Technical Working Group Meeting #3

Diving Deeper Part II

October 2, 2019, 5 pm

ASE VISION

INFORM. INVOLVE. COLLABORATE.

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Technical Working Group Introduction

Housekeeping

Involvement:

- The Technical Working Group will be the deliberating body. Questions will be taken from those attending as deemed appropriate and timely.

Member participation:

- Use of name tents.

Website: https://www.asevision.com/twg/

- Other working groups will have their own sites.
- Ours and other working groups meeting dates will be posted so that others and public can attend if desired.
- Data related to each meeting will be placed under their particular headings.
- Support data (general) still remains on the web where it resides today.

Technical Working Group

<u>Meeting #3 – Agenda Items</u>

I. Introduction and Welcome

II. Meeting II Follow Up – *Draft #1* Fleet Mix Ranking Results

III. Additional Information Requested / Commercial Aircraft

IV. Review of GA Aircraft Data

V. Review Emissions and Noise Data / Mary Vigilante

VI. Review of ASE Operational Capabilities with Alec Seybold

VII. Revisit Aircraft Scorecard

VIII. Q &A

IX. Next Meeting, October 16th, Pitkin County Roaring Fork Room, 4-7 pm

Technical Working Group

Strategic Questions

What are the aircraft that meet our community goals (enplanement, emissions and noise)?

- Step 1: Technical Analysis - Are the goals achievable with the fleet forecast estimated to date? Y or N

- Step 2: What are the aircraft (current and future) that meet our goals? What do the "design aircraft" tell us about our shared values?

- Step 3: Narrative of the group's conversation and recommendation.

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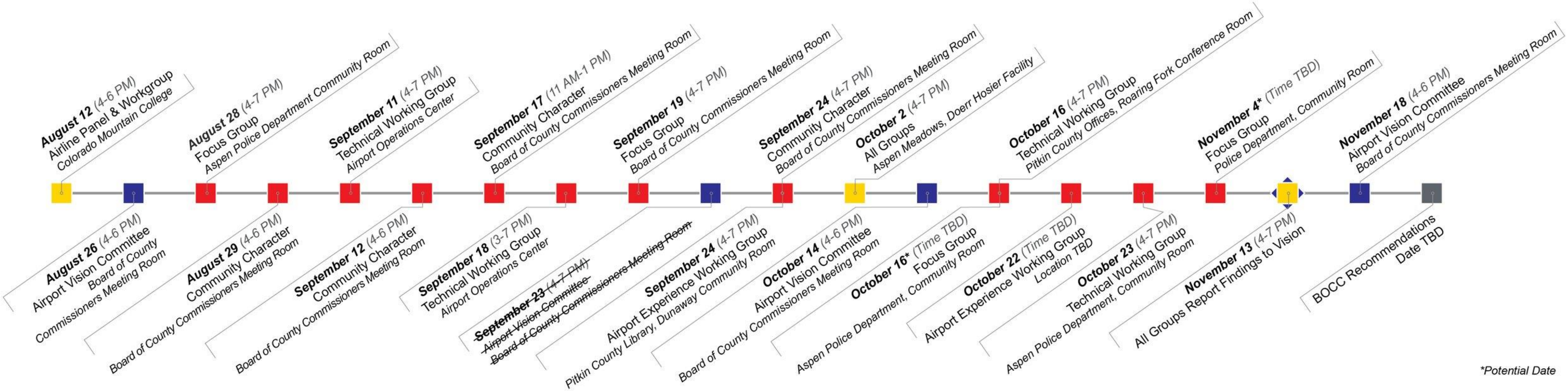
Future Meetings Schedule

Meeting 4 - Aspen Airfield: Airport Design 101, Non-Standard Conditions, Additional Green and Carbon Neutral Goals
October 16th, Pitkin County Building, Roaring Fork Room, 4 – 7
Possible Voting, Rules Apply

Meeting 5 – Draft Report: Finalize and Refine Recommendations
October 23rd, Aspen Police Department Building Meeting Room, 4 - 7 pm

Technical Working Group Deliverables

Process Timeline



AVC Guiding Principles

- Reduce overall airport emissions (aircraft & facilities) by 20-30% [Target for Overall Airport Emissions]

- Reduce noise levels by 20-30% [Target for Airport Noise Intensity]

- Accommodate limited growth [Airport Commercial Enplanement Target of . 8%]

ASE COMMUNITY VALUES SUMMARY

- Safety in the Air and on the Ground
- Adaptable, Flexible, Future-Proof
- Environmental Responsibility
- Community Character – Reflect local culture and values
- Economic Vitality
- Warm and Welcoming
- Design Excellence
- Efficiency – an airport that works well
- Preserve High Quality of Life
- Convenient and Easy Ground Transportation

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Deliverables by November to Report Back to the Airport Vision Committee

I. Design Aircraft Values Scorecard
   - Rank available aircraft to community values and goals

II. Answers to Strategic Questions
   - Preferred Design Aircraft, ADG, Green and Carbon Neutral Airfield
   - Identify areas of conflict and areas of group alignment

III. Success Factors for TWG
   - Community Character Lens

IV. Other Recommendations | Considerations
   - Other factors, comments, captured dialogue

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Official Voting Rules

Draft 1
Fleet Mix Ranking

Initial Aircraft Ranking TWG (9-18-2019) Draft_v1

	Emissions	Emissions Rank	Noise	Noise Rank	Enplanements/ Operations	Enplanements Rank	Average Score	Overall Rank
A220-300	1.125	2	1.25	1	1.833333333	5	1.4027778	3
A320 NEO Sharklet	1	1	1.25	1	1.833333333	5	1.3611111	2
737-MAX 8	1.5	5	2.25	8	2.166666667	11	1.9722222	6
A320-200 Sharklet	1.25	3	2.875	15	1.833333333	5	1.9861111	7
EMB 195-E2	1.625	6	2.5625	12	1.333333333	1	1.8402778	4
A220-100	1.25	3	1.25	1	1.333333333	1	1.2777778	1
A319-100 Sharklet	1.75	7	2.375	9	1.5	3	1.875	5
737-700 with winglets	2	9	2.875	15	1.5	3	2.125	10
EMB 175 LR, extended wingtips	1.875	8	2.625	13	2.666666667	16	2.3888889	14
EMB 190-E2	2.375	13	2.4375	11	1.833333333	5	2.2152778	11
E 190 Standard	2.5	15	2.375	9	1.833333333	5	2.2361111	13
CRJ 100/200/440 LR (CL-600-2B19)	2.375	13	1.5	5	2.8	19	2.225	12
CRJ 700/701/702 LR	2	9	2	6	2	10	2	8
E 170 Standard	2.1666667	12	2.6875	14	2.4	14	2.4180556	15
CRJ 550 (Same airframe as CRJ-700)	2.8333333	16	2	6	2.8	19	2.5444444	16
M100 SpaceJet		#N/A		#N/A	2.666666667	16		#N/A
M90 SpaceJet		#N/A		#N/A	2.333333333	13		#N/A
EMB 175-E2		#N/A		#N/A	2.5	15		#N/A
737-MAX 7 (same engine as MAX 8)		#N/A		#N/A	2.166666667	11		#N/A
Dash 8 Q400	2	9	1.375	4	2.666666667	16	2.0138889	9

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General Aviation Information

GA Aircraft Characteristics

Aspen General Aviation Aircraft Characteristics

Manufacturer	Model	Seat Count	# Engines	AAC	ADG	Approach Speed (Vref)	Wingtip Config	Wingspan, ft	Length, ft	MTOW
Boeing	737-BBJ	20	2	C	III	132	winglets	117.4	110.3	171,000
Bombardier	Challenger (BD-100-1A10) 300	9	2	B	II	117	winglets	63.8	68.8	38,850
Bombardier	Challenger (BD-100-1A10) 350 (the 300 with sn/ 20501 and subsequent)	8	2	C	II	125	winglets	69.0	68.8	40,600
Bombardier	Global 5000 (BD-700-1A11)	17	2	B	III	107.9	winglets	94.0	96.8	92,500
Bombardier	Global 6000/Express (BD-700-1A10)	19	2	B	III	107.9	winglets	94.0	99.4	99,500
Bombardier	Global 7500 (BD-700-2A12)	19	2	B	III	110.5	winglets	104.3	110.6	106,250
British Aerospace (BAe)/Avro	BAe HS 125-1/2/3-700/800	8	2	No Value	No Value		tbd		tbd	tbd
Cessna	Citation CJ1 (Model C525)	6	2	B	I	107.9	no winglets	46.9	42.6	10,600
Cessna	Citation CJ2 (Model C525A)	7	2	B	II	114.4	no winglets	49.8	47.7	12,300
Cessna	Citation XLS, XLS+	9	2	B	II	117	no winglets	56.3	52.5	20,200
Cessna	Citation Sovereign	8	2	B	II	107.9	no winglets	63.3	63.5	30,300
Dassault Aviation	Falcon 7X	16	3	B	III	104	winglets	86.0	76.1	70,000
Dassault Aviation	Falcon 8X	16	3	B	III	106	winglets	86.3	80.2	73,000
Eclipse Aerospace	Eclipse 500*	4	2	A	I	89.7	tip tanks	37.3	33.1	5,950
Embraer	Phenom 100 (EMB-500)	7	2	B	I	100.1	no winglets	40.3	42.1	10,582
Embraer	Phenom 300 (EMB-505)	11	2	B	II	115.7	winglets	52.2	51.3	17,968
Gulfstream Aerospace Corp.	Gulfstream V (G-V)	14	2	C	III	125	winglets	93.3	95.4	90,500
Gulfstream Aerospace Corp.	G650	18	2	D	III	145	winglets	99.6	99.8	99,600

Notes: *in lieu of the Eclipse 550 identified by LF Forecast 2019

Sources: FAA Aircraft Characteristics Database, Aircraft Manufacturer's Websites, accessed September 2019 by Kimley-Horn and Associates

GA Fuel Data

Aspen General Aviation Fuel Data

Manufacturer	Model	Type	Seat Count	ICAO Fuel Data	
				Fuel per LTO Cycle (kg) Aircraft	Fuel per LTO Cycle (kg) per Passenger
Boeing	737-BBJ	GA	20	364.9	18.2
Bombardier	Challenger (BD-100-1A10) 300	GA	9	152.0	16.9
Bombardier	Challenger (BD-100-1A10) 350 (the 300 wi	GA	8	157.0	19.6
Bombardier	Global 5000 (BD-700-1A11)	GA	17	299.0	17.6
Bombardier	Global 6000/Express (BD-700-1A10)	GA	19	299.0	15.7
Bombardier	Global 7500 (BD-700-2A12)	GA	19		
British Aerospace (BAe)/Avro	BAe HS 125-1/2/3-700/800	GA	8		
Cessna	Citation CJ1 (Model C525)	GA	6		
Cessna	Citation CJ2 (Model C525A)	GA	7		
Cessna	Citation XLS, XLS+	GA	9		
Cessna	Citation Sovereign	GA	8		
Dassault Aviation	Falcon 7X	GA	16	144.8	9.0
Dassault Aviation	Falcon 8X	GA	16		
Eclipse Aerospace	Eclipse 500*	GA	4		
Embraer	Phenom 100 (EMB-500)	GA	7		
Embraer	Phenom 300 (EMB-505)	GA	11		
Gulfstream Aerospace Corp.	Gulfstream V (G-V)	GA	14	295.7	21.1
Gulfstream Aerospace Corp.	G650	GA	18	304.6	16.9

Notes: *in lieu of the Eclipse 550 identified by LF Forecast 2019

Sources: FAA Aircraft Characteristics Database, Aircraft Manufacturer's Websites, ICAO Emissions EASA Database, accessed September 2019 by Kimley-Horn and Associates

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GA Noise Data

Aspen General Aviation Noise Data

Manufacturer	Model	Type	ICAO Noise Data		
			EPNdB Noise Level Lateral/Full-Power	EPNdB Noise Level Approach	EPNdB Noise Level Flyover
Boeing	737-BBJ	GA	88.2	94.1	81.3
Bombardier	Challenger (BD-100-1A10) 300	GA	87.6	89.6	75.4
Bombardier	Challenger (BD-100-1A10) 350 (the 300	GA	89.1	89.5	76.0
Bombardier	Global 5000 (BD-700-1A11)	GA	88.6	89.7	80.3
Bombardier	Global 6000/Express (BD-700-1A10)	GA	88.4	89.7	82.1
Bombardier	Global 7500 (BD-700-2A12)	GA			
British Aerospace (BAe)/Avro	BAe HS 125-1/2/3-700/800	GA			
Cessna	Citation CJ1 (Model C525)	GA	84.4	89.1	73.6
Cessna	Citation CJ2 (Model C525A)	GA	87.5	90.6	75.0
Cessna	Citation XLS, XLS+	GA	86.6	92.8	72.5
Cessna	Citation Sovereign	GA	87.6	90.2	71.7
Dassault Aviation	Falcon 7X	GA	89.8	92.1	82.0
Dassault Aviation	Falcon 8X	GA			
Eclipse Aerospace	Eclipse 500*	GA	79.0	81.9	68.5
Embraer	Phenom 100 (EMB-500)	GA	81.5	86.1	70.7
Embraer	Phenom 300 (EMB-505)	GA	88.8	88.7	70.3
Gulfstream Aerospace Corp.	Gulfstream V (G-V)	GA	89.9	90.8	79.1
Gulfstream Aerospace Corp.	G650	GA	90.0	88.3	76.2

Notes: *in lieu of the Eclipse 550 identified by LF Forecast 2019

Sources: FAA Aircraft Characteristics Database, Aircraft Manufacturer's Websites, ICAO Noise Certification Database, accessed September 2019 by Kimley-Horn and Associates

Aircraft Metrics Revisit Scorecard

Available Aircraft – Additional Characteristics

ADG	Manufacturer	Model	Physical Class (Engine)	AAC	Approach Speed (V_{ref})	Seating	Wingspan (ft.)	MTOW	Noise			ICAO Emissions Per Passenger		ASE Operational Capability			Operations Data	
									EPNdB Noise Level Lateral/Full-Power	EPNdB Noise Level Approach	EPNdB Noise Level Flyover	Fuel per LTO Cycle (kg) per Passenger	Fuel Compared to CRJ-700	ASE Missed Approach Capable? Winter	ASE Missed Approach Capable? Summer	Significant Wt Penalty at ASE?	Annual Ops 2018	Annual Ops Future
II	Bombardier	CRJ 100/200/440 LR (CL-600-2B19)	Jet	C	140	50	68.67	53,000	82.4	92.2	77.7	3.34	100%	Charter	N	Y	16,452	17,816
II	Bombardier	CRJ 550 (Same airframe as CRJ-700)	Jet	C	135	50	76.27	65,000	89.5	92.6	82.4	4.69	140%	Y	Y	N	16,452	17,816
II	Bombardier	CRJ 700/701/702 LR	Jet	C	135	70	76.27	77,000	89.5	92.6	82.4	3.35	100%	Y	Y	Y	11,751	12,726
III	Mitsubishi	M100 SpaceJet	Jet	C		76	91.30	86,000		Information not available		Information not available		Unknown	Unknown	Unknown	10,823	11,721
III	Embraer	EMB 175 LR, extended wingtips	Jet	C	141	76	93.92	85,517	91.8	95.1	93	3.23	96%	Y	Marginal	Y	10,823	11,721
III	Embraer	EMB 175-E2	Jet	C		80	101.70	98,767		Information not available		Information not available		Unknown	Unknown	Unknown	10,282	11,135
III	Airbus	A220-100	Jet	C	130	109	115.08	134,000	88	91.5	78.8	2.71	81%	Y	Y	N	7,547	8,173
III	Airbus	A220-300	Jet	C	135	140	115.08	149,000	87.5	92.4	80.3	1.98	59%	Unknown	Unknown	Unknown	5,876	6,363
III	Embraer	EMB 195-E2	Jet	C	141	120	115.15	135,584	92.3	92.7	84.9	2.63	78%	Unknown	Unknown	Unknown	6,855	7,423
III	Boeing	737-700 with winglets	Jet	C	130	137	117.42	154,500	93.1	95.9	83.5	2.99	89%	Y	Marginal	Y	6,528	7,070
III	Airbus	A319-100 Sharklet	Jet	C	126	132	117.45	168,653	91.4	92.9	83.3	2.89	86%	Y	Y	N	6,426	6,959
III	Airbus	A320neo Sharklet	Jet	C	136	157	117.45	174,165	86.4	92.4	80.5	1.99	60%	Unknown	Unknown	Unknown	5,876	6,363
III	Embraer	EMB 190-E2	Jet	C	141	97	110.70	124,341	92.3	92.3	83.8	3.23	96%	Unknown	Unknown	Unknown	8,480	9,184
III	Airbus	A320-200 Sharklet	Jet	C	136	157	117.45	171,961	90.9	93.6	84.1	2.57	77%	Unknown	Unknown	Unknown	5,484	5,939
III	Bombardier	Dash 8 Q400	Turboprop	C	125	76	93.25	65,200	84.94	93.96	77.75			Y	Y	N	10,823	11,721

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

Sources: FAA Aircraft Characteristics Database and ICAO Noise Certification Database, accessed August 2019 by Kimley-Horn and Associates

Mary Vigilante,

Synergy Consultants,

Inc.

Mary Vigilante's History at ASE

- Prepared the first airport-wide greenhouse gas inventory for the Canary Initiative in 2006
- Prepared the climate and air quality analysis for the 2009 Runway Extension EA
- Supported Canary Initiative Climate Action Plan identifying actions that the Airport operator can take
- Prepared the Climate evaluation for the 2018 EA for the Terminal and Airfield project

Canary Initiative

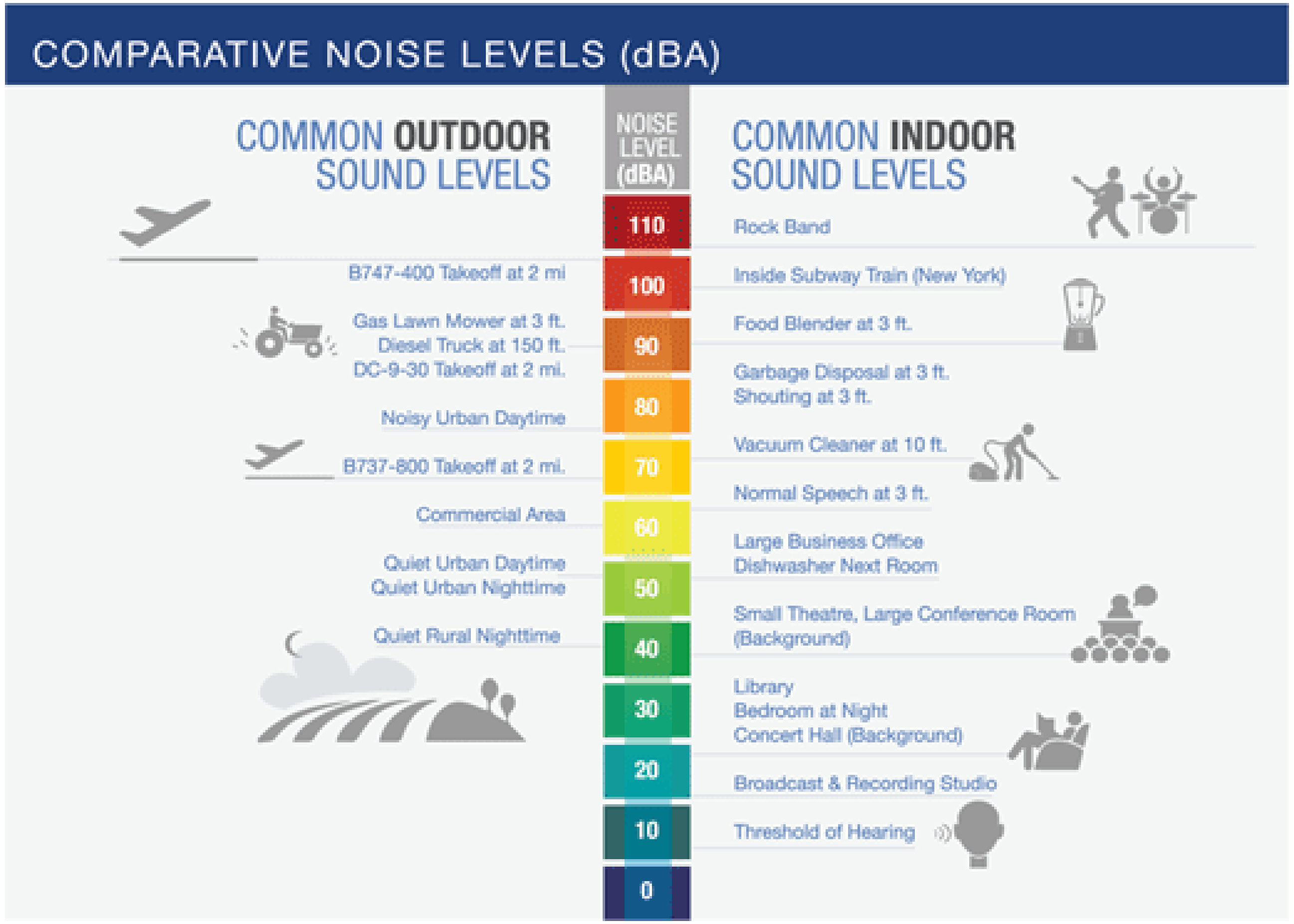
The Canary Initiative is Aspen's climate action plan which details how the city will promote sustainability and reduce greenhouse gas (GHG) emissions. The following actions were proposed to reduce GHG emissions at ASE:

- LED lighting on airfield
- Encourage airport taxi and shuttles to achieve higher fuel economy
- Support use of electric ground support equipment (GSE) vehicles
- Promote use of aviation biofuels in servicing local aircraft
- Encourage and support new terminal to be net-zero
- Encourage rental cars to have electric vehicle (EV) options
- Provide transit service directly to and from the airport

Emissions Considerations

- Data sets available to examine air emissions from aircraft:
  - Aircraft engine certification data is the best dataset.
  - Important to compare apples to apples
  - Primary regulatory model is Airport Environmental Design Tool (AEDT)
- When focusing on climate change, ***aircraft fuel burn is the best data set***.
- Important international considerations:
  - ICAO is the international standards setting organization
  - Airlines have committed to be carbon neutral growth post 2020 – meaning they can grow, but their emissions won't exceed 2020 levels
  - If carrier exceeds 2020 levels, they must comply with the CORSIA program
  - Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), is the first of its kind for a single industry in response to climate change

Noise Data - *What does dBA mean?*



Source: FAA – Comparative Noise Levels

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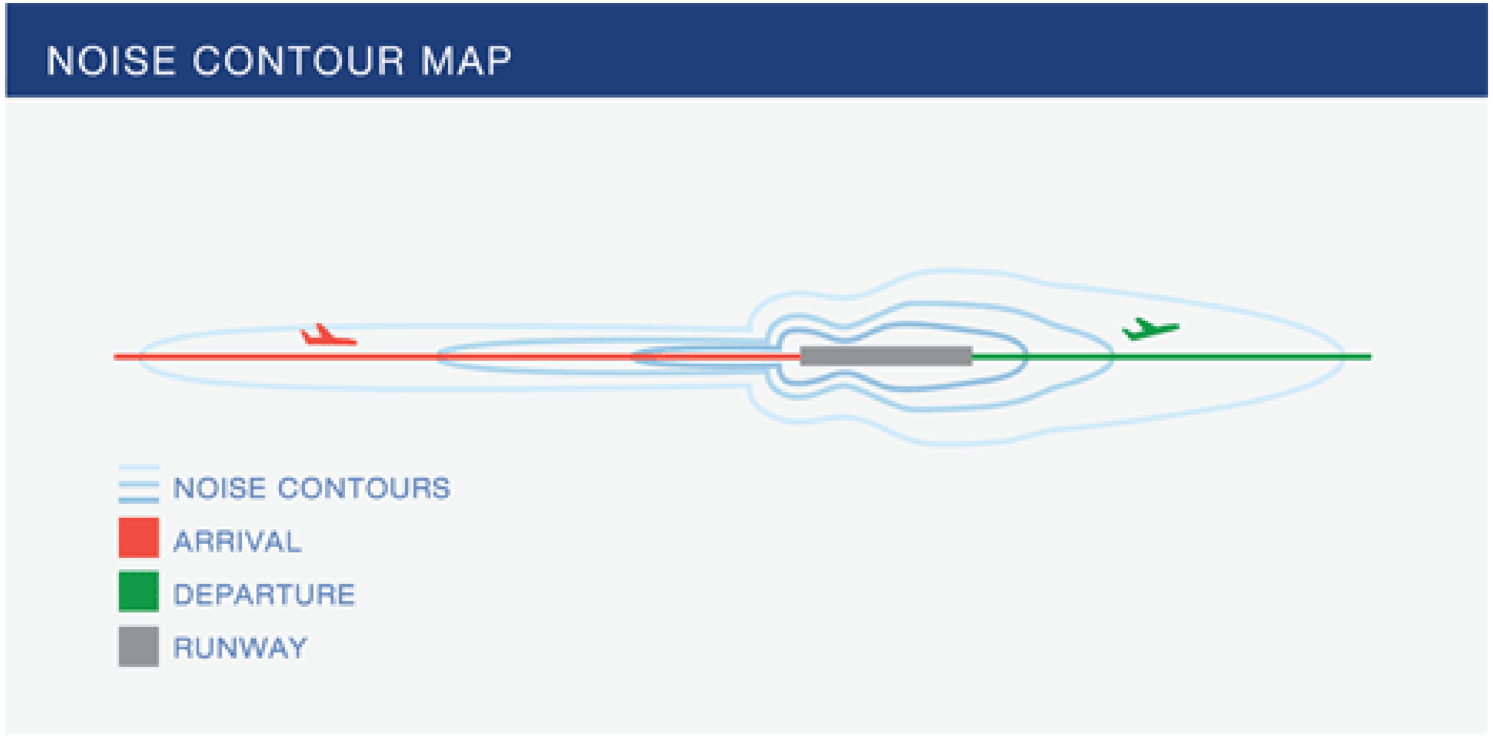
Noise Data

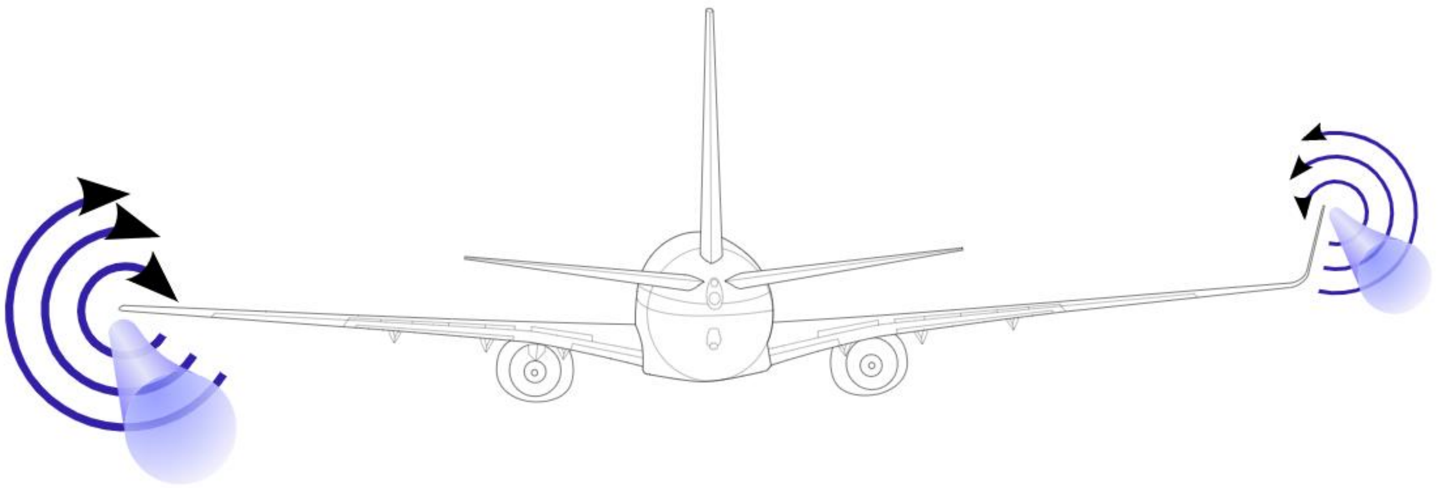
Noise is evaluated on intensity, duration and area impacted



Source: FAA – Noise Contour Map

New Technology

- Increasing efficiency
- Reducing noise



Longer wingspan | Winglets | Geared turbo fan engines

Source: Wikimedia Commons

Alec Seybold,

Flight Tech Engineering

CRJ 700 Regional Jet Update

- Bombardier has sold all rights to the CRJ series line to Mitsubishi
- All CRJ production has ceased
- There are no plans to restart production
- Through the acquisition, Mitsubishi acquired all the CRJ maintenance & service centers and will use those to service and support remaining CRJ aircraft and to provide a support network for the new Mitsubishi SpaceJet.

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Planning for the future fleet mix at ASE

- It will be business as usual for the next few years as CRJ 700s continue to support Aspen Airline Operations.
- As airlines take more deliveries of Embraer 175's (which are preferred by customers due to more spacious cabins and overall experience) the CRJ 700 fleet will gradually be reduced.
- Pilot Union scope clause agreements prevent additional 70-76 seat aircraft from being added to the regional fleet without removing older aircraft.
- Some CRJ 700s may find a second life as a CRJ 550 (i.e. United Express), but as the airframes start to accumulate higher hours, they'll eventually be retired as they reach expensive cycle-based airframe and engine maintenance requirements.
- Aircraft in the regional airline fleet have trended towards larger Jet aircraft paired with engine combinations that are setup for the most economical operations.

How do airlines determine the upcoming fleet mix for ASE?

The airline network planners and performance engineers review the following when determining new aircraft destinations:

- Historical passenger enplanements and load factor economics
- Aircraft Performance Capabilities
- Instrument Flight Procedure availability
- Weather Considerations
- Airport terminal and runway capabilities

Load Factors & Economics

- Just because an aircraft with 100+ seats is capable of flying into ASE doesn’t mean its economically viable for an airline to operate. The demand will self limit the type of aircraft for the route.
- The same can apply to smaller regional jet aircraft that have poor load carrying capabilities at challenging airports.
- Seasonal fluctuations (between Winter, Summer, and shoulder seasons) in passenger travel at Aspen currently require airlines to add or remove flights.
- With improved runway capabilities, airline planners will now have the option of changing to a larger aircraft with more seating density instead of increasing flight density.

Aircraft Performance Capabilities

Aircraft Performance Engineers have to sign off on any new aircraft that operates at ASE.

Aircraft marketing data is usually based on sea level conditions, standard temperatures, and doesn't account for the approach and departure obstacles.

This requires a review of:

- Takeoff weights
- Landing weights
- Non-standard scenarios
  - *One Engine Inoperative – Missed Approach*
  - *One Engine Inoperative Takeoff*
  - *Balked Landing or Go-Around below the Decision Altitude*

Engine thrust to weight ratio is a key factor in determining aircraft capabilities

Just because a regional jet is smaller doesn't mean it's more capable.

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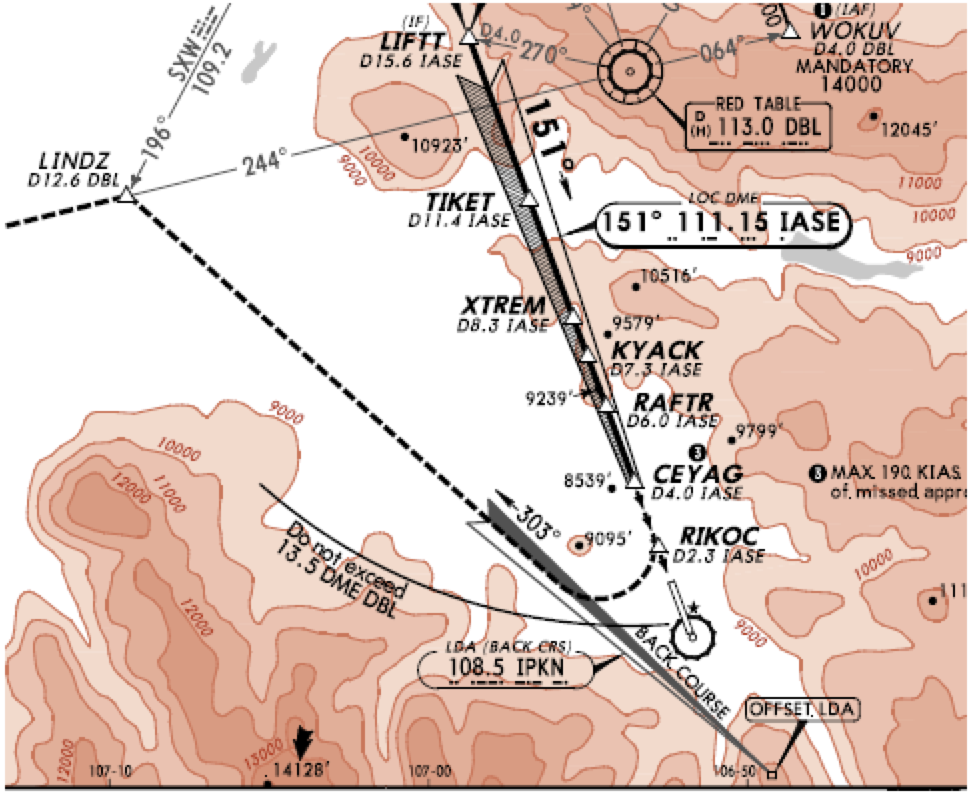
Instrument Flight Procedure & Performance Considerations

- The aircraft must be able to descend to the DA or MDA and be able to meet the Missed Approach Climb Gradient.
- The aircraft speed profile (i.e. CAT C/D) must meet any flight procedure restrictions.
- Airlines also review One-Engine Inoperative capabilities from the DA/MDA.
- Air Carriers and commercial charter operators also assess performance of executing a Go-Around below the DA/MDA.
- Departure Procedure are also reviewed for compliance with climb gradients and One Engine Inoperative climb-out performance.
- Only upon careful review of these flight and performance capabilities will an aircraft be approved to operate at ASE.



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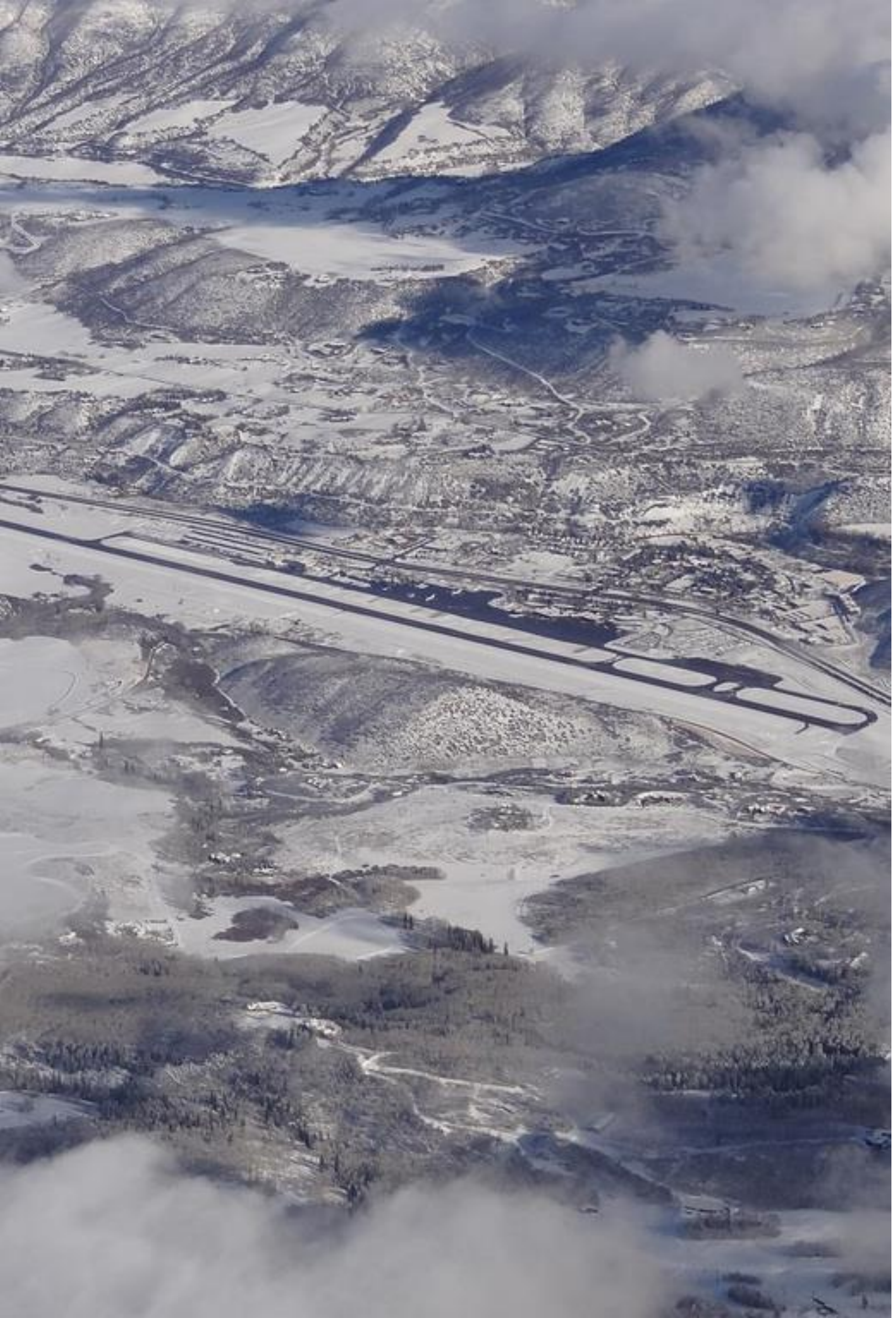

Weather Considerations

- Winter temperatures are more advantageous for aircraft operations, although present challenges during inclement weather (ex. Icing conditions reduce aircraft performance)
- Cooler weather usually permits higher load capacity in terrain constrained environments.
- Summer temperatures drastically affect passenger and cargo carrying capabilities
- Tailwinds experienced during takeoff and departure can ground flights or limit load carrying capabilities.
- These factors are more impactful for lower thrust aircraft.

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Most Favorable Aircraft for ASE Operations

- Airbus A220 (Former Bombardier CS100) High Thrust Version - Year-round operations
- Airbus A319 High Thrust Version (same seat capacity as A220) Year-round operations
- Boeing 737-700 series (NG & MAX) –seasonal operations

Potentially Capable of ASE Operations

- Embraer 175 – Cold Weather Operations (no high thrust option)
- Mitsubishi Space Jet- Conceptual – no data until flight test complete.

Lighting Round and Discussion

Next Steps

Meeting Schedule

Meeting IV
Airfield

Meeting V Report

Meeting 4 - Aspen Airfield: Airport Design 101, Non-Standard Conditions, Green and Carbon Neutral Goals
October 16th, Pitkin County Building, Roaring Fork Room, 4 – 7
Possible Voting

Meeting 5 – Report: Finalize and Refine Recommendations
October 23rd, Aspen Police Department Building Meeting Room, 4 - 7 pm

Thank You

Are we missing anything?

Setting the Stage…for a deeper discussion on design aircraft

ICAO Aircraft Certification - Noise Reference Points