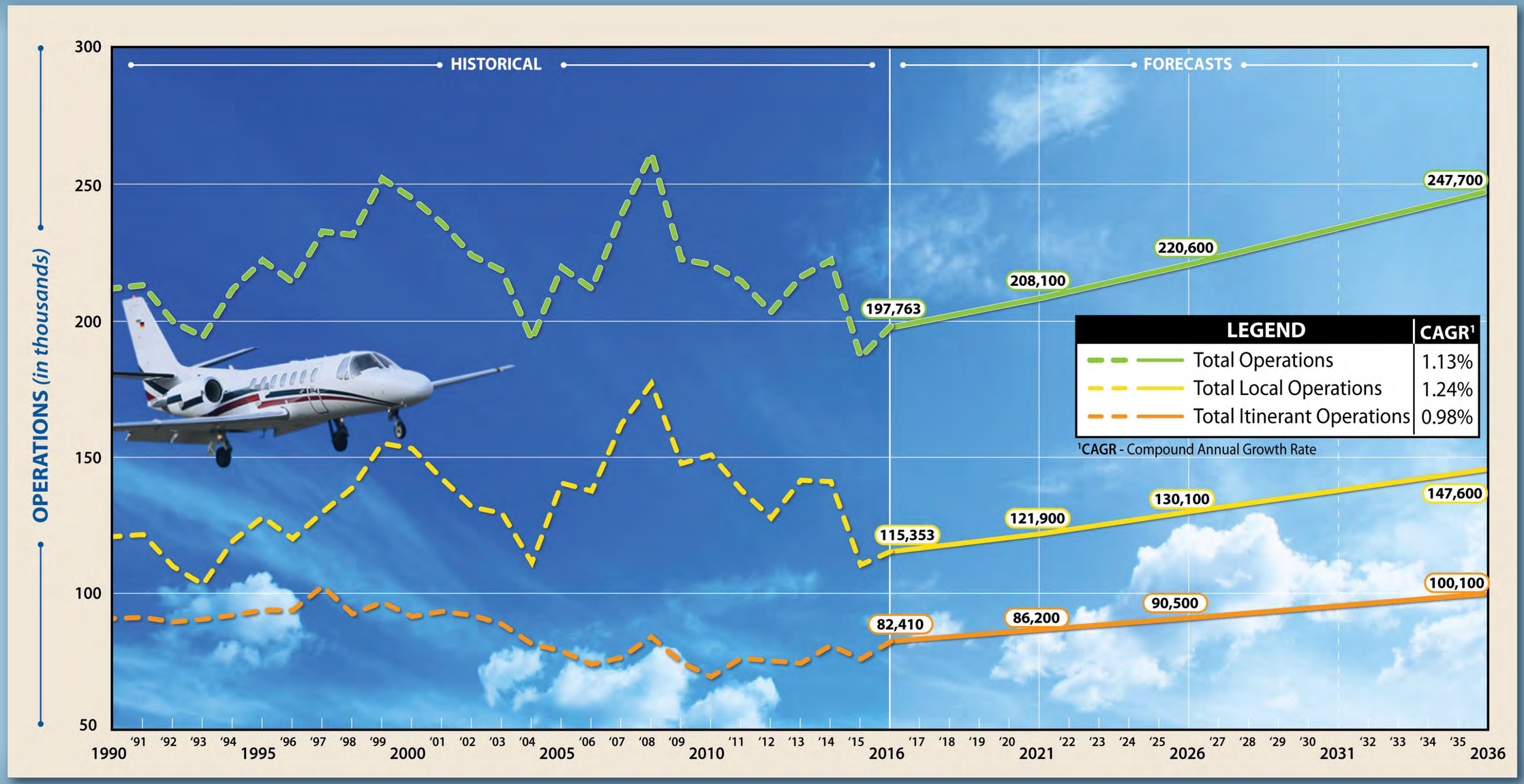
¹CAGR - Compound Annual Growth Rate

Military Operations Forecast



- Military mission can change.
- FAA does not forecast military operations
- Typically, held constant at an observed average
- Forecast for Hillsboro is 400 military operations annually:
  - 100 local
  - 300 itinerant

Hillsboro Total Operations Forecast Summary



Airport Peak Activity

- Several aspects of facility planning are related to times when the airport is busiest including:
  - Apron needs
  - Capacity determination
  - Terminal needs

	2016	2021	2026	2036
Annual	197,763	208,100	220,600	247,700
Peak Month (11.17%)	22,085	23,245	24,641	27,688
Busy Day	903	952	1,009	1,133
Design Day	712	750	795	893
Design Hour (11.02%)	79	83	88	98

- Peak Month (August): Absolute peak in a given year. All other peaks will be exceeded at times.
- Design Day: Peak month divided by days in the month (31)
- Busy Day: Factor of the four busiest days of each week in the peak month (1.27 * Design Day)
- Design Hour: Determined to be 11.02 percent of the design day (10-11 a.m.)

Coffman Associates analysis of tower operation counts.

Operations and Based Aircraft Forecast Summary

- Modest growth of slightly over 1.0% for based aircraft and operations.
- Appears that the decline in operations since the 2007-2009 recession has bottomed out.
- To be translated to facility requirements.

	BASE YEAR	FORECAST			CAGR[1] 2016-36
	2016	2021	2026	2036	
Itinerant Operations					
Air Taxi	4,364	4,400	4,600	5,000	0.68%
General Aviation	77,778	81,500	85,600	94,800	0.99%
Military	268	300	300	300	0.57%
Total Itinerant Operations	*82,410*	*86,200*	*90,500*	*100,100*	*0.98%*
Local Operations					
General Aviation	115,332	121,800	130,000	147,500	1.24%
Military	21	100	100	100	8.12%
Total Local Operations	*115,353*	*121,900*	*130,100*	*147,600*	*1.24%*
TOTAL OPERATIONS	**197,763**	**208,100**	**220,600**	**247,700**	**1.13%**
TOTAL BASED AIRCRAFT	**354**	**375**	**395**	**445**	**1.15%**

[1]CAGR: Compound annual growth rate

Fleet Mix Operations

Purpose
- Airfield capacity
- Noise analysis
- Air quality analysis
- Airfield design standards

Assumptions/Estimates
- Helicopters: 30% of Ops (ANOMS interpretation)
- Jets: FAA TFMSC
- Turboprops: 250 Ops per based turboprop
- Multi-Piston: 200 Ops per based multi-piston

	2016	2021	2026	2036
Local Operations				
Piston	62,438	66,193	71,058	81,477
Multi-Piston	2,916	2,916	2,916	2,800
Turboprop	400	600	800	1,200
Helicopter	49,599	52,191	55,326	62,123
Total Local	115,353	121,900	130,100	147,600
Itinerant Operations				
Single Piston	54,446	56,277	58,762	64,213
Multi-Piston	2,084	2,084	2,084	2,000
Turboprop	3,850	4,400	4,700	5,800
Jet	12,300	13,200	14,100	15,900
Helicopters	9,730	10,239	10,854	12,187
Total Itinerant	82,410	86,200	91,500	100,100
Total Operations	197,763	208,100	220,600	247,700

Source: Coffman Associates analysis

Critical Design Aircraft Selection

- Determines applicable design standards
- 500 or more annual operations
- Each runway has a critical design aircraft

- Aircraft are classified based up on:
  - **Approach Category** (A-E, approach speed):
    Runway related standards such as width, RSA, ROFA, RPZ, separation.
  - **Airplane Design Group** (I-VI, wingspan/tail height):
    Separation standards, TSA, TOFA, wingtip clearance.
  - **Taxiway Design Group** (1-7,Main wheel gear separation):
    Taxiway width, shoulder width, fillet dimensions.

Critical Aircraft Determination

- Hillsboro Airport current aircraft types that take off or land at least 500 times each year include the categories seen in the graphic to the right.
- The highlighted box indicates the largest and most demanding aircraft
- Design standards will be met for C-III and D-III aircraft weighing less than 150,000 pounds
- Actual historic operations by jets shown on the next slide

A-I

- Beech Baron 55
- **Beech Bonanza**
- Cessna 150
- Cessna 172
- Cessna Citation Mustang
- Eclipse 500/550
- Piper Archer
- Piper Seneca

B-I

- Beech Baron 58
- Beech King Air A90/100
- Cessna 402
- **Cessna 421**
- Piper Navajo
- Piper Cheyenne
- Swearingen Metroliner
- Cessna Citation I (525)

B-II

- Super King Air 200
- Cessna 441
- DHC Twin Otter
- Super King Air 350
- Beech 1900
- Citation Excel (560), Sovereign (680)
- Falcon 50, 900, 2000
- **Citation Bravo (550)**
- Embraer 120

A-III, B-III

- DHC Dash 7
- **DHC Dash 8**
- DC-3
- Convair 580
- Fairchild F-27
- ATR 72
- ATP

C-I, D-I

- Beech 400
- **Lear** 31, **35,** 45, 60
- Israeli Westwind

C-II, D-II

- **Cessna Citation X (750)**
- Gulfstream 100, 200,300
- Challenger 300/600
- ERJ-135, 140, 145
- CRJ-200/700
- Embraer Regional Jet
- Lockheed JetStar
- Hawker 800

C-III, D-III *less than 150,000 lbs.*

- ERJ-170
- CRJ 705, 900
- Falcon 7X
- **Gulfstream 500**, 550, 650
- Global Express, Global 5000
- Q-400

C-III, D-III *over 150,000 lbs.*

- ERJ-90
- Boeing Business Jet
- B-727
- **B-737**-300, **700,** 800
- MD-80, DC-9
- A319, A320

C-IV, D-IV

- **B-757**
- B-767
- C-130 Hercules
- DC-8-70
- MD-11

D-V

- **B-747-400**
- B-777
- B-787
- A-330, A-340

Historic Jet Operations at Hillsboro

APPROACH CATEGORY

ARC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
A	0	13	47	103	103	99	507	713	681	856
B	1,391	1,215	1,030	1,100	1,082	1,088	1,160	1,315	1,533	1,530
C	5,604	5,762	5,310	5,437	5,646	5,706	5,362	5,479	5,577	5,588
D	299	339	195	213	201	194	175	193	229	162
E	4	7	4	0	3	0	0	0	1	0
TOTAL	**7,298**	**7,336**	**6,586**	**6,853**	**7,035**	**7,087**	**7,204**	**7,700**	**8,021**	**8,136**

DESIGN GROUP

ARC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I	2,360	2,247	1,778	1,870	1,953	1,968	2,181	2,305	2,451	2,350
II	4,497	4,617	4,262	4,296	4,339	4,412	4,464	4,612	4,766	4,774
III	438	468	541	685	743	707	558	783	804	1,012
IV	2	2	5	2	0	0	1	0	0	0
V	1	2	0	0	0	0	0	0	0	0
TOTAL	**7,298**	**7,336**	**6,586**	**6,853**	**7,035**	**7,087**	**7,204**	**7,700**	**8,021**	**8,136**

TFMSC: Traffic Flow Management System Count (FAA database)
ARC: Aircraft Reference Code