ASE Vision

Technical Working Group Report

Report Finalized December 20, 2019

ASE VISION

Technical Working Group
Report and Recommendations
Report Voted by the Technical Working Group on December 3, 2019
Report Finalized 12/20/2019

Table of Contents

I. History that brought us here. History and Background

In February of 2019, the Technical Working Group (TWG) was created to advise the Airport Vision Committee (AVC) on technical areas of the proposed airport improvements. Specifically, the AVC has asked the TWG to answer the following questions:

To meet our community values and goals, what is our desired "design aircraft?"

How could the existing or future "fleet mix" meet the air pollution reduction, modest enplanement growth, and noise abatement goals established by the ASE Vision process?

In light of those community goals, what does the future airfield look like in terms of safety and airport design?

What are the implications of the status quo vs. Airplane Design Group II vs. Airplane Design Group III? Could any variations exist within these design groups that might help us attain our community goals?

What should be the commercial Design Aircraft for Aspen given what aircraft are currently available and known future aircraft?

For the desired Design Aircraft, does the airfield need to be ADG II or ADG III?

The **Airplane Design Group** (ADG) is an FAA-defined grouping of aircraft types which has six groups based on wingspan and tail height

FAA Airplane Design Groups (ADG)

Group #	Tail Height (ft)	Wingspan (ft)
I	<20	<49
II	20 - <30	49 - <79
III	30 - <45	79 - <118
IV	45 - <60	118 - <171
V	60 - <66	171 - <214
VI	66 - <80	214 - <262

In addition to the questions specifically posed by the AVC, the TWG is also tasked with addressing Success Factors identified by the Community Character Working Group (CCWG) final report.

This report constitutes the findings and recommendations of the TWG. The report is divided into: Background, Findings, Recommendations and Success Factor Response. This report was developed over a number of meetings between September 11, 2019 and December 3rd, 2019. Meeting materials and recordings can be found at: https://www.asevision.com/twg/

Background:

Airport Facilities and Aircraft History:

Walter Paepcke and John Spachner founded the Aspen-Pitkin County Airport (ASE) as a privately owned, public use gravel landing strip in 1946. The original facility consisted of a log cabin terminal building and a gravel runway. In 1956, Aspen Airport Corporation officially deeded the Airport to Pitkin County making it a publicly owned public use airport, one of the requirements to receive federal grants for airport development.

The Civil Aeronautics Administration (now FAA) and Pitkin County, as airport sponsor, funded the initial construction of Runway 15/33, a connecting taxiway, and an apron in 1957. This effort was led primarily by Commissioner Thomas J. Sardy. The original paved runway was 5,200 feet long by 60 feet wide. In 1958, the airport was officially dedicated as the Aspen/Pitkin County (Sardy Field) Airport. In 1963, the runway was lengthened to 6,000 feet. By 1969, the use of larger aircraft required the widening of the runway to 80 feet. The apron area was also expanded to 400,000 square feet during the same project. During the 1970s, in order to focus on commercial air service, the County planned and provided for centralized passenger service. A parcel of land containing approximately 29 acres was acquired to accommodate a new terminal building; and an aircraft-parking apron was constructed in 1973 to serve the new terminal. The new 17,500 square foot terminal building was constructed in 1976 and was the first commercial building in the United States to use passive solar heating. Commercial service during this period was provided by the Convair 240, 340, 440 and the De Havilland DHC-6 Twin Otter with capacities from 19-56 passengers and up to 105’ 4” wingspan (Convair 440).

In 1982 Pitkin County voters authorized the County to issue up to $3,250,000 in bonds to lengthen and widen the runway to accommodate larger aircraft. The question was approved 2,637 to 1,369 votes. The runway at Aspen-Pitkin County Airport was lengthened and widened in 1983 to 7,006 feet long by 100 feet wide. In 1988 voters again authorized the County to issue up to $3,000,000 in bonds for the general purpose of “acquiring and improving airport facilities,” which passed 4,097 to 1,829. Following completion of runway improvements in 1983 three variants of the BAE146 operated at ASE for 21 years from 1985-2006. The BAE 146-300, the largest commercial airliner to ever operate at ASE, was an Airplane Design Group III aircraft with a Category C approach speed rating. The BAE146 had a maximum seating capacity of 100 and an 86’ wingspan.

1995 Bond Ballot Question

In 1995 the County sought authorization from voters to issue up to $1.9 million in airport revenue bonds to widen and strengthen the runway to accept larger aircraft. The resolution approving the ballot language included a requirement that if the bond was approved, the Board would pursue another vote before allowing Boeing 737 or similar aircraft to operate at the airport. The bond authorization failed by a vote of 1,883 for and 2,824 against as did any subsequent requirements in the resolution approving the ballot language.

In 1998 the County proposed relocating Taxiway “A” from 221.5 ft. east of the runway centerline to 320 ft. east of the runway centerline to provide more separation for aircraft safety. In 1999 the FAA approved this proposal as a modification to standards with the following understanding:

> “Although the proposal [for a taxiway centerline at a separation of 320 feet from the runway centerline] does not meet criteria for all of Design Group III, the County is prepared to enact an ordinance restricting aircraft with wingspans greater than 95 feet. . . This 95-foot restriction will establish that this modification is contingent upon the ordinance being enacted and that the modified standard applies only to operations by aircraft with wingspans less than 95 feet. ***Should regular operations by a larger aircraft occur, the modification would be rescinded, and the airport would be required to meet the standard separation.*** This will ensure the airport meets the [Runway Object Free Area] standard even at the busiest times.” [emphasis added]

In 2001 Pitkin County adopted an ordinance restricting aircraft to wingspans of 95 ft. or less and maximum landing weight of 100,000 lbs. In 2005 the County completed relocation of Taxiway "A" to 320 ft. (ESID project) and readopted the 95 ft. wingspan restriction in County Code. In 2007 runway 15/33 was rehabilitated (7,000 ft X 100 ft. wide with shoulders).

Following the retirement of the BAE 146 from commercial service at ASE in 2006, three aircraft have provided commercial service under the restrictions established by the County and FAA: the 37 passenger Bombardier Dash 8-200 (1997-2008), the 70-74 passenger Bombardier Q-400 (2008-2016), and the 65-70 passenger CRJ700 (2006-present). In 2011 the runway was lengthened to its present dimensions of 8,006 feet long by 100 feet wide to improve safety and efficiency, especially during the summer months.

In 2012 the County conducted a regular update of the Airport Layout Plan (ALP). The update of the ALP did not recommend changing the runway/taxiway separation, 95' wingspan restriction, nor the 100,000lb max landing weight (MLW). In August 2013, the FAA approved the ALP with the following exception: "**The FAA's approval of this ALP does not apply to the proposed runway/taxiway separation distance of 320 feet on the west side of Runway 15/33…"** In response the County initiated a multi-year Future of Air Services Study to answer the following:

- What is the changing technology of future aircraft serving ASE?
- What can ASE do to best sustain future air service?
- How would ASE accommodate these operations?
- What are the impacts and benefits to the airport and community?
- What is best for the future health of the community?

This study is available at http://aspenairport.com/future-air-service-study/phase-i. The study found that the one commercial aircraft serving ASE (the CRJ700) had not had a North American order since 2011, and there were no other current regional jets that could serve ASE because of the required aircraft performance due to surrounding mountain terrain. Additionally, the study found that future regional aircraft would not meet the restrictions under the existing modification to standards primarily due to the 95' wingspan restriction and 100,000lb weight limit. Working with the FAA, the County examined 16 alternative airfield alignments, and found two feasible options to meet ADG III design standards and FAA airspace safety standards. After significant public outreach, the Board of Commissioners approved the current ALP meeting full ADG III separation standards in 2014.

In September 2015, the County initiated an Environmental Assessment (EA) per FAA requirements to analyze improvements proposed in the 2014 ALP. The EA analysis was conducted over a two-year period with significant public input. On August 25, 2017 the FAA released the draft EA for additional public comment and following public comment the Board approved the draft EA for final submission on October 25, 2017. On July 26th, 2018 the FAA approved the final Environmental Assessment for the Aspen/Pitkin County Airport for runway and terminal improvement projects. A summary of the approved airport EA can be found at: http://www.aspenairport.com/airport-improvements-ea/summary

One of the concerns expressed by members of the public about the EA process was that it didn't allow for the full scope of conversation about proposed airport improvements that are expected by residents of Pitkin County. To address these concerns, Pitkin County initiated a comprehensive community engagement process beginning in February 2019 to help establish a vision for the future of Aspen/Pitkin County Airport. This vision will define airport modernization and improvements for the next 30 years. The Board of Commissioners appointed interested members of the public to four working groups:

Community Character; Airport Experience; Technical; and Focus; each tasked with advising the Airport Vision Committee who is tasked with recommending a final vision for airport improvements to the Board of Commissioners.

Aircraft Operations and Commercial Enplanement History:

Overall aircraft operations, defined as either a take-off or landing, into ASE have decreased from 2000 to 2018. Though operations have not reached levels seen in 2000, the number of operations has been increasing since 2014. Overall, since 2000 the number of commercial operations has increased in actual number and as a percentage of overall aircraft operations. Commercial operations include the flights operated by United, American, and Delta Airlines in addition to those operated by air taxi services such as NetJets. In 2018 52% of aircraft operations were commercial and 48% were General Aviation. Of the 52% classified as “commercial” by the FAA, approximately half the operations were United, American or Delta and approximately half were air taxi such as NetJets. This is a significant change from 2000 when commercial operations represented roughly 1/3 of all operations.

General Aviation is simply defined as any aircraft which is not commercial or military. Commercial aircraft includes regional certified air carriers and air taxi. This data is broken out separately in the forecast report.

SkyWest is the operator for United, American and Delta airlines at ASE.

Enplanement trends are characterized by their growth rate, which is described as a compound annual growth rate. A compound annual growth rate is the average growth rate between years contemplated over a longer period. Between 1990 and 2018 commercial enplanements have grown by a compound rate of 0.9%, which is a lower compound growth rate than other similarly situated resorts (see Figure 2). Between 2000 and 2018 ASE commercial enplanements have grown by a compound rate of 1.89% and between 2009 and 2018 the enplanements have grown by 2.75%. Since 2013 the number of enplanements has grown at a greater than historical rate of just over 6% a year. This followed a period between 2000 and 2013 where enplanements decreased and remained relatively flat (see Figure 1).

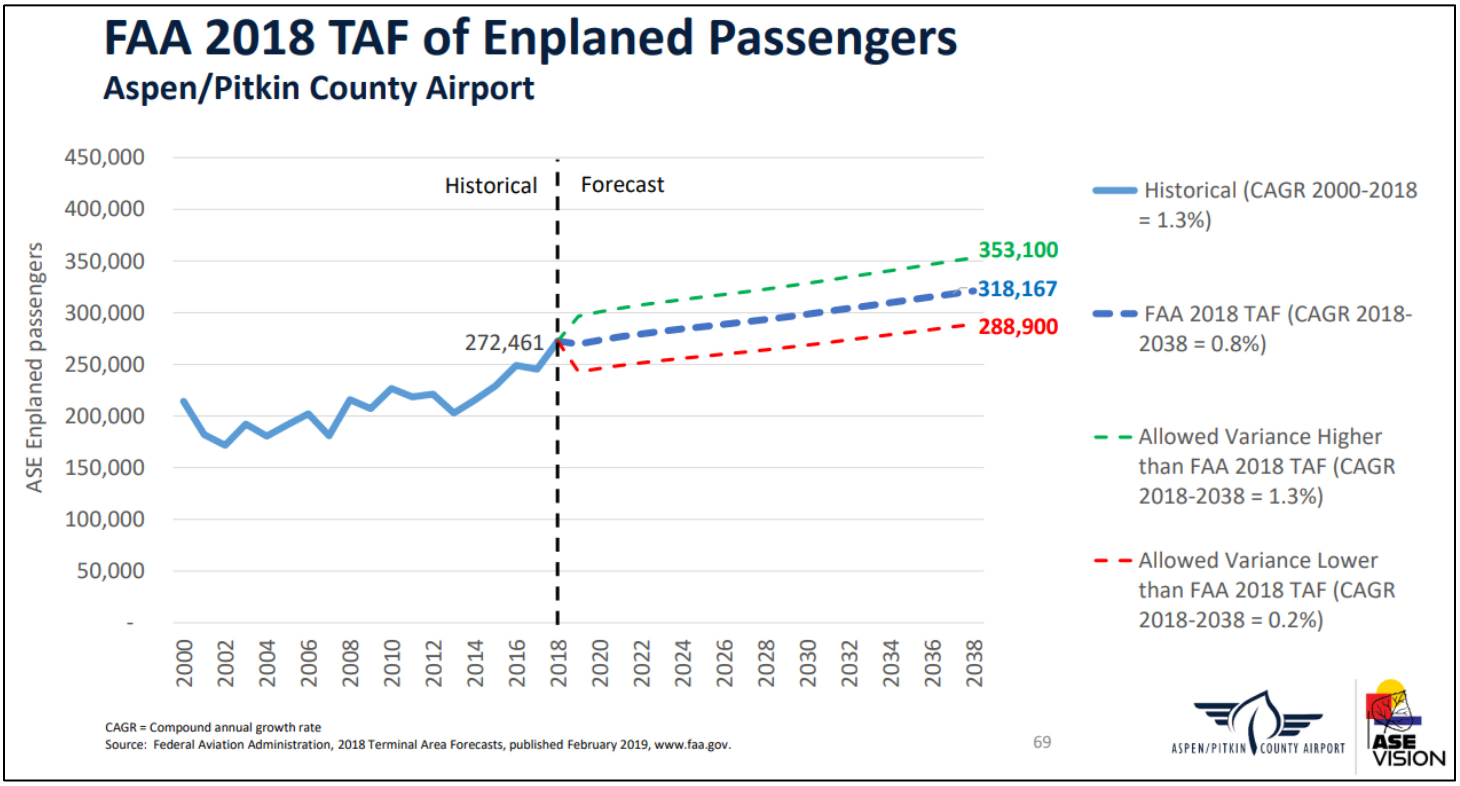


Figure 1

[Remainder of page left intentionally blank]

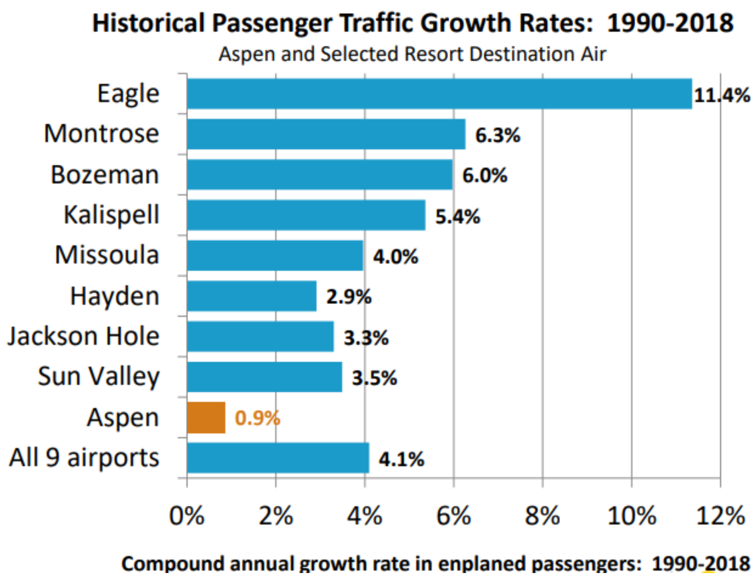


Figure 2

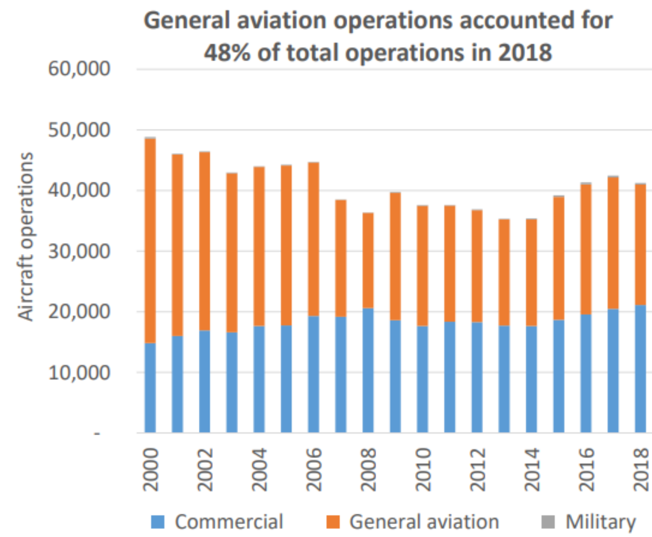


Figure 3

Passenger Enplanements Comparisons

YEAR	ASE	1 YR Annual Growth Rate	SUN	1 YR Annual Growth Rate	JAC	1 YR Annual Growth Rate	EGE	1 YR Annual Growth Rate
2009	216,405		50,540		281,674		180,272	
2010	222,255	2.7%	52,861	4.6%	286,660	1.8%	201,489	11.8%
2011	221,108	-0.5%	51,003	-3.5%	281,808	-1.7%	190,823	-5.3%
2012	214,207	-3.1%	47,882	-6.1%	272,888	-3.2%	173,639	-9.0%
2013	204,198	-4.7%	49,106	2.6%	292,176	7.1%	166,969	-3.8%
2014	217,134	6.3%	63,174	28.6%	305,204	4.5%	164,432	-1.5%
2015	233,476	7.5%	68,067	7.7%	307,150	0.6%	155,795	-5.3%
2016	254,302	8.9%	75,947	11.6%	336,951	9.7%	159,837	2.6%
2017	244,732	-3.8%	83,480	9.9%	341,192	1.3%	154,310	-3.5%
2018	283,877	16.0%	90,667	8.6%	367,167	7.6%	170,868	10.7%
10 year CAGR		2.8%		6.0%		2.7%		-0.5%

Sources: ASE: Airport Management Records;
SUN, JAC & EGE: FAA Terminal Area Forecast

Figure 4 *SUN= Sun Valley Airport, JAC= Jackson Hole Airport, ASE= Aspen-Pitkin County Airport, EGE=Eagle Airport*

Note: Compounded Annual Growth Rates are published in the Kimley-Horn Aviation Activity Forecast, dated August 2019.

History of Airport Safety:

Airport safety in the air and on the ground has been a major point of discussion in all airport planning processes. Aspen Airport sits at 7,828 feet above sea level in the Roaring Fork Valley. The terrain to the Northwest is modest and is the preferred approach with the vast majority of landings occurring on runway 15. In all other directions, peaks and ridges up to 14,000+ feet surround ASE making the terrain challenging for those without knowledge of it. The terrain around ASE leads to an uncommon approach and departure procedure where planes both depart and for the most part arrive from the Northwest. The head to head operations significantly reduce the number of operations that can occur at ASE to ensure appropriate safety clearances between aircraft on approach and takeoff.

According to data from the NTSB there have been 44 aircraft incidents on or around ASE from 1980 through today, with the majority of them related to general mountain flying and not attributable to the ASE airport. 13 of the incidents were fatal resulting in 44 fatalities over that 39-year period. 43 of the 44 incidents were General Aviation aircraft operating for personal use or as charters. Over the 39-year period for which data was available there was only one commercial incident (a mechanical failure of aircraft hydraulics) that occurred in 1999 (BAE 146-200 with 88 passengers) that resulted in minor aircraft damage and no fatalities or injuries.

The most significant accident occurred in 2001 when a Gulf-Stream III operating as a charter crashed into a hillside killing all 18 onboard. The NTSB determined that the probable cause of that accident was: “The flight crew’s operation of the airplane below the minimum descent altitude without an appropriate visual reference for the runway.” Figure 5 shows that for each 10-year period the total number of aircraft incidents at ASE has decreased, as have the number of incidents resulting in substantially damaged or destroyed aircraft. All modes of travel are attended by risk of accident and injury. For example, from 2010 through October 2019, there were 18 fatal automobile accidents, resulting in 19 deaths in Pitkin County.

Improvements in Technology

- Flying has shown a steady improvement in safety over decades as improvements from technology, training, and operating experience have made their way into the entire aviation system.
- In the period covered by the 44 incidents noted above, every aspect of aircraft navigation and control has improved as the FAA has evolved the nation’s air traffic control system from ground-based navigation aids and analog electronics to high speed digital computers, communications and satellite navigation.
- Over the past 10 years the FAA has accelerated the continued evolution through the NextGen program covering every aspect of managing and operating the nation’s airspace. Into the next decade the system will continue to evolve further with more precise navigation, more reliable aircraft.

The effectiveness of these improvements can be seen when looking at statistics for the nation as a whole over the years. Fatal accidents have fallen every decade since the 1950s, a significant achievement given the massive growth in air travel since then. In 1959, there were 40 fatal accidents per one million aircraft departures in the US. Within 10 years this had improved to less than two in every million departures, falling to around 0.1 per million today.

The improvements in safety are even more impressive when the increase in air traffic is considered. In 2014, the world's airlines carried a record 3.3 billion passengers in 2014. For that same year, there were 641 fatalities and 12 fatal accidents, according to the International Air Transport Association (IATA).

NTSB Aircraft Incident Data for ASE 1980-Present								
Years	Total # of Incidents	Aircraft Damage			# of Fatal Incidents	# of Fatalities	# of Commercial Incidents	# of Commercial fatalities
		Minor	Substantial	Destroyed				
2010 - Present	3	0	2	1	1	1	0	0
2000 - 2009	11	2	7	2	2	22	0	0
1990 - 1999	13	1	7	5	4	11	1	0
1980 - 1989	17	0	9	8	6	10	0	0
Total	**44**	**3**	**25**	**16**	**13**	**44**	**1**	**0**

Figure 5. NTSB Aircraft Incident Data for ASE 1980-Present

II. Technical Working Group (TWG) Mission and Meeting Summary

The Board of Commissioners appointed community advisory groups to convene community collaboration across a diverse and inclusive cross-section of interests to provide feedback, share project information, and ultimately inform Pitkin County's decision-making process. The Vision Committee is ultimately tasked with providing the Board with a recommendation of improvements to be made at ASE. To facilitate the work of the Vision Committee four work groups were appointed: Community Character, Airport Experience, Technical and Focus.

The Technical Working Group has been tasked with defining the desired functionality and physical facility requirements that will optimize the airport's ability to meet the community's future air service needs within the limited space available and to make recommendations for specific parameters for the future design of the Aspen / Pitkin County Airport (ASE). These came as the form as several questions from the Airport Visioning Committee (AVC) and from the Community Character Working Group (CCWG). You'll find the responses to these questions in Sections III and IV respectively.

Working Group Meeting History

Technical Working Group Meeting #1 - Wednesday, September 11, 2019, 4pm – 7pm at the Airport Operations Center (AOC). The meeting focused on establishing a baseline of technical information prior to developing any recommendations. The group reviewed strategic questions assigned by the AVC and reference documents setting the stage for a deeper discussion on the preferred design aircraft. Airport external factors were discussed, as well as current operational metrics. Reference materials included a technical memo presented by Kimley-Horn regarding the current performance of the Airport. Members were given a binder that included a large-scale map of the Airport Layout Plan and Master Plan. The outcome of the meeting was aligning and organizing the Technical Working Group around specific background information.

Technical Working Group Meeting #2 Wednesday, September 18, 2019, 4pm – 7pm at the AOC. This meeting began a deeper dive into the technical data including reviewing characteristics of available aircraft against the stated community values and guiding principles. The values-based scorecard was introduced, ranking the available aircraft on noise, emissions and community values. Linda Perry, consultant with LeighFisher, gave a presentation on the methodology and approach used in developing the aviation forecast. An initial ranking of aircraft was conducted.

Technical Working Group Meeting #3 – Wednesday, October 2, 2019, 4-7pm at the Aspen Meadows, Doerr-Hoiser Center. This meeting continued the conversation and dialogue around the preferred design aircraft. Two guest speakers presented: Mary Vigilante, Synergy Consultants, Inc. and Alec Seybold, Flight Tech Engineering. Alec's presentation was centered on planning for the future fleet mix at ASE. Mary Vigilante prepared the first airport-wide greenhouse gas inventory for the 2006 Canary Initiative. Mary's presentation was focused on considerations for data sets to examine air emissions, mainly aircraft fuel burn. Her presentation highlighted noise data and new technology to reduce noise of aircraft such as longer wingspan, winglets and geared turbo fan engines. This meeting gave the Technical Working Group much to consider; the information and resource materials were robust. The group also revisited scoring the preferred design aircraft.

Technical Working Group Meeting #4 – Wednesday, October 16, 2019, 4 – 7 pm at the AOC. The meeting began with a suggestion to table the discussion of preferred design aircraft due to limited control over the airline's choice of aircraft. Bob Jones from Kimley-Horn gave a presentation on specific elements of Airfield Design such as runway safety and taxiway separation. We reviewed ASE non-standard conditions. More detailed information was provided on requested additional aircraft data characteristics. Several reference materials were presented including an FAA Advisory Circular regarding Airport Design and a presentation on aircraft that are no longer flying into ASE. A straw poll was conducted on recommending ADG III. It was determined to not conduct a formal vote and get more information on potential mitigation options.

Technical Working Group Meeting #5 – Wednesday, October 23, 2019, 4-7 pm at the Aspen Police Department Building Meeting Room. The meeting provided information on the history of non-standard conditions at ASE and a detailed spreadsheet was reviewed listing all the potential options for aligning ADG III Airfield with Community Values. The TWG discussed these options as a group and listed their preferences in pursuing the mitigation options. No vote was taken at this meeting. The TWG nominated Bill Tomcich and Rick Heede to begin to develop the TWG's report and recommendation with the direction of the TWG to consider all available mitigation options and environmental goals.

Technical Working Group Meeting #6 – Wednesday, November 20, 2019, 4-7 pm at the AOC. The first draft of the TWG's report and recommendation was circulated prior to this meeting. The group reviewed the report section by section, line by line and identified areas of agreement and alignment. It was determined the report would include the following sections: Airport History, TWG Findings, Recommendation, Environmental Goals and Appendices with additional technical information. The group did not take a vote at this meeting. Members suggested edits and decided not to include information about the number of gates in a future terminal.

Technical Working Group Meeting #7 – Tuesday, December 3, 2019, 4-7 pm at the AOC. There was no presentation at this meeting. The group reviewed the entire draft 16-page report line by line. Additional edits were suggested. A total of 11 members of the 17-member group were present for voting; 9 members voted in favor of the recommendations and report and 2 members opposed the report. The 2 opposing members agreed to the majority of the information in the report. The report was to be finalized and circulated to members of the Vision Committee on December 13, 2019.

Preferred Design Aircraft Scoring Exercise Explained:

The FAA defines Design Aircraft as the most demanding aircraft type or grouping of aircraft with similar characteristics that make regular use of the airport. Regular use is 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations. The AVC asked the TWG what is the preferred design aircraft that best meets our community values. To answer this question the TWG was presented with a list of ADG II and ADG III Aircraft that are capable of operating at ASE now and into to the foreseeable future. Characteristics of each Aircraft were presented in a chart with data points on Noise, Emissions, Operational Capability and Operational Data. The Aircraft were also classified by Engine, Approach Speed, Seating, Wingspan and MTOW. The TWG was asked to score Aircraft based on what Aircraft met community goals, the CRJ 700 was the baseline in this analysis. The following ranking system was used:

1= Measurably meets community goals; 2= Generally, maintains current condition; 3= Worsens current condition. Results of the initial ranking identified A220-300, A320 NEO Sharklet, EMB 195-E2, A220-100 and A319-100 Sharklet were the top-ranking aircraft. It should be noted a final vote was not taken.

We note that the current CRJ 700 ranked lower in emissions and noise than the top ranked aircraft. If the CRJ-700 remains the only commercial aircraft operating at ASE, it will not be possible to make any meaningful headway towards the community's goals of reducing greenhouse gas emissions or noise.

Combined Ranking Results for the Top Five Aircraft

Noise Ranking			
III	Mitsubishi	M100 SpaceJet	1
III	Mitsubishi	M90 SpaceJet	1
III	Embraer	EMB 175-E2	1
III	Airbus	A220-100	1.25
III	Airbus	A320 NEO Sharklet	1.25
III	Airbus	A220-300	1.25
III	Bombardier	Dash 8 Q400	1.375
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	1.5
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	2
II	Bombardier	CRJ 700/701/702 LR	2
III	Boeing	737-MAX 7 (same engine as MAX 8)	2
III	Boeing	737-MAX 8	2.25
III	Embraer	E 190 Standard	2.375
III	Airbus	A319-100 Sharklet	2.375
III	Embraer	EMB 190-E2	2.43
III	Embraer	EMB 195-E2	2.5
III	Embraer	EMB 175 LR, extended wingtips	2.6
III	Embraer	E 170 Standard	2.687
III	Airbus	A320-200 Sharklet	2.8
III	Boeing	737-700 with winglets	2.8

Emissions			
III	Airbus	A320 NEO Sharklet	1
III	Mitsubishi	M90 SpaceJet	1
III	Embraer	EMB 175-E2	1
III	Boeing	737-MAX 7 (same engine as MAX 8)	1
III	Airbus	A220-300	1.125
III	Airbus	A220-100	1.25
III	Airbus	A320-200 Sharklet	1.25
III	Boeing	737-MAX 8	1.5
III	Embraer	EMB 195-E2	1.625
III	Airbus	A319-100 Sharklet	1.75
III	Embraer	EMB 175 LR, extended wingtips	1.87
III	Bombardier	Dash 8 Q400	2
II	Bombardier	CRJ 700/701/702 LR	2
III	Boeing	737-700 with winglets	2
III	Mitsubishi	M100 SpaceJet	2
III	Embraer	E 170 Standard	2.16
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	2.375
III	Embraer	EMB 190-E2	2.375
III	Embraer	E 190 Standard	2.5
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	2.83

Operations			
III	Bombardier	Dash 8 Q400	1.25
III	Airbus	A220-100	1.25
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	1.25
III	Airbus	A319-100 Sharklet	1.25
II	Bombardier	CRJ 700/701/702 LR	2
III	Boeing	737-MAX 8	2.75
III	Boeing	737-700 with winglets	2.75
III	Embraer	EMB 175 LR, extended wingtips	2.75
III	Boeing	737-MAX 7 (same engine as MAX 8)	2.75
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	3
III	Airbus	A320 NEO Sharklet	3
III	Airbus	A220-300	3
III	Embraer	E 190 Standard	3
III	Embraer	E 170 Standard	3
III	Embraer	EMB 190-E2	3
III	Airbus	A320-200 Sharklet	3
III	Embraer	EMB 195-E2	3
III	Mitsubishi	M100 SpaceJet	3
III	Mitsubishi	M90 SpaceJet	3
III	Embraer	EMB 175-E2	3

Top Five Aircraft		
III	*Airbus*	*A220-300*
III	Airbus	A220-100
III	Airbus	A320 NEO Sharklet
III	Embraer	EMB 195-E2
III	Airbus	A319-100 Sharklet

Baseline: CRJ 700

Top Ranking Aircraft to Community Values

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (V_{ref})	Seating	Wingspan (ft.)	Range (NM)	MTOW	Noise	Emissions	Operations	Growth
ADG	Manuf	Model	Engine	AAC	pproach Speed (Vre	Seats	Wingspan	Range	MTOW				
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	1,650	53,000	1.5	2.375	3	2.8
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	1,100	65,200	1.375	2	1.25	2.7
III	Airbus	A220-100	Jet	C	130	109	115.08	3,400	134,000	1.25	1.25	1.25	1.8
III	Airbus	A320 NEO Sharklet	Jet	C	136	157	117.45	3,500	174,165	1.25	1	3	1.8
III	Airbus	A220-300	Jet	C	135	140	115.08	3,350	149,000	1.25	1.125	3	1.3
III	Boeing	737-MAX 8	Jet	D	142	178****	117.83	3,550	181,200	2.25	1.5	2.75	2.2
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	1,000	65,000	2	2.83	1.25	2.8
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	1,400	77,000	2	2	2	2
III	Embraer	E 190 Standard	Jet	C	124	96**	94.25	2,450	105,359	2.375	2.5	3	1.8
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	3,750	168,653	2.375	1.75	1.25	1.5
III	Embraer	E 170 Standard	Jet	C	124	69	85.42	2,150	82,012	2.687	2.16	3	2.4
III	Embraer	EMB 190-E2	Jet	C	124	97	110.70	2,850	124,341	2.43	2.375	3	1.8
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	3,300	171,961	2.8	1.25	3	1.8
III	Embraer	EMB 195-E2	Jet	C	124	120	115.15	2,600	135,584	2.5	1.625	3	1.3
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	4,400	154,500	2.8	2	2.75	1.5
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	124	76	93.92	2,150	85,517	2.6	1.87	2.75	2.7
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	1,910	86,000	1	2	3	2.7
III	Mitsubishi	M90 SpaceJet	Jet	C		88*	95.83	2,040	94,358	1	1	3	2.3
III	Embraer	EMB 175-E2	Jet	C	124	80	101.70	2,000	98,767	1	1	3	2.5
III	Boeing	737-MAX 7 (same engine as MAX 8)	Jet	D	142	153***	117.83	3,850	177,000	2	1	2.75	2

Exhibit A

III. Technical Working Group Findings

The TWG has been presented with numerous reports, reviewed technical presentations and documents from experts in the field of airport design, noise and carbon emissions, aircraft design and utilization, airline specific operations, and airport operations. Analysis has been conducted of all technical information and reporting to develop this report. The following determinations have been discussed and agreed on by the group:

A. Safety

1. According to National Transportation Safety Board data from 1980 to today commercial operations (FAA Part 119) at ASE have been very safe. For the 39-year period between 1980 and today there has only been one commercial aircraft incident, which resulted in minor damage and no injuries or deaths. Commercial pilots operate under strict operating procedures and training required by airlines and FAA that reduce the likelihood of accidents.
2. National Transportation Safety Board data from 1980 to today shows there have been 43 incidents with GA Aircraft at or around ASE. Of those 43 incidents, 13 were fatal with 44 total deaths. Pitkin County is preempted by the FAA and is not able to require all pilots to adhere to the same safety requirements as commercial pilots. The TWG does recognize that Part 135 (charter) operators have more demanding requirements than Part 91 (civil) operators. These regulations are implemented and enforced by the FAA exclusively. The County can promote information to Part 135 and Part 91 operators to help these operators familiarize themselves and operate more safely in and out of ASE.
3. According to NTSB data, since 1980 the number of aircraft incidents at or around ASE have decreased for each 10-year period with a high of 17 incidents from 1980-1989 and a low of 3 incidents from 2010-present.
4. The current terminal facility has several safety challenges, including, but not limited to: The terminal does not meet National Fire Protection Code with the most significant issue being the slope of the ramp that drains back to the terminal. In the event of a fuel spill, fuel would drain towards and not away from the terminal.
5. Safety of aircraft operations has been identified by the ASE Vision Community Survey as the #1 priority.

6. The proposed runway to taxiway separation improvements identified in the Environmental Assessment and accepted by the FAA represent important safety enhancements which are feasible to implement at ASE.
7. Most general aviation pilots utilize the standard instrument approach to Runway 15, however there is a special instrument approach to runway 15 that is often used by Part 121 and Part 135 commercial operators and that requires additional higher level of training.
8. Aspen/Pitkin County Airport is a challenging airport to fly in and out of due to the presence of high mountainous terrain in close proximity to the airfield, often rapidly changing weather conditions, and non-standard visual and instrument approaches.

B. Commercial Airplane Availability

1. The only existing commercial aircraft certified to operate into ASE under the current 95' wingspan restriction are the Bombardier CRJ-700 and Dash-8 Q400. The only commercial aircraft operating at ASE today is the CRJ-700. The only remaining Q400 aircraft in the U.S. are operated by Horizon Airlines and are operated by Alaska Airlines hubs in SEA & PDX. The last CRJ-700 was delivered to a North American operator in 2011. Retirement of the CRJ700 is dependent on two factors: 1.) business decisions of airlines and 2.) The useful life of the aircraft. The CRJ-700 is being phased out by some airlines now and will likely be retired by additional airlines over the next 10-15 years (2030-2035). The CRJ-550 is the only 50-passenger regional jet with the required operational performance to successfully operate at ASE. Neither the Bombardier CRJ-200 nor the Embraer ERJ-145 have this capability. The range of the CRJ-550 is less than the CRJ700 due to reduced maximum takeoff weight (MTOW) and would not be able to serve the ORD and ATL markets currently within the CRJ-700 capabilities. We also note that the CRJ-550 are not new planes but are effectively interior conversions of CRJ-700's with the same limitations to their service life as the CRJ-700 fleet.

2. The TWG identified five narrow body aircraft that best align with community goals for emissions, noise, and number of operations at ASE: Airbus A220 (100 & 300); Airbus A320 Neo; Embraer 195-E2; and Airbus A319-100. All have wingspans and weights that exceed ASE's current 95' wingspan restriction and 100,000 lb. landing weight restriction. The only Next Generation aircraft that may meet ASE's current restrictions is the Mitsubishi MRJ-100. The MRJ-100 is currently in design, no prototype has been built, nor has Mitsubishi ever certified a commercial aircraft in the United States. Implementing Airplane Design Group (ADG) III separation standards will give airlines the flexibility to make future fleet decisions that would retain commercial service as the CRJ-700 is replaced. The prospect of possibly not having commercial aircraft available to service the needs of the community would cause irreparable harm to its businesses and residents, and the TWG recognizes its fiscal responsibility to Pitkin County and other communities throughout the Roaring Fork Valley. See the appendices and aircraft matrix for reference.

3. It is recognized that if the wingspan restriction at ASE is increased to 118' (ADG III), this would allow certain high performance mainline and some larger GA aircraft to operate at ASE. Based on the current forecast, it appears that market conditions are such that it is unlikely that an airline would choose to operate mainline aircraft into ASE exclusively

without also being able to offer a smaller regional aircraft for the majority of their flights to allow for schedule diversity, connectivity and continuity of year-round service into ASE.

Examples of mainline and narrow body. "Mainline" aircraft are those operated by the major (mainline) airlines, such as United, American and Delta rather than "regional" aircraft operated by regional operators such as SkyWest. Under current agreements in place with pilots and the airlines, any aircraft with over 76 seats are mainline aircraft. "Narrow body" aircraft are single aisle mainline aircraft such as Airbus A-220 and A-319's and Boeing 737's.

C. GA Aircraft

1. ADG III GA aircraft with wingspans of 95' or less currently operate at ASE. GA Aircraft that have wingspans larger than 95 feet are relatively rare and all of them are very new designs with the most efficient engines and quietest operation of any of the ADG III GA planes. The differences between the largest of today's ADG III GA aircraft are minor with the largest of dedicated GA planes having wingspans of approximately 100 feet. Overall GA operations have decreased since 2000. The Aviation Activity Forecast projects modest growth in GA operations regardless of future changes to airfield geometry.

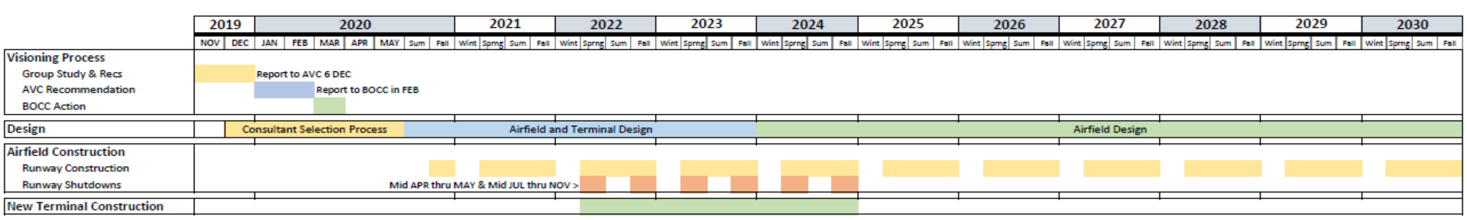
D. Scope Clause

1. A scope clause is part of a contract between a major airline and the trade union of its pilots that limits the number and size of aircraft that may be flown by the airline's regional airline affiliate. The primary limitation under today's scope clause provisions is on the number of planes with 51-76 seats that can be operated by Regional operators such as SkyWest. The goal is to protect the union pilots' jobs at the major airline from being outsourced by limiting the regional airlines' passenger capacity. Every time a new regional jet (e.g. Embraer 175) is added to an airline fleet an older scope compliant aircraft (e.g. CRJ700) must be removed from the airline's fleet. Aircraft with 50 seats or less (such as the CRJ-550) are not limited under the scope clause with American Airlines and far less restricted for both United and Delta.

E. Phasing

1. The potential improvements will require phasing to ensure the airport remains operational during busy seasons. Additionally, the scope of the project may also require phasing to be economically feasible depending on FAA grant availability.

Conceptual ASE Program Schedule / Phasing



F. Growth

1. Multiple factors contribute to the projection of the annual growth rate. As growth is a regional issue, studying the County's growth should be considered when planning the future of the Airport, but such a study should not stop the progress of planning for improvements that offer flexibility for long term the terminal and runway. Growth should be a community conversation, but not a limiting factor in developing an implementation plan for the working group's recommendations. Generally, the airport is a piece of the infrastructure of the valley and is responding to growth, however, it may play a small role in inducing some demand.

IV. <u>Technical Working Group Recommendation</u>

A. Airfield Recommendation

The risks associated with the uncertainty of any future aircraft with wingspans of 95' or less actually being able to operate at ASE, and the likely degradation of commercial air service into ASE is more consequential than the undesired impacts of the possible introduction of some mainline aircraft. The TWG recommends removing the Non-Standard conditions at ASE and building an ADG III airfield that fully complies with ADG III separation standards. The TWG also recommends that the County explore phasing options to meet full ADG III compliance. Phasing should be prioritized to first meet separation standards, followed by runway strength (weight capacity); and finally, runway width (approach speed).

B. Mitigation Recommendations

To mitigate the concerns of the community, we further recommend exploring the following mitigation options:

1. Reduction in Emissions

Modernization of Airport planning should include an aspirational goal of 30% reduction in Greenhouse Gases (GHG) and Emissions and should take the following into consideration for airport design and operations:

- The TWG has studied the overall goal of reducing Greenhouse Gases (GHG) and Emissions by 30% at length (Exhibit A) and notes that no specifics on how this should be measured or the timeframe for implementation were provided with that goal. Along with implementing strategies to reduce carbon usage in the terminal, construction and for general airfield equipment (Ground Support Equipment, Snow removal and general operations primarily), the group recommends relative to the largest component – aviation fuel use, that the goal be established to reduce total fuel sales at ASE by 30% by the year 2030. The TWG believes this to be an aggressive, but attainable goal.

- Realizing that changes to the airfield which would allow newer more efficient planes to operate will not be in place until 2025 at the earliest, the TWG recommends participating in a certified and verifiable Carbon Offset Program. Without the ability to change from the current CRJ-700, there is no way to make any appreciable headway on the 30% GHG and emissions reduction on commercial operations, therefore the offset program should be implemented immediately.

- Pitkin County should become a leading voice supporting implementation of Bio-Fuels as an aviation fuel. We should explore the feasibility of not only providing ready access to these fuels at ASE but advocate for their adoption into the commercial and GA fleet serving ASE.

- To encourage GHG reductions, the County should investigate financial incentives to the use of more efficient and/or alternative fuel aircraft including taxes on fossil fuel sales, and landing fees which encourage the Next Generation of "greener" aircraft.

- The TWG review of all commercial aircraft currently identified as suitable for service at ASE (both ADG II and ADG III planes), suggests that the newest small narrow body aircraft are significantly more fuel efficient and quieter than the current CRJ-700 fleet or any of the smaller available regional jets. To meet the community goals of reducing both noise and emissions/GHG we should provide an airfield which can allow these aircraft to operate.

- Electrify airfield to provide for electric ground support equipment, ground power and air tempering for both GA and Commercial ramps. This will significantly reduce APU usage, and noise/air emissions from ground equipment.

- All new airport facilities should be designed to be net zero to the extent possible within reasonable design parameters and county budgetary constraints.

- 30% reduction in emissions is aspirational, aggressive but attainable.

2. Safety and Airspace Clearance

There are a multitude of avionic components to the FAA's emerging NEXTGEN Program. The County should work with the FAA to ensure safe clearances, enhanced efficiency, and the implementation of NEXTGEN Avionics.

V. <u>Vision Committee Questions</u>

A. ***To meet our community values and goals, what is our desired "design aircraft?"***

The TWG did not formally vote on *a* preferred design aircraft, although there was a consensus around a group of Next Generation available aircraft: Airbus A220-100, Mitsubishi M100 SpaceJet, and Embraer E175/190/195-E2. Next Generation of small narrow body aircraft are quieter, use less fuel per passenger and will likely require fewer operations to meeting market demands. (Refer to appendices for charts of ranked aircraft characteristics.)

All these new generation small narrow body jets have similar capacity to those aircraft that operated at ASE prior to when the CRJ700 was introduced in 2006.

Examples: The BAE146-300 had 100 seats and operated at ASE for 17 years (1988-2005), the BAE 146-200 had 86-100 seats and operated at ASE for 20 years (1986-2006), and the BAE 146-100 had 86 seats and operated at ASE for 16 years (1985-2001).

B. How could the existing or future "fleet mix" meet the air pollution reduction, limited enplanement growth, and noise abatement goals established by the ASE Vision process?

The following design specifications should be considered:

- To the extent possible, design to ADG III aircraft;
- Weight limit the asphalt to the most rigorous aircraft likely to serve ASE (e.g. Airbus A220).
- Electrify airfield to provide for electric ground support equipment, ground power and air tempering for both GA and Commercial ramps. This will significantly reduce APU usage, and noise/air emissions from ground equipment.
- Reconfigure FBO ramps to move heavy GA aircraft to North end of airport away from North40 residents.
- Increase berm and sound-walls along HWY 82 to reduce noise at the AABC and North Forty.

C. *In light of those community goals, what does the future airfield look like in terms of safety and airport design?*

- Meet runway design separation standards for ADG III.
- Enhance training/resources available to Pilots regarding unique characteristics of ASE operations.
- Encourage the implementation of NextGen program and precision approaches.
- Greater separations on the airfield reduce the likelihood to conflicts on the ground.

D. *What should be the commercial Design Aircraft for Aspen given what aircraft are currently available and known future aircraft? For the desired Design Aircraft, does the airfield need to be ADG II or ADG III.*

- Next Generation small narrow body jet (e.g. Airbus A220, Mitsubishi SpaceJet or Embraer E2)
- Build to accommodate weight of Next Generation ADG III design aircraft.
- Airfield geometry will need to accommodate ADG III dimensions.

E. How could our future airfield be as green and carbon neutral as possible?

Recognizing physical constraints and county budget limitations, the airfield, and associated facilities should incorporate all energy conservation measures feasible for onsite design, such as:

- Geo-thermal (facilities and snowmelt),
- LED lighting (airfield and facilities),
- Electrifying the airfield to accommodate plug-ins for GA and commercial aircraft (limit APU usage),
- Utilization of onsite renewables (e.g. solar) to support facilities and airfield.
- Implement a carbon pricing strategy such as basing landing fees and/or fuel costs on efficiency. Use fees to fund onsite renewables and then to purchase certified carbon off-sets to meet goal to reduce Greenhouse Gas emissions by 30%.

VI. Community Character Success Factors: How do these recommendations address or not address Community Character success factors?

The TWG recognizes that safety should be prioritized. Many of the items that the Community Character group have identified in this area we agree with.

A. Safety in the Air and on the Ground:

1. The CCWG asked that prioritization of investments be made in policies and procedures that minimize the risk of crashes, accidents and hazardous materials spills. Work with FAA to maximize safety and enhance airspace.

2. The CCWG asked that enhanced requirements for pilots flying into ASE Airport be made. Pitkin County is not able to require all pilots adhere to the same safety requirements as commercial pilots. The TWG does recognize that Part 135 Pilots have more demanding requirements than Part 91 Pilots. These regulations are implemented and enforced by the FAA exclusively. The TWG does recommend that the County enhance training and resources available to pilots regarding the unique characteristics of ASE operations.

3. Additionally, advancing the airfield to the full ADG III design requirements brings the separation between the taxiway and runway of the airfield up to higher safety standards. This addresses the safety concerns brought by the FAA in 2012 when the ALP was filed with them.

B. Airside Community Character

1. The CCWG encouraged the use of Next Generation of regional aircraft, capping passengers to 76 per flight (consistent with current US Scope Clause restrictions). The Next Generation of aircraft does aid in meeting the environmental goals that the process has set forth. The technical working committee recognizes that in order to continue viable commercial service into ASE, upgrading the airside to ADG III separation standards is necessary. Because the County cannot unjustly discriminate against aircraft, this makes it impossible to ban aircraft with higher capacities. The market and existing conditions will necessitate that many of the flights will need to be served by regional aircraft and pilots, however, a Next Generation, scope compliant aircraft that can operate at ASE cannot be identified at this time. Bringing the airfield geometry to ADG III separation standards will give the airlines some flexibility in identifying future aircraft.

2. There are several aircraft identified to come to market soon, however, most have capacities of more than 76 passengers, and all are ADG III meaning they are mainline narrow body aircraft (operated by the major airlines, not regional carriers like SkyWest). Use of aircraft larger than 76 seats will reduce the number of operations needed to accommodate the demand into ASE regardless of what that demand is. These newer planes, including the Airbus A220-100, are more fuel efficient and quieter than the CRJ-700 and have the potential to reduce operations by 30% or more compared to today. These new larger aircraft are also closer in capacity to some of the aircraft that flew into ASE in the past

including the BAE146-300 (100 passenger) which operated between 1988 and 2005, the BAE146-200 (86-100 passenger) which operated between 1986-2006, and the BAE 146-100 (86 seats) which operated 1985-2001.

3. In the attempt to reduce the noise generated at the airport, the TWG has evaluated the potential aircraft that could fly into ASE. The Airbus 220 (100 and 300) and Boeing 737-Max are quieter aircraft than the CRJ 700 in all segments of the ICAO data. These include Lateral/Full-Power, Approach, and Flyover measurements. Reducing noise by a percentage is a difficult metric to contemplate because of the difficulty in defining the metric. Sound is typically measured in decibel which is a logarithmic scale. There are other mitigations available to help relieve the noise experienced by airport neighbors including building sound walls and berms, reconfiguring the FBO ramps to move heavy GA toward the north end of the airport, away from the North 40. These are all mitigatory efforts that the TWG recommends.

4. The CCWG encouraged the TWG to consider unintended consequences of a new class of general aviation aircraft. For the size of aircraft being considered, bringing the airfield up to full ADG III standard would only allow several additional aircraft. Gulfstream and Bombardier make the only GA specific private aircraft with wingspans over 95 feet. The Gulfstream G650 series has a wingspan of 99.6 feet and the just announced G700 has a wingspan of 103 feet. The Bombardier Global 7500 and 8000 both have wingspans of 104 feet. Determining how these aircraft would be mixed into the General Aviation Fleet Mix is difficult. Both Boeing and Airbus sell "Private Jet" versions of their commercial aircraft. As of the end of 2018 Boeing had orders for 20 BBJ MAX series (based on the latest 737). In total across all types, Boeing had delivered 233 BBJs (1996 thru 2018). As of June 2019, Airbus has 213 operating business jets (all sizes but the majority are based on the A319) and they had 222 on order, of which 128 are based on the A320. The majority of BBJ and Airbus Business Jet sales have been to Middle East customers. There have been two Boeing Business Jet operations into ASE in the last year. This jet has a 94.75' wingspan and meets the current ASE wingspan. These larger private jets would create difficult parking situations for the fixed base operator. The final data point to be considered here is that Netjet operates approximately 50% of the GA flights at ASE (2018). The largest aircraft in their current fleet is the Bombardier Global 6000, which has a 94' wingspan.

C. Environmental Responsibility

1. CCWG recommends a baseline emission study be completed including particulates and VOCs to aid in establishing a 30% (at minimum) reductions from those baseline emissions. The technical working group has evaluated the potential aircraft to serve ASE in the future, should it go to ADG III. In this analysis it is apparent that most other aircraft analyzed burn less fuel per landing, takeoff, and operation (LTO) cycle per passenger than the CRJ 700. These aircraft are capable of saving up to 41% per LTO cycle compared to the CRJ 700. Along with fuel spent, other considerations were CO_2 Total Mass per passenger, and NO_x total mass per passenger. This analysis, the Airbus A320 NEO Sharklet and A220-300 ranked highest. The TWG also recommends the promotion of the use of aviation biofuels in

servicing local aircraft.

2. Mary Vigilante presented to the TWG and discussed these metrics as well. Overall, in the US Method 2 is used to baseline carbon emissions in the air industry. This contemplates the total fuel burn. While it may not be as accurate at the granular local level, it takes a holistic view of the country. The TWG recommends creating a baseline like the national standards on a local level, working with partners such as the Canary Initiative, CORE, Rocky Mountain Institute, etc.

3. For non-aircraft specific recommendations, the TWG has discussed and endorses LED lighting on the airfield, electrification of the airfield equipment, such as ground support equipment (GSE) as much as practical and encouraging other improvements that may address climate change and address vision committee goals.

D. Reflect the Local Culture and Values

1. The CCWG request that models be created to test the consequences of design options on the current character of the airports and surrounding areas.
   - As the total culmination of County noise and emissions volumes involves more analysis than just the airspace recommendation, the TWG ranked design aircraft that ***are the best aircraft to meet with community values*** resulting in reduction of emissions and noise over the long term.
   - The TWG recommends continued monitoring of noise at the airport in order to measure against the recommended reductions. Studies of noise and compatible land use were addressed in section 4.11 in the Environmental Assessment. These studies suggest that as newer narrow-body commercial aircraft are introduced, and given the study area, the noise increase would not be a significant impact (EA page 18).
   - While emissions are covered in the EA, this is outside of the scope to the TWG to address.

2. The Technical Working Group identified options for aligning an ADG III airfield with community values. This exercise was discussed amongst all group members. While some of these items are preempted by FAA, nonetheless they could be explored.

Options for Aligning ADG III Airfield with Community Values

Mitigation Options	Description	Consistency with FAA Rules & Guidance	Enhance Safety	Mitigates Emissions	Mitigates Noise	Mitigates Growth	Unintended Consequences and other Notes
Peak Operations Frequency / Spacing	Work with FAA to enhance safety by reducing flow rate	Unknown/FAA Preemption	X	X	X	X	Potentially adds to passenger delays, reduces overall airport capacity. May spread operations throughout the day.
Build Gates to Community Targets	Provide gates consistent with Community Values and Affordability	Yes/County Decision		X	X	X	Potentially adds to passenger delays if growth is not anticipated
Negotiate with Airlines	Engage airlines on aircraft type and frequency serving ASE	Unknown		X	X	X	New airline begins to serve ASE without an agreement. May not be enforceable.
Electrify Airfield	Provide for electric Ground Support Equipment, Ground Power and Air Tempering	Yes/County Decision		X	X		Costly to implement without using Jet Bridges for commercial. May be difficult to design for GA parking.
Design Runway Weight Limits for Desired Design Aircraft	Design Runway around A220-100 Design Aircraft	Unknown/FAA Preemption			X	X	
Reconfigure FBO	Move heavy GA aircraft to North end of airport away from ABC	Yes/County Decision			X		Moves APU emissions & noise away from ABC but doesn't reduce total amount of emmissions.
Air Space	Encourage NextGen Avionics and Precision Approaches	Yes/FAA Preemption	X				Potentially concentrates sound over narrow corridors
Carbon Pricing	Base landing fees and/or fuel costs on efficiency	Unknown/FAA Preemption		X			
Sound attenuation along HWY 82	Increase Berm / Soundwalls along HWY 82 to reduce noise at ABC	Yes/County Decision			X		Potentially unsightly and conflicts with current standards

Appendix

VII. Appendix

A. Commercial Aircraft

CRJ-700

- The newest CRJ-700 was built in 2011.
- Delta has actively begun retiring CRJ-700 aircraft primarily due to fuel consumption. There are only 12 CRJ-700's in Delta's SkyWest fleet and they have reduced ASE service this year by one flight per day due to aircraft availability.
- The CRJ-700 falls within the "Scope Clause" meaning for every new "in scope" aircraft the airlines buy (Currently E175's), they must retire one CRJ-700. United has ordered 20 additional E-175's in 2019 with 19 further options.
- Mitsubishi has purchased the entire CRJ program from Bombardier in 2019. They are responsible for the ongoing maintenance, support, refurbishment, sales and marketing commitments for the entire CRJ family. Mitsubishi has openly stated that the purchase of the CRJ line was made to provide a US Network for service of their announced SpaceJet family and they have no intentions of continuing any CRJ activities beyond that required by the purchase agreement.
- The CRJ-550 are mid-life CRJ-700 airframes with a new exterior paint job and a new interior to seat 50 passengers. The refresh did not include any major maintenance checks, nor did it extend the life of the airframes. A total of 54 of these aircraft have been ordered by United to use in small markets where planes under the Scope clause (50 passengers or less, and under 65,000 lb MTOW) and limited range (current max scheduled is 850NM) are appropriate to service demands.
- GoJet is the only regional operator announced to fly the CRJ-550 for United based out of O'Hare and Newark. The CRJ-550 does not have the range for ASE to either ORD or EWR.

Embraer

- The Embraer E175 is the only "scope compliant" regional jet currently in production being purchased by US Airlines. As of June 2019, backlog stood at 194 planes.
- Boeing has announced the intent to acquire the majority interest in Embraer' commercial aircraft division plans to rebrand it Boeing Brazil. The Joint Venture is expected to close in 2020. Until the deal closes, they remain separate companies.
- Embraer has announced a Next Generation of their regional jets starting with the E190-E2. The E2 program was announced in 2013 and the E190-E2 was certified by the FAA in Feb 2018. The E195-E2 was certified in April 2019. The first E175-E2 is final assembly and Embraer promises revenue service by the end of 2021. None of the E2 series planes meet current US Scope Clause limits.

Mitsubishi M100 SpaceJet

- The Mitsubishi M100 SpaceJet, is promised to be a 76 passenger, scope compliant plane with an approximately 91-foot wingspan. No prototype of this plane yet exists, however Mitsubishi states it is based on their discontinued MRJ70 aircraft which had Pratt & Whitney, PW1000G series Geared Turbofan Engines, like that on the Airbus A220 series. Current service entry date is targeted as 2023 according to Mitsubishi. Mitsubishi materials for the M100 state it will be the only in-production jet with the capability to serve ASE. The time sequence of the MRJ program is as follows:

- 2005 – Formerly adopted a program to develop a 70-90 seat regional jet
- 2007 – Mockup of MRJ90 shown at Paris Airshow
- 2008 – Officially launched with order for 25 MRJ90's for ANA Airlines to be delivered in 2013
- 2010 – Announced start of production for MRJ90
- 2012 – First MRJ90 delivery pushed back to 2017
- 2014 – Official Rollout of first MRJ90 test plane
- 2015 – MRJ90 maiden test flight. Announced delay of delivery to mid-2018
- 2017 – Two-year delay for MRJ90 announced with delivery to ANA set for mid-2020
- 2019 – Announced M100 program (sized between MRJ90 and MRJ70) with delivery anticipated in mid-2023. Cabin mock-up presented at Paris Air Show.
- 2019 – Announced a Memorandum of Understanding to negotiate purchase of up to 100 (50 firm orders / 50 options) M100's with Mesa Airlines. SkyWest has conditional order for up to 100 MRJ90 planes which could be converted to M100's depending on how changes to scope clause limits are resolved.

Retirement of Available Aircraft

- The remaining CRJ700's operated by SkyWest for either American, Delta or United are facing retirement over the next decade, while the only remaining Q400 aircraft in the U.S. are operated by Horizon Airlines and have been relegated to Alaska Airlines hubs in SEA & PDX.
- The current Embraer E175 with enhanced performance winglets (EPW) has been studied by regional airlines for ASE operations, but procedures have not yet been successfully developed that potential operators are comfortable with that would allow this aircraft to safely and reliably operate into ASE on a year-round basis.
- The recently announced Mitsubishi SpaceJet M100 is a potential CRJ700 replacement. To date there is no flying prototype of this aircraft, actual performance capabilities are unknown and there are not any firm orders by US carries yet in place. The announced service entry date for this plane is currently 2023, however Mitsubishi has yet to certify a commercial plane under FAA rules and regulations.

The CRJ-550 is the only 50-passenger regional jet with the required operational performance to successfully operate at ASE. Neither the Bombardier CRJ-200 nor the Embraer ERJ-145 have this capability. The range of the CRJ-550 is less than the CRJ700 due to reduced maximum takeoff weight (MTOW) and would not be able to serve the ORD and ATL markets currently within the CRJ-700 capabilities. We also note that the CRJ-550 are not new planes but are effectively interior conversions of CRJ-700's with the same limitations to their service life as the CRJ-700 fleet.

B. ASE Historical Commercial Aircraft

- The BAE146-300 was the largest aircraft to operate at ASE. Passenger Capacity was 100 seats and the plane operated for 17 years at ASE from 1988 to 2005
- The Table below lists the commercial planes which have served ASE

Plane	Years flown to ASE	Duration at ASE	Seats
Convair 240	68-70	2	52
Convair 340/440	70-77	7	52
De Havilland Twin Otter	68-86	17	19
Convair 580	73-94	21	56
De Havilland Dash-7	78-94	16	50
ATR 42	90-94	4	50
ATR 72	93-94	2	70
BAE 146-100	85-01	16	86
BAE 146-200	86-06	20	86-100
BAE 146-300	88-05	17	100
Avro RJ70	95-96	1	70
Dornier 328	95-98	3	30
Avro RJ85	97-06	9	69
Bombardier Dash 8-200	97-08	11	37
Bombardier Q400	08-16	8	69-74
Bombardier CRJ-700	06-Present	13 so far	63-70

C. General Aviation

- Gulfstream and Bombardier make the only GA specific private jets with wingspans over 95 feet. For Gulfstream both the G650 series (WS= 99.6 feet) and the just announced G700 (WS=103) are over the 95-foot ASE limit. Bombardier makes the Global 7500 and 8000 (both with WS=104).
- Both Boeing and Airbus sell "Private Jet" versions of their commercial aircraft. As of the end of 2018 Boeing had orders for 20 BBJ MAX series (based on the latest 737). In total across all types, Boeing had delivered 233 BBJs (1996 thru 2018). As of June 2019, Airbus has 213 operating business jets (all sizes but the majority are based on the A319) and they had 222 on order, of which 128 are based on the A320.
- A BBJ based on the Boeing 737-500 has come into ASE twice in the last 12 months. It has a wingspan of 94.75 feet and meets the current ASE wingspan and weight limits.

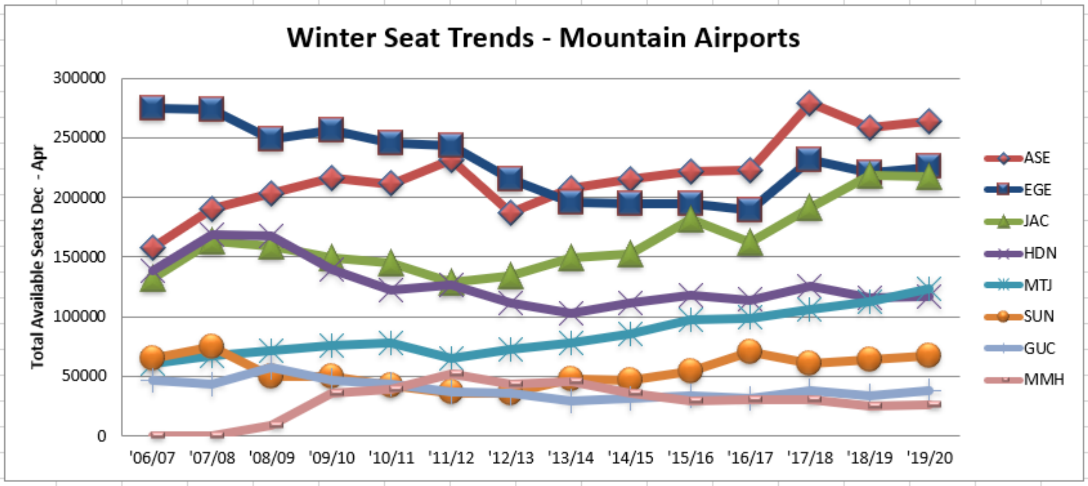
NetJets operated approximately 50% of the GA flights at ASE in 2018. The largest of their current fleet is the Bombardier Global 6000 which has a 94-foot wingspan.

Fourteen-Year Seat Capacity Trends at Eight Mountain Airports

Source: Airports USA Avaition DataMiner / Boyd Group International

Seat Counts are from Dec 1 - Apr 30 of each ski season ('19/20 updated 10.19.19)

Airport	'06/07	'07/08	'08/09	'09/10	'10/11	'11/12	'12/13	'13/14	'14/15	'15/16	'16/17	'17/18	'18/19	'19/20	# Seats up/down	% *Increase*
ASE	157583	190782	203139	216157	211530	231530	187066	208128	215519	222020	222590	278701	258716	264179	5463	*2.1%*
EGE	275178	273377	249228	255927	246086	243831	215490	196037	194496	195072	189151	231759	220624	225576	4952	*2.2%*
JAC	132296	162962	159120	148850	144962	128994	134471	149373	152945	181789	161998	191244	218913	217971	-942	*-0.4%*
HDN	138248	169001	167966	140076	122455	127107	111223	102900	112032	118390	114205	126065	115687	117411	1724	*1.5%*
MTJ	60473	67038	71187	75342	78472	65362	72727	77695	85617	97755	99082	106243	112979	123369	10390	*9.2%*
SUN	64764	74342	49756	50187	42384	36364	35766	47352	46900	53936	70114	60825	63718	66871	3153	*4.9%*
GUC	46661	43290	57227	46471	43616	37108	36306	29430	31664	33456	31848	37544	33646	37899	4253	*12.6%*
MMH	0	0	8584	35770	38920	51980	43212	45484	36086	29692	30126	30688	24850	26250	1400	*5.6%*
	875203	980792	966207	968780	928425	922276	836261	856399	875259	932110	919114	1063069	1049133	1079526	30393	*2.9%*



E. Aircraft Characteristics

- Please see Exhibit A

Exhibit A

Aircraft Characteristics

EXHIBIT A

Operations at 0.8% Compound Annual Growth

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (Vref)	Seating	Wingspan (ft.)	Range (NM)	MTOW	Operations Data		Ability to limit Operations Score
										Annual Ops 2018	Annual Ops Future	
III	Boeing	737-MAX 8	Jet	D	142	178****	117.83	3,550	181,200	4,621	5,005	
III	Boeing	737-MAX 7 (same engine as MAX 8)	Jet	D	142	153***	117.83	3,850	177,000	5,376	5,822	
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	3,300	171,961	5,484	5,939	
III	Airbus	A220-300	Jet	C	135	140	115.08	3,350	149,000	5,876	6,363	
III	Airbus	A320 NEO Sharklet	Jet	C	136	157	117.45	3,500	174,165	5,876	6,363	
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	3,750	168,653	6,426	6,959	
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	4,400	154,500	6,528	7,070	
III	Embraer	EMB 195-E2	Jet	C	124	120	115.15	2,600	135,584	6,855	7,423	
III	Airbus	A220-100	Jet	C	130	109	115.08	3,400	134,000	7,547	8,173	
III	Embraer	EMB 190-E2	Jet	C	124	97	110.70	2,850	124,341	8,480	9,184	
III	Embraer	E 190 Standard	Jet	C	124	96**	94.25	2,450	105,359	8,569	9,279	
III	Mitsubishi	M90 SpaceJet	Jet	C		88*	95.83	2,040	94,358	9,348	10,123	
III	Embraer	EMB 175-E2	Jet	C	124	80	101.70	2,000	98,767	10,282	11,135	
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	1,910	86,000	10,823	11,721	
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	124	76	93.92	2,150	85,517	10,823	11,721	
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	1,100	65,200	10,823	11,721	
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	1,400	77,000	11,751	12,726	2
III	Embraer	E 170 Standard	Jet	C	124	69	85.42	2,150	82,012	11,921	12,910	
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	1,650	53,000	16,452	17,816	
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	1,000	65,000	16,452	17,816	

1 = Measurably meets community goals
2 = Generally maintains current condition
3 = Worsens current condition

Notes:

Noise and Emissions Source - ICAO Certification Database, August 2019 | HMMH, August 2019; Per-passenger interpretation - Kimley-Horn August 2019.
Operations 2018 = Actual Enplanements at 70% load factor. Future = 2028 Enplanments at 0.8% Annual Growth and 70% load factor
Aircraft Load and Dimensions from FAA Aircraft Design Characteristics Database OCT 2018
ASE Operational Capability from August 2018 Aircraft Feasibilty analysis done by Alec Seybold - Flight Tech Engineering
Range is nominal stated by manufacturer

* Single-class seating as configured for ANA for use in Japan. Range is 76 to 92
** Dual-class seating per Manufacturer
*** Dual-class range 138 to 153
**** Dual-class range 162 to 178

Operational Capability

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (Vref)	Seating	Wingspan (ft.)	Range (NM)	MTOW	ASE Operational Capability: ASE Missed Approach Capable? Winter	ASE Missed Approach Capable? Summer	Significant Wt Penalty at ASE?	ASE Operation Capability Score
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	1,000	65,000	Y	Y	N	
III	Airbus	A220-100	Jet	C	130	109	115.08	3,400	134,000	Y	Y	N	
III	Boeing	737-MAX 7 (same engine as MAX 8)	Jet	D	142	153***	117.83	3,850	177,000	Y	Y	N	
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	3,750	168,653	Y	Y	N	
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	1,100	65,200	Y	Y	N	
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	1,400	77,000	Y	Y	Y	2
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	124	76	93.92	2,150	85,517	Y	Marginal	Y	
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	4,400	154,500	Y	Marginal	Y	
III	Boeing	737-MAX 8	Jet	D	142	178****	117.83	3,550	181,200	Y	Marginal	Y	
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	1,650	53,000	Charter	N	Y	
III	Airbus	A220-300	Jet	C	135	140	115.08	3,350	149,000	Unknown	Unknown	Unknown	
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	1,910	86,000	Unknown	Unknown	Unknown	
III	Mitsubishi	M90 SpaceJet	Jet	C		88*	95.83	2,040	94,358	Unknown	Unknown	Unknown	
III	Embraer	EMB 175-E2	Jet	C	124	80	101.70	2,000	98,767	Unknown	Unknown	Unknown	
III	Embraer	EMB 195-E2	Jet	C	124	120	115.15	2,600	135,584	Unknown	Unknown	Unknown	
III	Embraer	E 170 Standard	Jet	C	124	69	85.42	2,150	82,012	Unknown	Unknown	Unknown	
III	Embraer	E 190 Standard	Jet	C	124	96**	94.25	2,450	105,359	Unknown	Unknown	Unknown	
III	Embraer	EMB 190-E2	Jet	C	124	97	110.70	2,850	124,341	Unknown	Unknown	Unknown	
III	Airbus	A320 NEO Sharklet	Jet	C	136	157	117.45	3,500	174,165	Unknown	Unknown	Unknown	
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	3,300	171,961	Unknown	Unknown	Unknown	

1 = Measurably meets community goals
2 = Generally maintains current condition
3 = Worsens current condition

Notes:

Noise and Emissions Source - ICAO Certification Database, August 2019 | HMMH, August 2019; Per-passenger interpretation - Kimley-Horn August 2019.
Operations 2018 = Actual Enplanements at 70% load factor. Future = 2028 Enplanments at 0.8% Annual Growth and 70% load factor
Aircraft Load and Dimensions from FAA Aircraft Design Characteristics Database OCT 2018
ASE Operational Capability from August 2018 Aircraft Feasibilty analysis done by Alec Seybold - Flight Tech Engineering
Range is nominal stated by manufacturer

* Single-class seating as configured for ANA for use in Japan. Range is 76 to 92
** Dual-class seating per Manufacturer
*** Dual-class range 138 to 153
**** Dual-class range 162 to 178

Emissions

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (V_{ref})	Seating	Wingspan (ft.)	Range (NM)	MTOW	ICAO Emissions											Emissions Score
										Fuel per LTO Cycle (kg) per Passenger	Fuel Compared to CRJ-700	CO2 Total Mass LTO (g) per Passenger	CO2 Compared to CRJ-700	NOx Total Mass LTO (g) per Passenger	NOx Compared to CRJ-700	NOx Takeoff	NOx Climbout	NOx Approach	NOx Idle	NOx Total (All Segments)	
III	Airbus	A220-300	Jet	C	135	140	115.08	3,350	149,000	1.98	59%	14.33	40%	25.08	85%	0.24	0.19	0.10	0.06	0.58	
III	Airbus	A320 NEO Sharklet	Jet	C	136	157	117.45	3,500	174,165	1.99	60%	22.00	62%	19.13	65%	0.16	0.13	0.06	0.03	0.37	
III	Boeing	737-MAX 8	Jet	D	142	178****	117.83	3,550	181,200	1.99	60%	13.52	38%	32.01	108%	0.27	0.13	0.06	0.03	0.48	
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	3,300	171,961	2.57	77%	27.55	77%	31.17	106%	0.16	0.13	0.07	0.04	0.40	
III	Embraer	EMB 195-E2	Jet	C	124	120	115.15	2,600	135,584	2.63	78%	53.83	151%	26.17	89%	0.16	0.13	0.07	0.03	0.39	
III	Airbus	A220-100	Jet	C	130	109	115.08	3,400	134,000	2.71	81%	17.44	49%	36.83	125%	0.17	0.14	0.07	0.03	0.40	
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	3,750	168,653	2.89	86%	39.96	112%	31.07	105%	0.12	0.08	0.06	0.03	0.29	
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	4,400	154,500	2.99	89%	47.66	134%	32.15	109%	0.15	0.12	0.06	0.03	0.37	
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	124	76	93.92	2,150	85,517	3.23	96%	26.96	76%	30.34	103%	0.20	0.17	0.14	0.06	0.57	
III	Embraer	EMB 190-E2	Jet	C	124	97	110.70	2,850	124,341	3.23	96%	67.14	188%	31.81	108%	0.20	0.17	0.09	0.04	0.49	
III	Embraer	E 190 Standard	Jet	C	124	96**	94.25	2,450	105,359	3.24	97%	68.39	192%	31.59	107%	0.20	0.17	0.09	0.04	0.49	
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	1,650	53,000	3.34	100%	67.00	188%	22.74	77%	0.23	0.20	0.14	0.08	0.65	
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	1,400	77,000	3.35	100%	35.62	100%	29.50	100%	0.20	0.18	0.15	0.06	0.60	2
III	Embraer	E 170 Standard	Jet	C	124	69	85.42	2,150	82,012	3.57	107%	29.65	83%	33.63	114%	0.22	0.19	0.16	0.07	0.63	
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	1,000	65,000	4.69	140%	49.87	140%	41.30	140%	0.29	0.25	0.22	0.09	0.84	
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	1,910	86,000					Information not available							
III	Mitsubishi	M90 SpaceJet	Jet	C		88*	95.83	2,040	94,358					Information not available							
III	Embraer	EMB 175-E2	Jet	C	124	80	101.70	2,000	98,767					Information not available							
III	Boeing	737-MAX 7 (same engine as MAX 8)	Jet	D	142	153***	117.83	3,850	177,000					Information not available							
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	1,100	65,200					Information not available							

1 = Measurably meets community goals
2 = Generally maintains current condition
3 = Worsens current condition

Notes:

Noise and Emissions Source - ICAO Certification Database, August 2019 | HMMH, August 2019; Per-passenger interpretation - Kimley-Horn August 2019.
Operations 2018 = Actual Enplanements at 70% load factor. Future = 2028 Enplanments at 0.8% Annual Growth and 70% load factor
Aircraft Load and Dimensions from FAA Aircraft Design Characteristics Database OCT 2018
ASE Operational Capability from August 2018 Aircraft Feasibilty analysis done by Alec Seybold - Flight Tech Engineering
Range is nominal stated by manufacturer

* Single-class seating as configured for ANA for use in Japan. Range is 76 to 92
** Dual-class seating per Manufacturer
*** Dual-class range 138 to 153
**** Dual-class range 162 to 178

Noise

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (Vref)	Seating	Wingspan (ft.)	Range (NM)	MTOW	ICAO Noise EPNLdB Noise Level Lateral/Full-Power	ICAO Noise EPNLdB Noise Level Approach	ICAO Noise EPNLdB Noise Level Flyover	Noise Score	Operations for 2018 Enplanements
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	1,650	53,000	82.4	92.2	77.7		16,452
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	1,100	65,200	84.9	94.0	77.8		10,823
III	Airbus	A220-100	Jet	C	130	109	115.08	3,400	134,000	88.0	91.5	78.8		7,547
III	Airbus	A320 NEO Sharklet	Jet	C	136	157	117.45	3,500	174,165	86.4	92.4	80.5		5,876
III	Airbus	A220-300	Jet	C	135	140	115.08	3,350	149,000	87.5	92.4	80.3		5,876
III	Boeing	737-MAX 8	Jet	D	142	178****	117.83	3,550	181,200	88.2	94.0	80.9		4,621
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	1,000	65,000	89.5	92.6	82.4		16,452
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	1,400	77,000	89.5	92.6	82.4	2	11,751
III	Embraer	E 190 Standard	Jet	C	124	96**	94.25	2,450	105,359	92.2	92.3	82.9		8,569
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	3,750	168,653	91.4	92.9	83.3		6,426
III	Embraer	E 170 Standard	Jet	C	124	69	85.42	2,150	82,012	92.0	94.5	81.3		11,921
III	Embraer	EMB 190-E2	Jet	C	124	97	110.70	2,850	124,341	92.3	92.3	83.8		8,480
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	3,300	171,961	90.9	93.6	84.1		5,484
III	Embraer	EMB 195-E2	Jet	C	124	120	115.15	2,600	135,584	92.3	92.7	84.9		6,855
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	4,400	154,500	93.1	95.9	83.5		6,528
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	124	76	93.92	2,150	85,517	91.8	95.1	93.0		10,823
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	1,910	86,000	Information not available				10,823
III	Mitsubishi	M90 SpaceJet	Jet	C		88*	95.83	2,040	94,358	Information not available				9,348
III	Embraer	EMB 175-E2	Jet	C	124	80	101.70	2,000	98,767	Information not available				10,282
III	Boeing	737-MAX 7 (same engine as MAX 8)	Jet	D	142	153***	117.83	3,850	177,000	Information not available				5,376

1 = Measurably meets community goals
2 = Generally maintains current condition
3 = Worsens current condition

Notes:

Noise and Emissions Source - ICAO Certification Database, August 2019 | HMMH, August 2019; Per-passenger interpretation - Kimley-Horn August 2019.
Operations 2018 = Actual Enplanements at 70% load factor. Future = 2028 Enplanments at 0.8% Annual Growth and 70% load factor
Aircraft Load and Dimensions from FAA Aircraft Design Characteristics Database OCT 2018
ASE Operational Capability from August 2018 Aircraft Feasibilty analysis done by Alec Seybold - Flight Tech Engineering
Range is nominal stated by manufacturer

* Single-class seating as configured for ANA for use in Japan. Range is 76 to 92
** Dual-class seating per Manufacturer
*** Dual-class range 138 to 153
**** Dual-class range 162 to 178

Report and Email

Submitted by, Rick Heede

ASE Vision / Technical Review Group

Draft discussion of climate goals
Rick Heede / Climate Mitigation Services
12 November 2019

Preamble

The ASE Vision committee's community commitment regarding the climate impacts of aviation and facilities at the Aspen Pitkin County Airport proposed a consensus target to reduce emissions by 30 percent.

This report is a brief presentation of the emission reduction target, how to track and define the metrics required, and short discussions of some of the measures and programs that may be employed to effectively reduce aviation-related net emissions at ASE. It is a springboard for a balanced discussion by the Technical Review Committee. It is not an exhaustive presentation of policy options, jurisdictional issues, or the numerous opportunities to reduce the climate impact of aviation at Aspen.

The 30% reduction target leads to several questions on how to define the target, its nuances and uncertainties, how to measure emissions, whether the proposed metric is reasonable and comprehensive, and how, most importantly, we measure progress.

Introduction

The ASE Vision Committee proposed a consensus target to reduce emissions related to air travel at ASE by 30 percent.

However, the Committee did not define the target's rate of decline or target year.

For the purposes of this report, the Technical Working Group (TWG) assumes a target year of 2030 for the 30% reduction of carbon dioxide emissions from aviation-related activities.

Note: this has not been discussed or confirmed by the full TWG; the drafting team including Jon Peacock, GR Fielding, Bill Tomcich, and Rick Heede provisionally agreed to assume 2030 as the target year, subject to revision by the TWG and ASE Vision Committee, for the purposes of this analysis.

The aviation inventory protocol: a discussion

This analysis covers aircraft operations only, and excludes all other emission sources such as from energy and electricity used in the terminal, runway lighting, auxiliary power units (APUs), airport equipment such as tugs, snowplows, and other ground equipment.

In compliance with the methodology followed by the Aspen greenhouse gas inventory for 2017,[1] this analysis bases aviation emissions on the quantity of Jet-A and AvGas dispensed in each year.[2]

---

[1] *City of Aspen's Community-Wide Greenhouse Gas Emissions Inventory Report for Calendar Year 2017*, Lotus Engineering.

[2] This author notes that the aviation-related emissions applies the methodology (Method 2) discussed in Airport Cooperative Research Program (2009) *Guidebook on Preparing Airport Greenhouse Gas Emission Inventories*, for Federal Aviation Administration, Transportation Research Board, Washington, 64 pp. See Aircraft Method 1: fuel dispensed, p. 21; Aircraft Method 2: fuel dispensed, but segregated into LTO cycles p. 22; Aircraft Method 3: operational flights, aircraft type, fuel burn rates, route miles, etc., p. 23; "The FAA AEDT/SAGE-based aircraft fuel burn and CO_2 data are expected to be made available on an annual basis for each U.S. airport and, as such, could be the preferred aircraft emissions method."

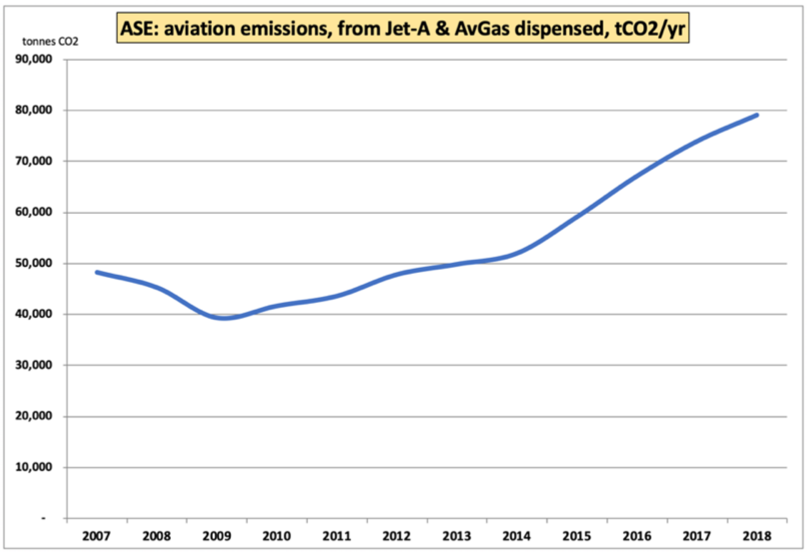
For the purposes of this analysis we adopt the emissions methodology based on fuel sales. Reviewing the fuel sales data for ASE from 2003 to 2017:[3]

Table 1. fuel dispensed and aviation emissions 2003 – 2017

	Jet-A1 gallons	AvGas gallons	Emissions tonnes CO_2
2003	4,688,479	53,949	45,296
2007	5,008,692	38,035	48,227
2011	4,527,545	33,219	43,584
2017	7,691,176	40,825	73,909
2018	8,246,211	24,389	79,081

Emissions from fuel sales have increased since 2009, and quit rapidly in the last five years:

Figure 1. ASE Aviation emissions 2003 – 2018



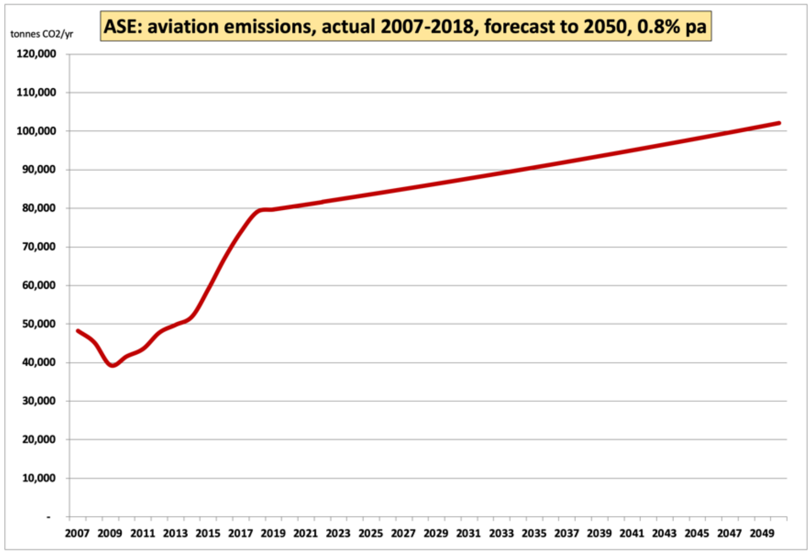
Assuming that total fuel sales and CO_2 emissions from aviation follows the ASE Vision Committee's related target to keep commercial operations and enplanements to a growth rate of 0.8% per year, and we apply this growth rate to aviation emissions then emissions are projected to reach 87,016 tCO_2 in 2030 and 102,050 tCO_2 in 2050. See Table 2 & Fig. 2.

Table 2. annual aviation emissions 2017 (actual), **(A)** increasing at 0.8%/yr to 2050, and **(B)** decreasing by -3.504%/yr in order to meet the target of 30% below 2020 by 2030.

	(A) Growth +0.8%/yr Emissions tonnes CO_2	**(B)** -30% by 2030 Emissions tonnes CO_2
2017	73,909	73,909
2020	80,352	80,352
2025	83,618	67,227
2030	87,016	56,246
2040	94,234	39,731
2050	102,050	27,560

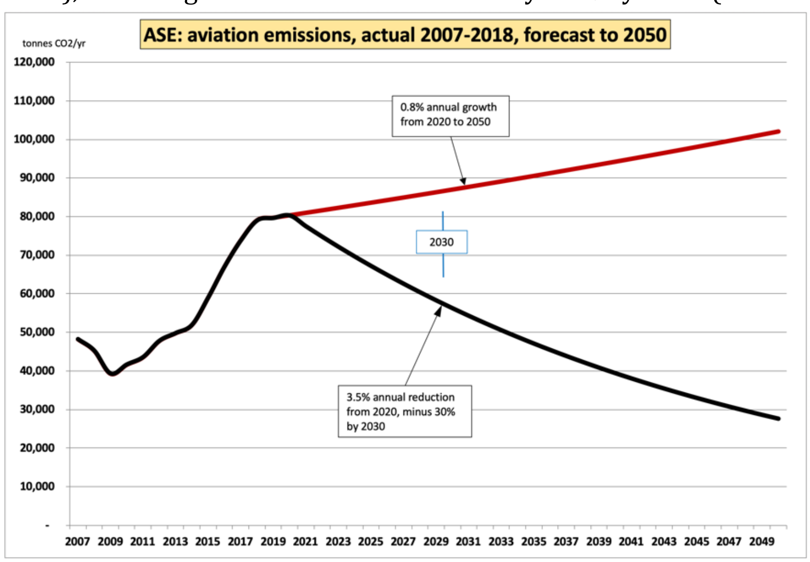
[3] Data courtesy of ASE staff & Kathleen Wanatowicz.

Figure 2. aviation emissions 2003 – 2017 (actual) and forecast to 2050 at 0.8%/yr growth rate



However, if we forecast emissions to *decline* by 30% by 2030 — meeting the target set by the ASE Vision Committee — then emissions reach 56,246 tCO_2 in 2030. See Fig. 2.[4]

Figure 2. aviation emissions 2003 – 2017 (historical), forecast to 2050 at 0.8% per year growth rate (red line), and mitigation to reduce emissions by 30% by 2030 (black line).



To review:

- Fuel sales reduced from 8.4 million gallons in 2020 to 5.9 million gallons in 2030;
- Fuel sales emissions reduced from 80,352 tCO_2 in 2020 to 56,246 tCO_2 in 2030;

This target, if reached, is only to 2030. It behooves the TWG and/or ASE Vision Committee to consider an additional target that reduces net emissions to zero by mid-century.

[4] The aggregate sum of the difference between a growth rate of 0.8% per year and a decline of -3.5% per year between 2020 and 2030 totals 175,880 tCO_2. A "shadow price" of $40/$tCO_2$ is sometimes used to evaluate fuel supply & mitigation options; at this price, the value is $7.04 million. In comparison, the estimated value of the saved fuel 2020-2030 if the emission reductions are from operational reductions, more fuel-efficient aircraft, and other fuel savings (~18 million gallons) is ~$92 million. This discussion is for background only, and is not meant to suggest that the ASE Vision committee consider applying a carbon tax on fuel sales, or that such a tax would compel the target savings.

Potential measures and strategies to meet the 2030 target

This assumes that the reductions come from reduced operations, more efficient aircraft, increased tankering, and other means of *reducing fuel sales* and related emissions.

Aircraft efficiency: historically, commercial aircraft have improved efficiency (fuel burn per passenger-km) at a rate of ~2.5% per year. Electric propulsion, hydrogen fuels, new materials, and other technical advances are sure to foster continued progress in reducing aviation emissions

Limiting the number of gates at ASE: Reducing commercial operations by restricting the number of gates. This is under consideration by TWG. The impact on commercial flights has not been quantified.

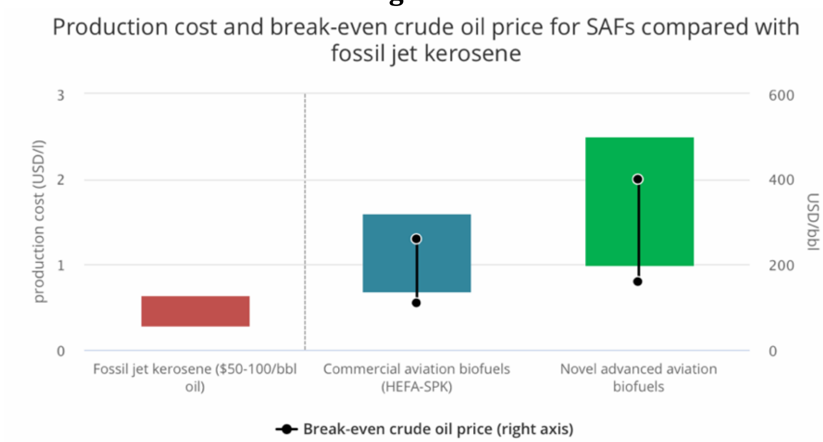
Bio-fuel: Mandate that a total of 18.4 million gallons of Bio-Jet fuel is sold at ASE between 2020 and 2030; total fuel sales over that period of time is projected at 96.2 million gallons, thus an average blend of (18.4/96.2), or 19% bio-fuel will suffice over the decade to 2030.[5]

Jurisdictional and other issues may prevent ASE from mandating bio-fuel.

Technical issues of suitability of blended bio-fuel require testing, verification, and approval for use (and fuel storage) in cold conditions and by the aircraft operating out of ASE. This will likely take years to resolve, but that is not to say the TWG should dismiss the idea of providing bio-fuel in the future as a way to reduce carbon emissions from fuel sold at ASE.

The hurdles of sourcing bio-fuel — known as Sustainable Aviation Fuel (SAF) — are high, especially to the Aspen market. A local mandate to ramp up the availability in a gradual and predictable fashion, coupled to a willingness for local authorities to help fund the premium cost of bio-fuel (Fig. 3, Le Feuvre, 2019),[6] perhaps from increased landing fees or a carbon tax on dispensed fuel.

Figure 3.



Notes: Novel advanced aviation biofuels refers to Fermented Sugars-to-Synthetic Isoparaffin (HFS-SIP), Alcohol-to-Jet (ATJ) and Fischer-Tropsch pathways. In reality these production pathways have different fuel production cost ranges.

Only five airports currently have regular biofuel distribution: Bergen, Oslo, Brisbane, Los Angeles, and Stockholm. Oslo's international airport (OSL) recently committed to supply

[5] This calculation assumes that the bio-fuel has a net zero carbon footprint, whereas in all likelihood will have a lower but still substantial carbon emission factor.

[6] Le Feuvre, Pharoah (2019) *Commentary: Are aviation biofuels ready for take off?* International Energy Agency, March. https://www.iea.org/newsroom/news/2019/march/are-aviation-biofuels-ready-for-take-off.html

30% of its total jet-fuel from biological sources by 2030, chiefly from forestry wastes, and requires a public subsidy.[7]

Logistical, routing, and flow efficiency: improved aircraft approach & departure spacing, a reservation system, installation of next-gen nav-aids, and similar improvements are, to some degree, within control of local authorities, in cooperation with (and funding from?) the FAA. TWG/ASE is considering increasing the separation requirement from six miles to ten miles (verify) in order to reduce congestion and flattening the approach density.

Local carbon offsets: a system of carbon fees and investment in carbon reductions was established in Aspen in 1994. Fees are imposed on new construction that fails to meet building energy codes or exterior energy use, such as heated driveway systems and heated pools. The funds are invested in energy efficient appliances and equipment rebates in private residences and schools, for photovoltaic and thermal energy systems, energy retrofits, insulation, improved glazing, and so on. The program is a collaborative effort by local governments and utilities, and is operated by the Community Office for Resource Efficiency. CORE invested ~$1.2 million in 2017, and reduced emissions by ~3,600 tCO_2.

Airline offset programs: the International Civil Aviation Organization (ICOA) adopted the Carbon Offset and Reduction Scheme for International Aviation (CORSIA) in 2016. While this agreement is focused on international aviation and line carriers, the programs may in time benefit domestic aviation from the emerging focus on the acquisition of more efficient aircraft, operational savings (approaches, pilot technique), fuel management, ground-ops, tankering, re-engining, scheduling, offset programs, and a host of initiatives aimed to reduce the carbon intensity of air travel. See Anjaparidze, 2019.[8]

Flight offsets: several programs are available that use voluntary contributions from the flying public to fund afforestation, soil building, and other carbon mitigation programs. One such program — Good Traveler — is promoted by local non-profit Rocky Mountain Institute. Such programs must be thoroughly vetted to assure that investments in mitigation projects are effective, evaluated, and certified before the Aspen community offers such a voluntary program to local travelers and visitors.

Increased landing fees: currently, commercial aircraft landing fees are ~$5.15 per 1,000 lbs, and for GA the fee is ~$6.75/1000 lbs.

A highly preliminary estimate: Air carrier operations in 2018 totaled 11,590 (thus ~5,800 landings, all of which were CRJ-700, with a max takeoff weight of 77,000 lbs; I don't know the average landing weight, but assume 70,000 lbs, thus a landing fee of 70 * $5.15 is $360, and total 2018 fees were ~$2.1 million. General aviation operations totaled 29,600, thus 14,800 landings. Assuming an average air taxi and GA (mix of predominantly personal and business jets, but also piston singles and twins) had an average landing weight of 48,000 lbs ($324 per average GA),[9] then 14,800 times 48 * $6.75 = $4.8 million. Say ASE doubles

[7] GreenAir (2017) A 30 per cent share of sustainable aviation fuel at Norway's airports by 2030 is achievable with public funding help, finds report, 25 Aug: https://www.greenaironline.com/news.php?viewStory$01

[8] Anjaparidze, George (2019) *The Extraordinary Climate Agreement on International Aviation: An Airline Industry Perspective*, October, Harvard Project on Climate Agreements, 16 pp. https://www.belfercenter.org/sites/default/files/files/publication/191021-anjaparidze-viewpoint.pdf

[9] Typical GA jest range from Cessna Citations (~12,000 lbs) to Gulfstream G-V (~90,000 lbs). Piston singles (Cessna 182 ~3,000 lbs) and twins e.g. Beechcraft King Air (~16,000). Jets dominate at ASE.

GA landing fees earmarked for carbon mitigation, then $4.8 million is potentially available, minus admin costs and other factors.

Carbon tax on Jet-A and AvGas dispensed at ASE ABO: while a carbon tax, even a substantial one, is unlikely to dramatically suppress the number of arriving flights by GA aircraft or commercial operations, it is more likely to reduce the quantify of fuel sold by increased tankering, passenger drop-off and buy fuel elsewhere (especially when on-ramp tie-downs are tight), and other efforts to reduce fuel purchases. This elasticity has not been examined. However, a preliminary back-of the-envelope calculation suggests that a carbon flowage fee of $1 per gallon could raise ~$7 million annually. This fee could then be applied to fund verified offsets, the mandate to make bio-fuel available, and local carbon mitigation programs (such as through CORE or a newly established Green Air Fund).

Solar and renewable energy generation on airport property: In concert with the City of Aspen's Electric Department, Holy Cross Energy, and other interested parties (such as CMC, RFTA, AABC), the Airport should pursue the potential of installing thermal and renewable electricity capacity on Airport property.

In summary, there are a number of ways to both *reduce* the fuel sales (and some counter-vailing pressures that will act to *increase* sales) and, perhaps more effectively, reduce the *carbon intensity* of fuel sold (e.g., bio-fuels) or *offset* emissions from fuel sales.

Recommendation: The TWG and ASE Vision Committee should do further work to identify the most promising programs, trends, and initiatives that reduce emissions from fuel sales, the efficient use of fuel, and offset emissions from continued (and perhaps increasing) sale of fuel at ASE/ABO.

Recommendation: The TWG and ASE will then be in a position to recommend to the BOCC that the Aspen community clearly endorses the target of reducing aviation-related by 30% by 2030, and that the BOCC will direct County staff to identify and quantify the most promising pathways to reduce emissions, and how to best fund the expenditures of meeting the target.

Other discussion.

Suppose ASE and BOCC supports airport improvements to ADG III, how might that effect fuel sales and thus our emission baseline metric?

If the ASE Vision Committee, the TWG, and the BOCC accept the recommendation to invest in airport improvements and Airport Design Group III (ADG III) specifications, which would allow larger aircraft to operate at ASE, what might the consequences, good and bad, be?

For one, it would seem plausible that airlines would consider adding new destinations with the availability of larger aircraft with a longer range. The CRJ-700 has a range of ~1,600 miles (verify with local high-altitude operations, runway length, etc.). New aircraft able to access ASE under ADG III might extend that range to 2,200 to 3,900 miles, which opens up the east coast market (JFK ~1,740 miles, BOS ~1,880, MIA ~1,800).[10]

[10] These include the Airbus A-220-300 with a range of 3,350 nm (3,970 miles)) and the Embraer E172-E2 range of 2,000 nm (2,300 miles). The Mitsubishi SpaceJet is not certified, though a range of ~2,000 nm. However, these are published ranges, and likely will be effectively shorter given ASE's operating conditions, 8,000 ft runway, and high altitude.

While this will certainly improve aircraft efficiency per passenger-mile (longer flights are inherently more "efficient"), it will also increase stage length, which may increase fuel requirements at ASE, going counter to our metric of emissions from fuel sales.

Fuel sales to commercial airlines and the GA aircraft are roughly equal (~4 million gallons each). The strategies to reduce fuel sales, improve efficiency, manage operations, account for total operational emissions (not just fuel sales), and adopt mitigation and offset measures will differ.

Consider ASE Vision Committee, Board of County Commissioners, and local support for making a climate commitment beyond 2030, such as aligning all emissions from aviation, ground operations, equipment, runway lighting, and the terminal to the internationally recognized goal of reducing emissions to net zero by mid-century.[11] Other goals may be discussed by TWG or ASE Vision Committee in the weeks ahead.

Conclusion

The Aspen community, the ASE Vision Committee, and this Technical Working Group has within its remit to preserve the local and global environment an opportunity to embrace and seek to achieve the goal of reducing aviation-related emissions by 30% by 2030. This is achievable, and will require concerted effort.

Furthermore, the TWG, the ASE Vision Committee, and the BOCC are in a position to take a lead among the world's airports and aviation communities to support the international goal of reducing emissions to net zero by mid-century. This may seem like an unachievable goal, whereas in fact it is achievable, and we will serve our community by making such a commitment and driving the policies to achieve it. In my view, Aspen has a unique opportunity to foster our prosperity, preserve our environment, and enhance the reasons our citizens and visitors want to be here.

Respectfully,

Richard Heede

Director, Climate Mitigation Services
Director, Climate Accountability Institute
heede@climatemitigation.com
heede@climateaccountability.org
+1-970-343-0707
Old Snowmass, CO

[11] Intergovernmental Panel on Climate Change (2018) *Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C,* Geneva, 33 pp. http://www.ipcc.ch/report/sr15/

Email to TWG

Rick Heede
4 December 2019

Dear Technical Working Group members:

Herewith a few comments on our draft findings and recommendations to the ASE Vision Committee.

I agree with most of the technical findings and recommendations regarding the importance of maintaining commercial air service to the community of Aspen and the Roaring Fork Valley, our visitors, businesses, and citizens. The drafting committee members have done a great job in capturing the technical aspects, and summarizing Findings and Recommendations.

I rely on the expertise of aviation professionals and the findings described in the Draft TWG report regarding aircraft, airport design, and potential improvements:

I have a few comments for the TWG subcommittee members as the final report is revised and the Majority and Minority reports are drafted:

a) The limited life expectancy of our current fleet of CRJ-700s, adversely affecting some airlines more than others with a newer fleet, the general conclusion that no new CRJ-700 will be built, that the Q-400 is unlikely to service ASE, and that a new fleet of narrow-body jets can and is likely to be used by airlines to service our local market going forward, and, therefore, that:

b) ASE improvements to ADG-III regarding runway/taxiway separation is indicated and perhaps necessary in order to allow both existing alternatives (e.g, A-220, A-320 Embraer 195-E2, etc.) and future generations of commercial aircraft (e.g., Mitsubishi MRJ-100) to service Aspen;

c) However, approving ADG-III without a wingspan restriction also permits aircraft with a wingspan of 118 ft and Maximum Landing Weight of DR (don't recall), both criteria will allow all versions of the B-737 to operate at ASE;

d) The community, in my judgment, appears adamantly against allowing B-737s (and BBJ-737s) and would fault this committee and the ASE Vision Committee if it were allowed to proceed to full safety enhancements and runway re-location under ADG-III that *might* (perhaps? likely? certainly?) require ASE to accept B-737 operations if upgraded to CAT D approach options;

e) Therefore, the TWG has discussed the adoption of a runway strength limitation, in terms of the thickness of asphalt or concrete applied. However, the effectiveness of this limitation has not been vetted, and it is unknown (to me) whether it is the Maximum Take-Off Weight (MTOW) or Maximum Landing Weight (MLW) that may be employed as an effective restriction. Assuming the former, then 737s do not make a <150,000 MTOW limit (whereas the A-220 and A-320 are below this weight), but if it's a matter of MLW, then the A-319 is heavier (138,000 lb) than the B-737-700 (128,928 lb);

f) The specific limitation of either MTOW or MLW has not be clarified in the Draft Report, nor has it (to my knowledge) been tested with the FAA. It is therefore incumbent on the TWG and/or ASE Vision Committee to recommend that a technical and legal inquiry be made prior to making the assumption that one or the other restriction will actually be effective in allowing some "desired" commercial aircraft capable of our high-altitude and mountainous operating conditions to service our community, but simultaneously not open us to an FAA requirement to accept 737s and similar large aircraft under ADG-III;

g) Therefore, it remains my concern that the TWG, the Vision Committee, and the Board of County Commissioners (BOCC) will approve the upgrade to full ADG-III specifications, including safety, nav-aids, and runaway relocation, thus setting in motion a series of steps that will require fair and equal access to scheduled operations by larger aircraft, such as the 737s and similar. The community may end up being hoodwinked into accepting runway relocation and safety improvements that make larger aircraft inevitable, falsely relying on mitigation measures and restrictions (such as MTOW and/or MLW restrictions) that prove ineffective against the FAA juggernaut. No offense to the FAA, but the agency has rules and procedures that may foil our community's attempts to bend the rules in favor of restricting larger "undesirable" aircraft;

h) I recognize that we need to assure that ASE is operational for commercial aircraft as the aging CRJ-700 fleet is retiring over the next decade or so. For that reason I lean towards approving the improvements to ADG-III, but at this point I have no assurance (and the TWG draft report does not affirm) that our contemplated restrictions will in fact be effective.[1] It is my hope that the County, its consultants, and the BOCC will ascertain the likelihood that specific locally-imposed limitations on aircraft size will be an effective deterrent before any final decision by the BOCC is made. Of course, community opinion with respect to larger aircraft may well change, too, making my concern moot.

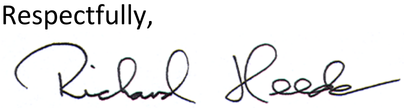
With respect to air pollution and climate goals, measurement, and mitigation options (Section IV. A. 1.):

i) Overall, the discussion on reducing emissions is muddled. It should be clearly stated that the 30% emission reduction goal for both aviation carbon dioxide emissions as well as local particulate pollutants and VOCs is for the target year 2030. In my opinion, it is not an "aspirational" goal, but a firm community commitment to achieve said reduction. Aspen has and should continue to lead on measuring and reducing emissions. Aspen City Council has repeatedly affirmed an overall 30% reduction from all emission sources by 2030 (and an 80% reduction by 2050), and the County should align with this objective. In Section A1a the goal is misstated as "reduce total fuel sales at ASE by 30% by the year 2030." This is incorrect insofar as the goal is to reduce *net emissions* by 30% by 2030 (reducing fuel sales by this amount is virtually impossible), which then allows the use of bio-fuels to be mandated and made available at ASE out to 2030 and beyond, investment in local carbon offset programs (e.g., CORE), local electricity and heat generation (partially on ASE parcels), and vetted and certified offset programs that invest in emission reductions elsewhere. All of these programs can be fully or partially funded by increased landing fees and fuel flowage fees, although much work needs to be done to reach a fair and effective set of programs to achieve this aggressive target.

j) The carbon target is based on the current metric adopted by the ASE emissions inventory protocol, and is based on emissions from fuel sales. While I think this baseline metric can be improved, I have no problem with basing the reduction target on this way of measuring net emissions and reductions, for now. It allows for crediting bio-fuel blends as they are brought on the market (which may require local subsidies), and local and national offsets can be credited against emissions. Additional discussion is presented in Appendix XX to the TWG Final Report.

k) The TWG correctly asserts (Section VI. C. 1) that new generation aircraft have lower emissions per LTO cycle per passenger. However, this should not be used as a metric or a success factor insofar as aviation emissions can simultaneously increase as the LTO per passenger (kgCO_2/LTO/pax) decreases. Real and effective reductions are measured on the basis of fuel sales (increasing or decreasing), CO_2 emissions per gallon sold (accounting for blended bio-fuel), local generation, and accredited offsets.

Respectfully,



Technical Working Group member of the ASE Vision Committee
Director, Climate Mitigation Services, Snowmass Colorado

---

[1] The draft TWG report's statement (p. 11) that "it is unlikely that an airline would choose to operate mainline aircraft into ASE exclusively without also being able to offer a smaller regional aircraft for the majority of their flights …." is less than reassuring, especially since we are taking the long view, and market conditions will change.