FAA EAGLE Avgas Transition: Considerations for Impacts on Alaskan Supply Chains

A working paper prepared by

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Abstract:

Federal bodies have called for a directed transition away from 100 octane low lead aviation gas (100LL avgas) due to public health concerns. Leaded avgas currently powers piston engine aircraft in general aviation and air taxi fleets, serving both recreational and commercial purposes. In considering the unleaded avgas transition, we must acknowledge that public policy frequently generates unintended consequences that reduce anticipated net benefits for subgroups of the population. Particular attention should be placed on regions which are heavily reliant on piston aircraft for core commercial services to remote environments, and where infrastructure adjustments are highly complex and costly. Alaska is one such key context. This brief outlines considerations for potential core supply chain impacts in this remote, aviation-dependent environment and which communities are particularly exposed.

While Alaska is 48th in total population, the state is 1st in total volume of intra-state air cargo delivery. Over 80% of the state's communities lie off the road system, and piston engine aircraft are an important component of that commercial fleet. Leveraging granularity in the Bureau of Transport Statistics (BTS) T-100 database, we find that over 50% of carriers reporting intra-Alaska flights had at least one piston engine aircraft in their fleet. In 2023, T-100 data recorded 130,850 commercial piston aircraft flights transporting 201,729 passengers and 30.6M lbs of cargo between Alaskan communities. For non-hub 'bush' communities, almost 50% of all commercial flights, 30% of passengers, and 20% of recorded cargo were delivered by piston aircraft. We map community reliance across the state, with particular importance found for off-road destinations in the Southeast, Southwest, and Kodiak. A complete tabular breakdown of piston-engine market shares is generated for all Alaskan destination communities.

We conclude by providing key economic questions for Alaska to address ahead of a fuel transition. Assuring the technical performance of unleaded fuel alternatives in Alaskan environments is foundational. Then, to most efficiently utilize the preparation window, policymakers and sector leadership should understand the impact of increased fuel expenses on overall linehaul cost per ton-mile, the share of cost increases borne by service communities, impacts on route viability, and the potentially complex process of staging any necessary support infrastructure such as fuel storage to off-road communities in Alaska's narrow barge season.

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1 INTRODUCTION:

Lead additives are utilized in aviation gasoline (avgas) for piston aircraft to boost octane ratings and maintain engine condition and performance at high power settings (USDOT, 2023). While leaded automotive fuel was phased out decades ago, use of 100 octane low lead (100LL) avgas has persisted. Following the FAA Reauthorization Act of 2018, the Piston Aviation Fuels Initiative (PAFI) and the Eliminate Aviation Gasoline Lead Emissions (EAGLE) program are working with industry to develop unleaded avgas alternatives, with a stated goal to "eliminate lead emissions from piston aircraft by 2030, without adversely impacting the safe and efficient operation of the existing fleet" (USDOT, 2023; p2).

This directed transition to unleaded avgas follows research linking increased ambient lead levels to airport proximity, and higher blood lead levels of airport-adjacent residents (Feinberg et al., 2016; Zahran et al., 2017, 2023). The impetus for a transition is furthered by the EPA's 2023 final finding that "lead emissions from aircraft engines that operate on leaded fuel cause or contribute to air pollution that may reasonably be anticipated to endanger public health and welfare" (EPA 2023). The EPA notes that they are now "subject to a duty to propose and promulgate regulatory standards for lead emissions from aircraft engines" and that the FAA is "also now subject to a duty to prescribe standards for the composition or chemical or physical properties of aircraft fuel to control or eliminate aircraft lead emissions".

There is an inherent challenge for a fuel transition to generate a reasonably equivalent product that performs under a wide variety of extreme environments, while mitigating operational, cost, and logistical impacts for carriers and individual aviators. The EAGLE initiative specifically aims to eliminate lead emissions "*without adversely impacting the safe and efficient operation of the existing fleet*" (USDOT, 2023; p2). At the time of writing, very limited alternatives to 100LL avgas exist and production is nascent. The EAGLE initiative aims to broaden the set of unleaded alternatives through private sector collaboration for fuel chemistry research and development. Presumably, any alternative would need to undergo testing in each of the extreme environments that 100LL is currently utilized to ensure reliability, which may - understandably - take time to implement. Commercial (and private) aviators may also naturally seek clarity in anticipated availability and differential price points of new fuel products. For example, at the time of writing, the firm General Aviation Modifications, Inc. (GAMI) has received an approval for an unleaded fuel 'G100UL' and has begun ramping up production for a national market. GAMI's website states that "current best estimates are that the premium components that comprise G100UL avgas could cost 70¢ to $1.05 more per gallon than 100LL until it becomes more widely available" though they note further that "it is likely the higher fuel price will be offset by lower maintenance costs for the aircraft." It is unclear to what extent the landed costs in Alaskan rural hubs may exceed these (likely Lower 48 focused) initial projections.

States with a disproportionate reliance on piston aircraft in commercial aviation, and aviation supply chains in general, have a strong interest in ensuring a smooth fuel transition – one that

supports public safety, while preserving reliability and minimizing impact on operational costs. Alaska is one of these critical regions. Alaska is a large and diffuse state that faces extreme cold for prolonged months and is extremely reliant on small aircraft in commercial supply chains to an extensive network of off-road communities.

Amid concerns of economic impact and supply chain disruptions, recent amendments allowed for Alaska to extend the transition goal to “December 31, 2032” or “6 months after the date on which the Administrator of the Federal Aviation Administration finds that an unleaded aviation fuel is widely commercially available at airports throughout the State of Alaska that (i) has been authorized for use by the Administrator of the [FAA] as a replacement for 100-octane low lead aviation gasoline; and (ii) meets either an industry consensus standard or other standard that facilitates and ensures the safe use, production, and distribution of such unleaded aviation fuel.” However, clarity is still needed regarding the reliance of Alaskan communities on impacted aircraft, what to expect as the market adapts to new mandates, and where any additional time to plan can translate to strategic investment to mitigate undesirable impacts.

In this brief, we:

1. Describe Alaska’s unique dependence on aviation for essential supply chains;

2. Outline the primary piston aircraft in Alaskan commercial fleets and their overall market share in total flights, passengers, and cargo;

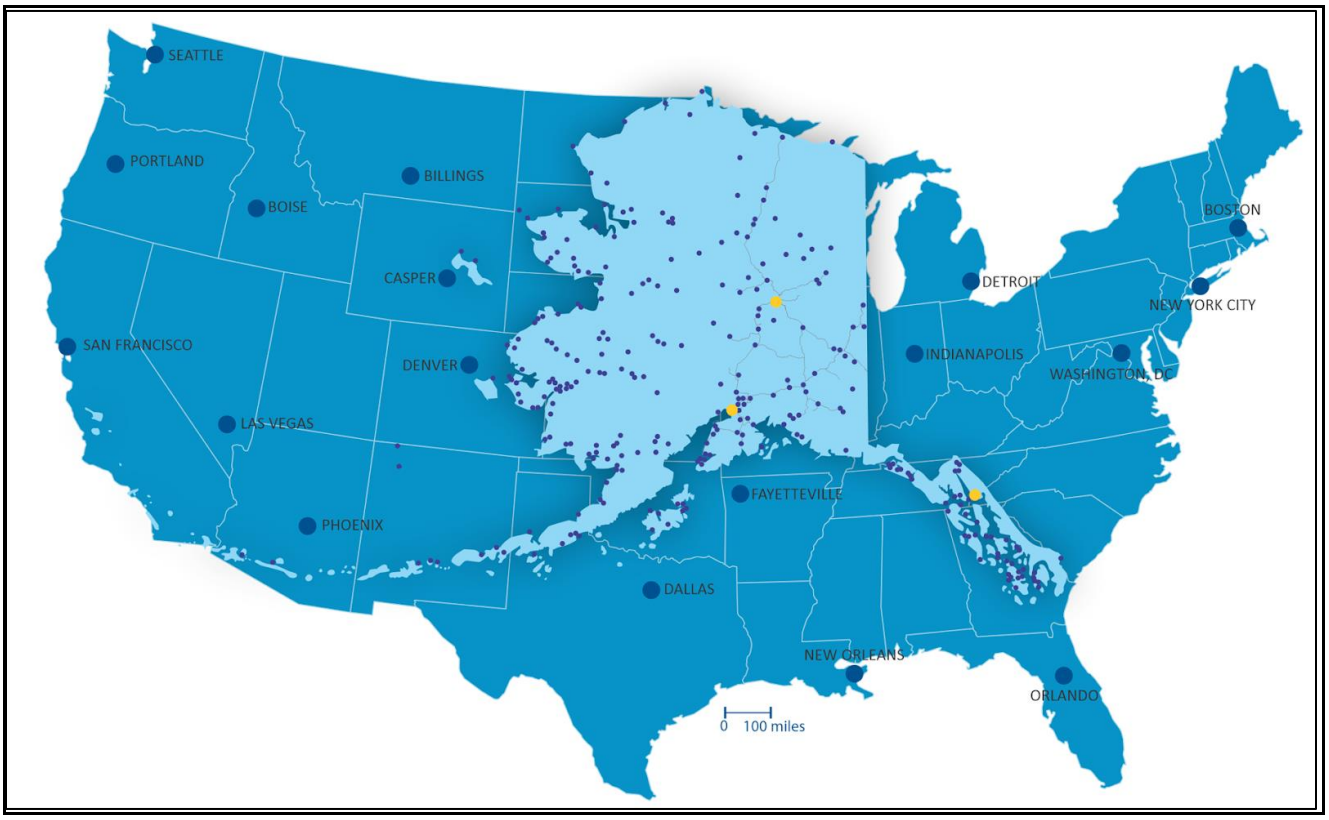
3. Decompose community-level reliance on piston aircraft, uncovering considerable heterogeneity that is masked by statewide averages; and

4. Offer several key economic questions for Alaska to understand ahead of a fuel transition

2 ALASKA AS AN AVIATION-DEPENDENT STATE

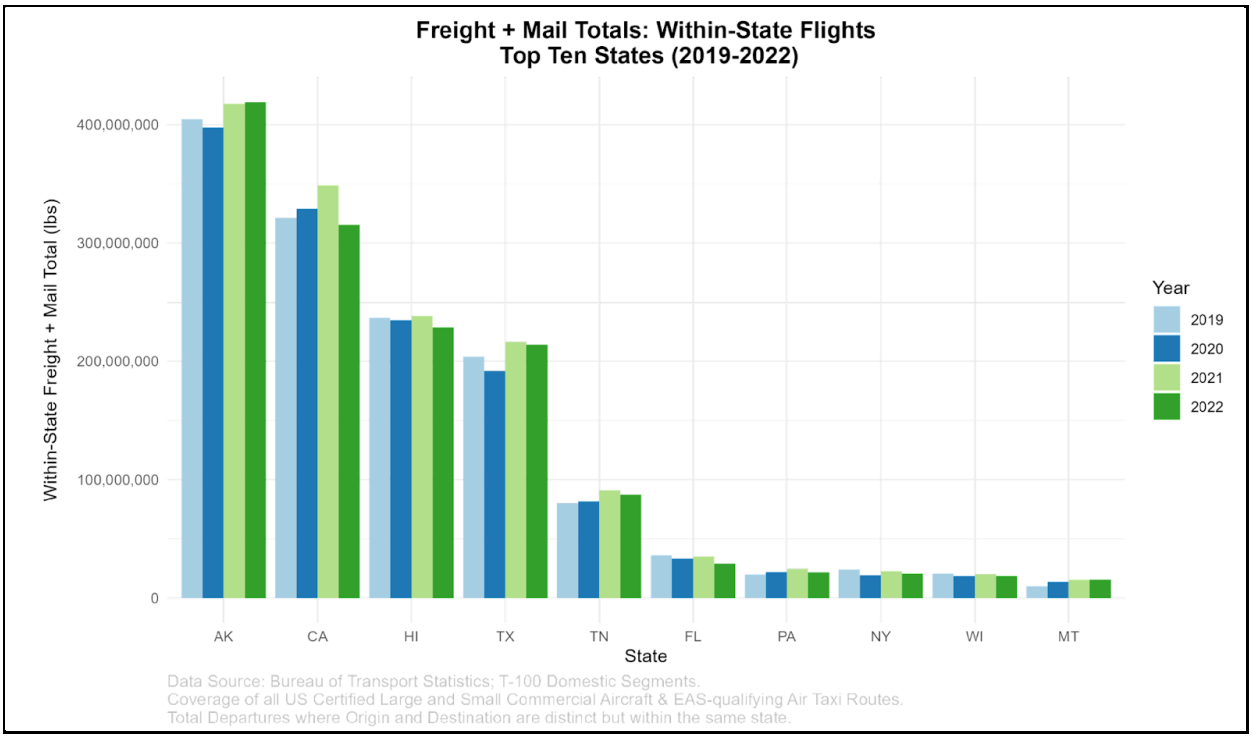
Alaska is more reliant on aviation than any other state for intra-state transportation and flow of commercial goods. Over 80% of the state's communities and almost 25% of the state's population are disconnected from the state's major road system and face a level of isolation that is simply not observed anywhere else in the United States (Fig.1; ADOT&PF, 2024; ADOL&WD, 2024). These off-road communities have a unique reliance on aviation for year-round supply chains. While Alaska is 48th in total population, the state is 1st in total volume of intra-state air cargo delivery, moving over 400,000,000 lbs of freight and mail annually on commercial flights captured within the Bureau of Transportation Statistics (BTS) T-100 data (Fig. 2; BTS T-100 Domestic Segment).

Figure 1: Alaskan communities, airports, and limited road networks



Source: ADOT&PF Alaska Aviation Systems Plan (AASP). Adapted to remove text.
Note: Includes limited road system in grey, 'medium & small' hubs of Juneau, Anchorage, and Fairbanks (yellow) and all other airports (blue).

Fig. 2: Alaska has the highest intra-state volume of commercial air cargo delivery



Note: Alaska is 48th in population but 1st in total volume of intra-state air cargo (across all flights; BTS T-100 Domestic Segment records).

Alaskan “off-road” communities are, in general, much less economically developed and face significantly higher costs for food and essentials than those on the road system. This highly unique geographic and economic environment is the impetus for specialized federal programs such as the US Postal Service’s Intra-Alaska Bypass Mail System, which provides a substantial subsidy for a large volume of retail goods moving to many of the state’s remote communities (for further details, see: **USPS PO508 Handbook**). Despite subsidization programs, very high price disparities remain for many essential goods. For example, in February 2024, a half-gallon of 2% milk would cost about $3 in major road system communities, but rises to $7.50 - $10.00 in off-road communities. A can of powdered infant formula retailing $18-21 on the road system would likewise range between $26-35 in off-road regions.

Given this context, policies that could lead to disruptions to these commercial aviation networks or have substantial impacts on operating costs merit very careful attention.

3 DECOMPOSING COMMERCIAL DEPENDENCE ON SMALL PISTON AIRCRAFT

Alaskan supply chains operate in a 'hub and spoke' model. First, almost 90% of goods by volume enter the state of Alaska by barge, and the vast majority of those barged goods enter through the Port of Anchorage (Freight Analysis Framework, 2023; McDowell, 2019). Mainline carriers operating under a Part 121 certificate generally move goods from urban centers of Anchorage (and to a lesser extent Fairbanks) out to 'hub' communities. For the purposes of this brief, we follow the community airport classification of 'regional hub' and 'non-regional hub' as defined by the ADOT&PF's Alaska Aviation System Plan (AASP). The plan identifies some 30 'hubs' that include Bethel, Dillingham, Nome, Kotzebue, and Utqiaġvik (Barrow), among others. Bush carriers generally operating under a Part 135 certificate then move goods from hubs out to 'spoke' bush communities, a common local term for remote towns and villages.

The following analysis approach leverages data from the Bureau of Transport Statistics (BTS) T-100 'Domestic Segment' database, which provides monthly data by carrier, aircraft type, and origin-destination pair for total departures performed, passenger counts, and weight of transported freight and mail (BTS, 2025). This allows us to disentangle the most utilized aircraft models, by route and year, by engine type to derive market shares for piston aircraft. We examine years 2015-2023 for trends and then isolate 2023 data for more in-depth analysis. The T-100 Domestic Segment data includes routes originating from US (domestic) airports from all U.S. certificated air carriers, large and small. This also includes U.S. commuter air carriers – those who run scheduled passenger service between two points at least five times a week with small aircraft. Lastly, the data includes any air taxi route awarded in an Essential Air Service (EAS) Contract. While providing rich detail for this analysis, the T-100 data does not capture flights by U.S. air taxis whose service is exclusively scheduled cargo or on-demand passenger/cargo service with small aircraft, or the key segment of General Aviation/Corporate Aviation.

The T-100 data indicate that over 50% of all carriers reporting within-state Alaskan flights had at least one piston engine aircraft in their fleet. This has remained consistent over the last ten years (see Supp. Fig. 1). In Table 1, we outline the most frequently utilized piston aircraft categories in the commercial sector for 2015 - 2023. In 2023, there were 130,850 commercial piston aircraft flights transporting 201,729 passengers and 30.6M lbs of cargo between all Alaskan communities. This corresponds to about 35% of all commercial flights, moving about 7 and 8% of all passengers and cargo, respectively (Fig. 3).

However, statewide statistics mask the particular relevance of piston aircraft to smaller and more numerous bush communities. In 2023, almost 50% of all commercial flights to non-hub 'bush' destinations were performed by piston engine aircraft. This comprised about a 30% market share of passengers and 20% of freight & mail transported (Fig. 4). This share has declined over the last decade by about 10 percentage points across each category.

Carriers remark that turbine-driven engines are regarded in many ways as safer, more reliable, and able to carry greater payloads, though they are generally much more expensive. However, particularly in tight, rougher environments prevalent for many of Alaska's small communities, carriers may favor the responsiveness of piston engine aircraft for enhanced safety. Carriers also state that smaller-scale markets are much more economically viable to service with smaller capacity and cheaper piston aircraft. Carriers (and state universities) also heavily rely on smaller piston aircraft for training and this workforce development role should not be overlooked. Further, though to a smaller extent, Alaska is a significant research and development test bed for autonomous aviation and many larger drone platforms currently use 100LL fuel. It would also be important to understand the impact of a fuel transition on autonomous platform development and viability.

Table 1: Most utilized piston engine aircraft in Alaskan commercial fleets (BTS T-100, 2023; isolated to intra-state flights)

Piston Aircraft Type (BTS T-100 Grouping)	Flights	Cargo	Passengers
Cessna C206/207/209/210 Stationair	79,354	12,744,702	105,177
Piper PA-31 (Navajo)/T-1020	13,949	1,905,125	36,129
Gipps Aero Ga8 Airvan	11,871	1,765,467	22,140
PiperPA-32 (Cherokee 6)	7,879	882,418	10,363
De Havilland DHC2 Beaver	6,413	1,061,093	9,669
Cessna 172 Skyhawk	4,851	290,983	3,573
De Havilland DHC3 Otter	2,584	1,129,865	8,228
P2012 Traveler	1,849	2,990	6,072
Beechcraft Beech 18 C-185	1,142	5,144,914	-
McDonnell Douglas DC-6A	470	5,214,516	-
Cessna 185A/B/C Skywagon	213	6,814	317
Helio H-250/295/395	180	13,374	61
Curtiss C46/20t/A/D/F/R Commando	95	474,855	-
TOTAL	**130,850**	**30,637,116**	**201,729**

Fig. 3: Alaska statewide market share of piston aircraft

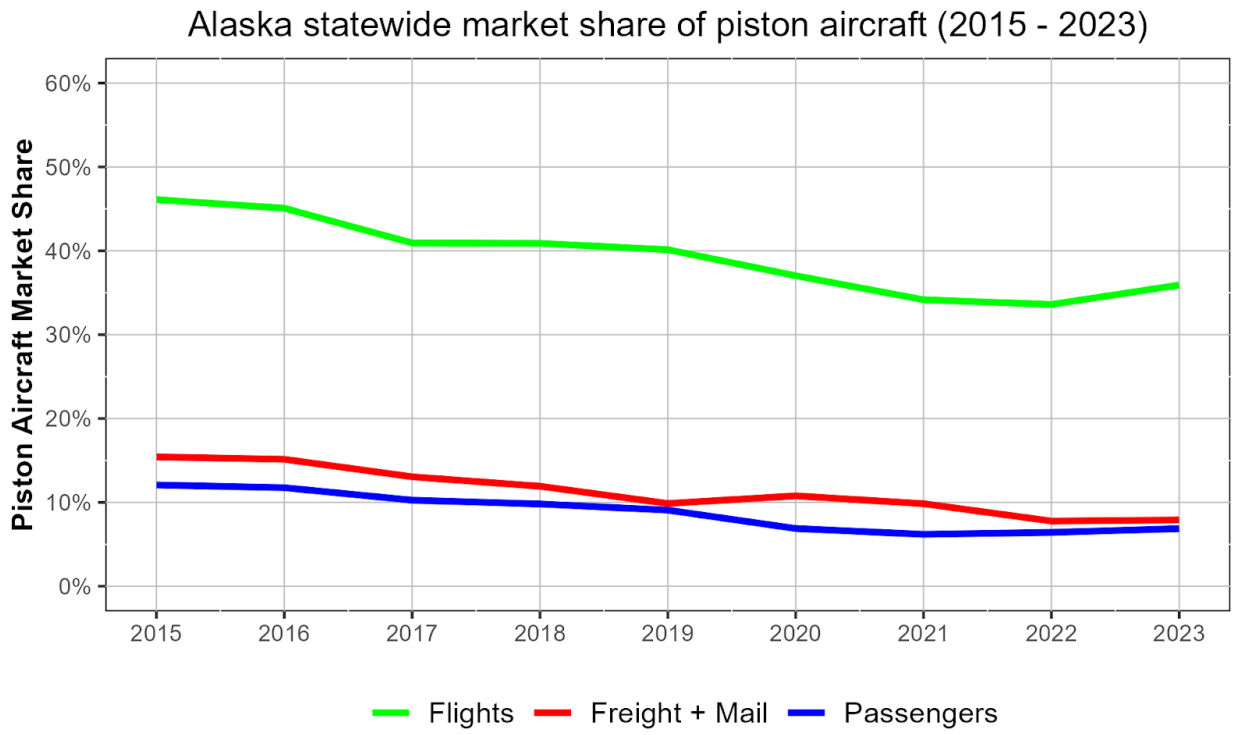
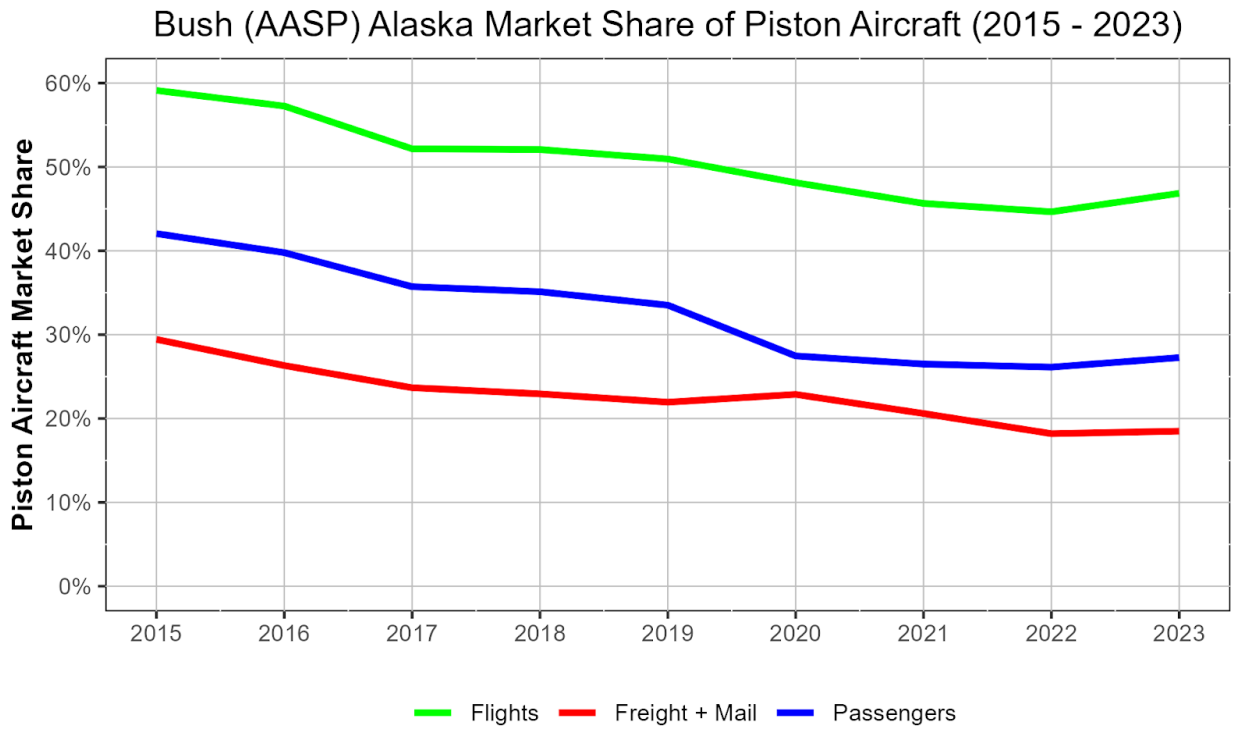


Fig. 4: Alaska bush route market share of piston aircraft



4 ALASKAN COMMUNITY-LEVEL RELIANCE ON PISTON AIRCRAFT

We can leverage the granularity of the BTS T-100 data to gain an even clearer picture of the variation in reliance on aircraft engine types. Of the 321 Alaskan destinations reported in the T-100 data in 2023, piston aircraft delivered some non-zero volume of passengers and cargo to 73.2% and 63.2% of locations, respectively. A total of 78 destinations (24.3%) were exclusively serviced by piston aircraft, though most are quite small. For example, this includes the communities of Metlakatla, Coffman Cove, and McCarthy, as well as remote bays with lodges such as Brooks Lodge and Kiliuda Bay (see Suppl. Table 1). These destinations with 100% market share had an annual total of 7,112 flights transporting 17,763 passengers and 3.68M lbs of freight and mail. Another 30 destinations had a piston market share of at least 90% (but <100%). Table 2 provides a full breakdown of the distribution of community reliance on piston aircraft. Piston market share is binned by decile, isolating the edge cases of 100% and 0%.

We separate the analysis by flights, passenger transport, and cargo transport, presenting:

1. the percentage of total Alaskan destinations falling within each bin, and

2. the raw total *for all engine types* of flights, passengers, and cargo volume transported to communities within each bin.

Listing the total volume of flights, passengers, and cargo to the communities in each bin provides a sense of scale, as communities/destinations vary widely in size. Locations with less commercial air traffic (i.e. smaller communities) are generally more reliant on piston aircraft, which may indicate an equity issue in who must bear the cost of this policy change.

For transparency and to facilitate future research, we list all 2023 individual community piston market shares and flight, passenger, and cargo totals in Supplemental Table 1.

Table 2: 2023 Alaskan Piston Market Share Breakdown by Destination (BTS T-100)

	Flights		Passengers		Cargo (Freight + Mail lbs)	
Piston Market Share	% Total Communities	Total Flights (All Engines)	% Total Communities	Total Pax (All Engines)	% Total Communities	Total Cargo (All Engines)
100%	24.3	7,112	23.7	17,763	19.6	3,677,762
>90% - <100%	9.3	27,603	5.9	36,957	3.7	1,319,536
>80% - 90%	5.3	16,054	3.1	13,334	2.8	1,676,148
>70% - 80%	4.4	15,536	2.5	8,481	3.7	4,890,294
>60% - 70%	4.7	57,501	2.2	11,814	4.0	4,852,540
>50% - 60%	3.7	15,923	2.8	13,677	3.4	6,856,064
>40% - 50%	3.4	16,886	5.3	32,582	1.9	10,664,336
>30% - 40%	2.5	3,623	2.2	15,573	2.2	3,744,040
>20% - 30%	4.0	33,339	5.9	223,988	5.0	9,018,299
>10% - 20%	5.6	27,785	2.2	55,233	4.7	14,241,457
>0% - 10%	14.6	102,807	17.4	1,906,467	12.1	118,937,728
0%	18.1	40,122	26.8	602,214	36.8	207,949,244

**Note: Of 321 unique Alaskan destination communities in the BTS T-100 dataset (isolated to intra-state transport between unique destinations). In the T-100 data for 2023, 12,566 flights (denoted as 'departures performed') are listed with zero recorded passengers, freight, or mail delivered, which generally indicates re-positioning of aircraft when origin and destination differ.*

Community reliance on piston aircraft is highly clustered within the state. In Figures 5 & 6, we present a graphical display of BTS T-100 destination communities, color coded by piston market share for passengers and cargo. Southwest, Southeast, Kodiak, the Lakes & Peninsula Borough, and Bristol Bay appear as particularly striking clusters of importance for piston aircraft. As we anticipate any impacts or disruptions ahead of a fuel transition, it seems advisable to focus on these key zones of disproportionate reliance.

Fig. 5: Map of Alaskan passenger market share intensity for piston aircraft

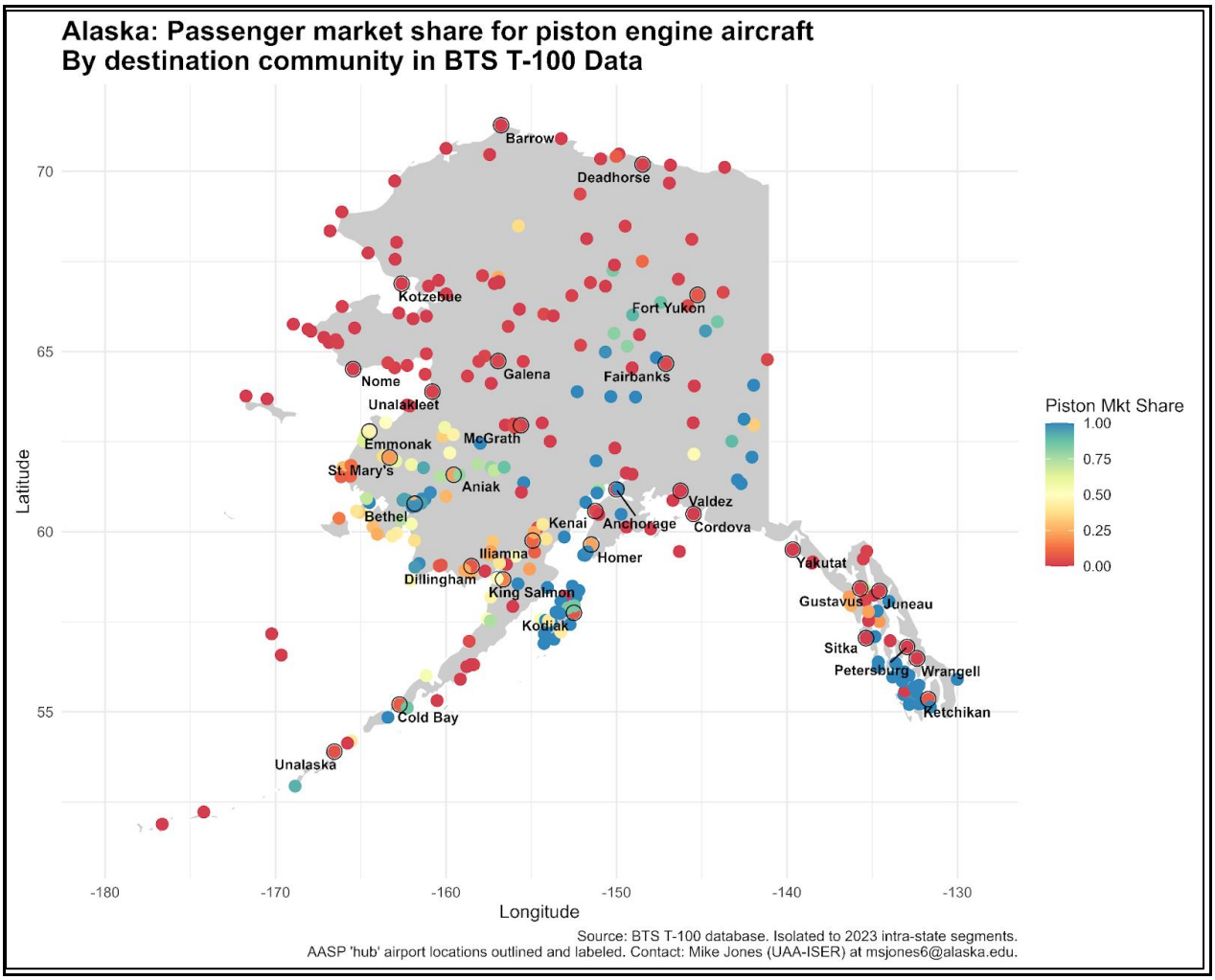
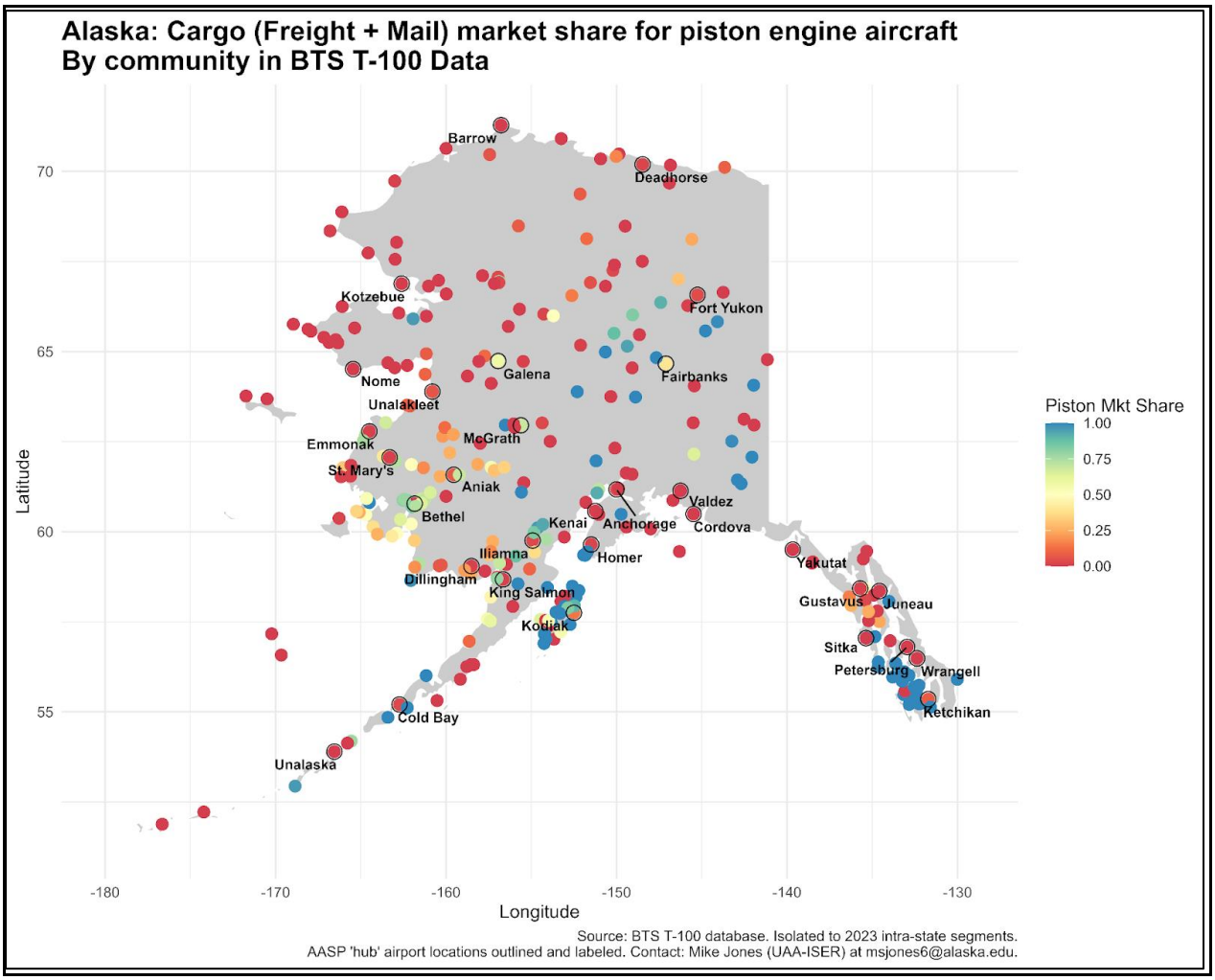
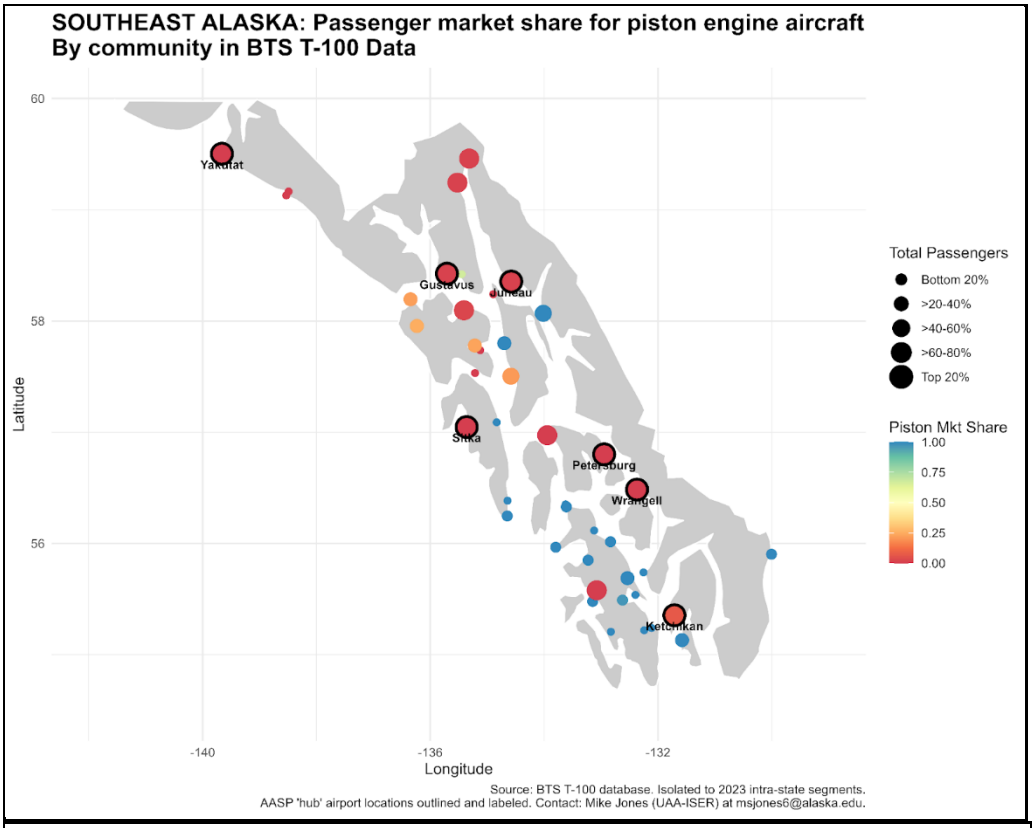


Fig. 6: Map of Alaskan cargo market share intensity for piston aircraft



In Figures 7-12, we present volume-weighted regional comparisons for more granular analysis in the focal regions of the Southeast, Southwest, and Kodiak (others available by request). Points with a larger radius indicate higher (state-wide) quintiles of passenger or cargo volumes to a particular destination.

Fig. 7 & 8: Southeast region; Piston market shares for passengers (7) and cargo (8)



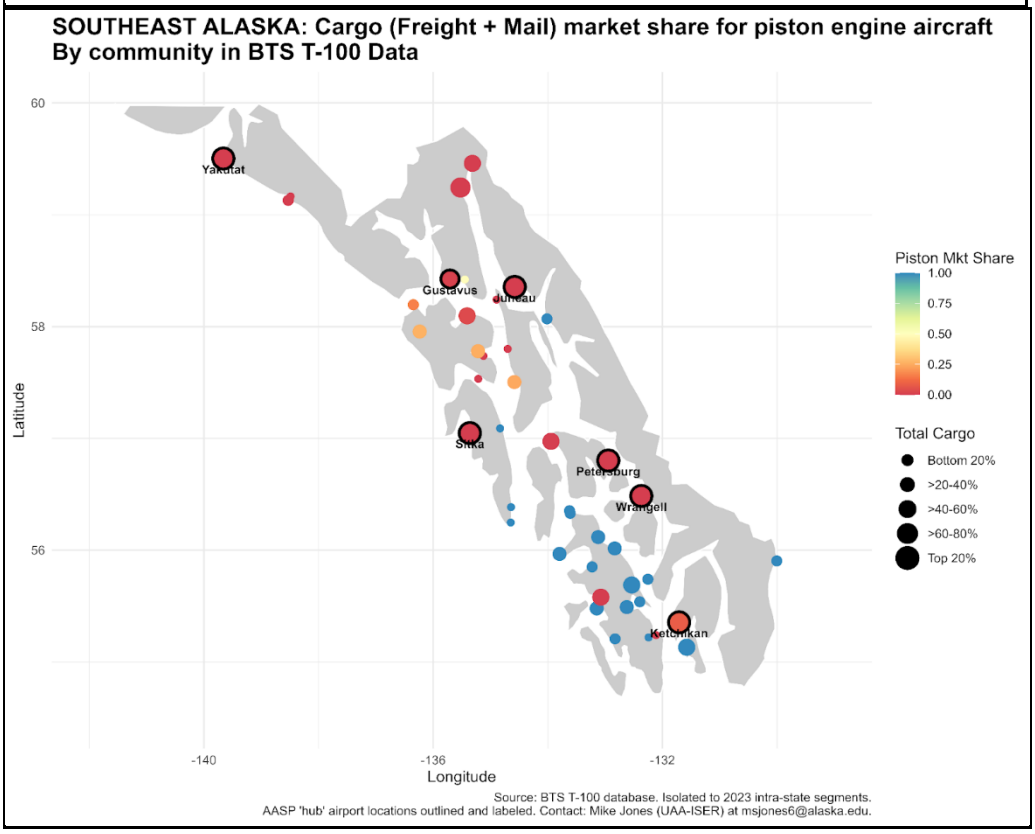
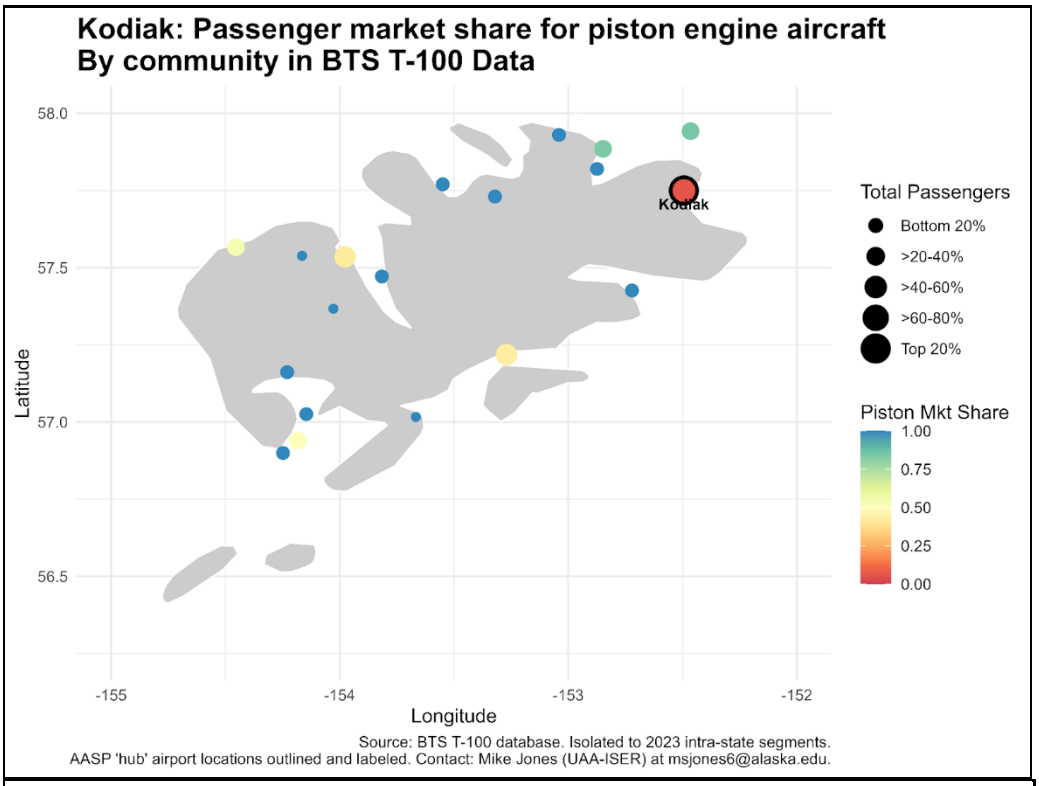


Fig. 9 & 10: Kodiak region; Piston market shares for passengers (9) and cargo (10)



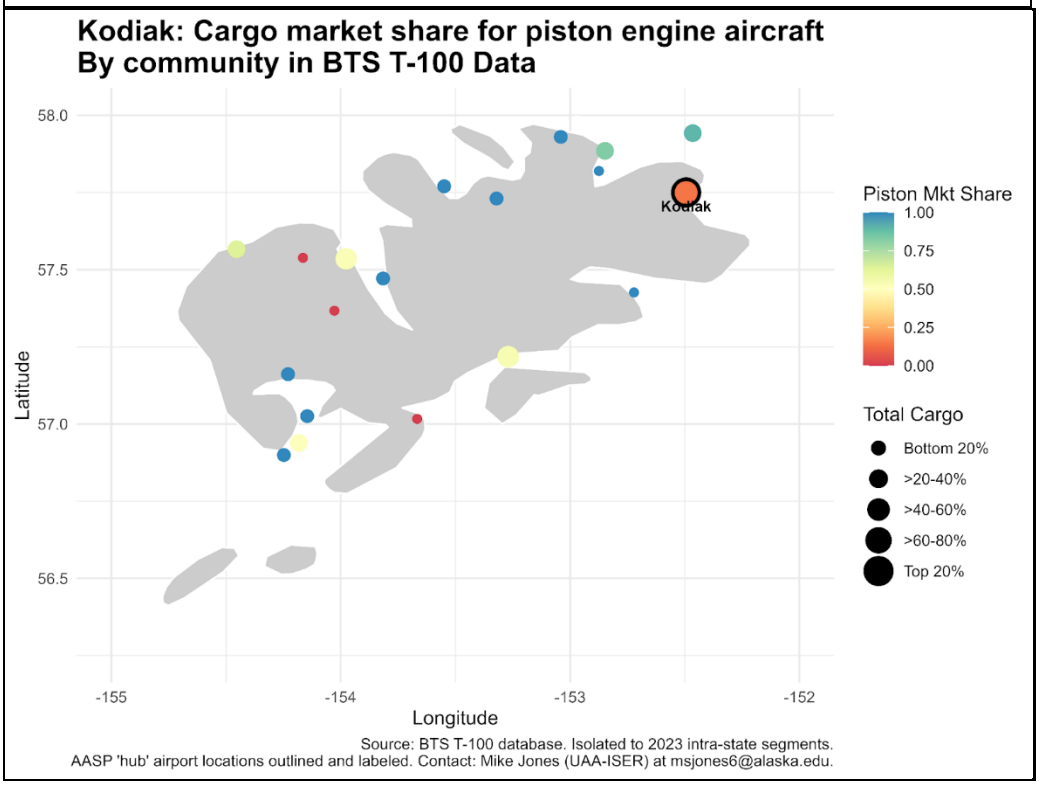
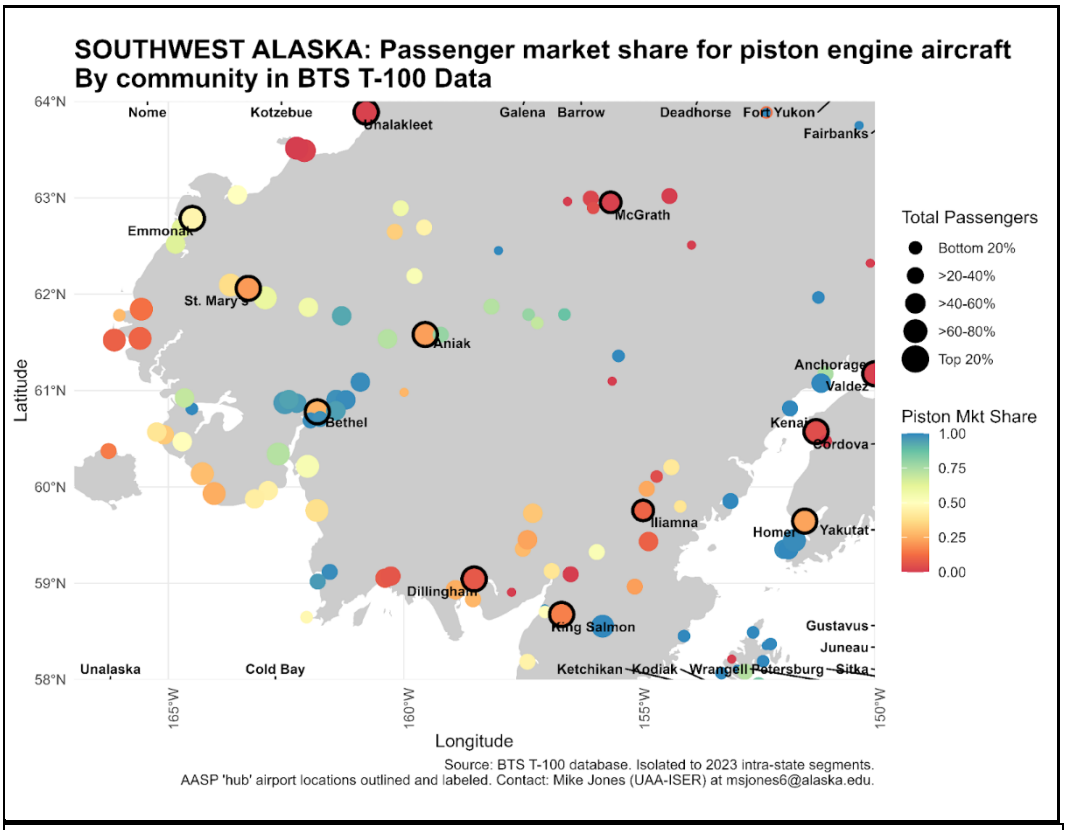
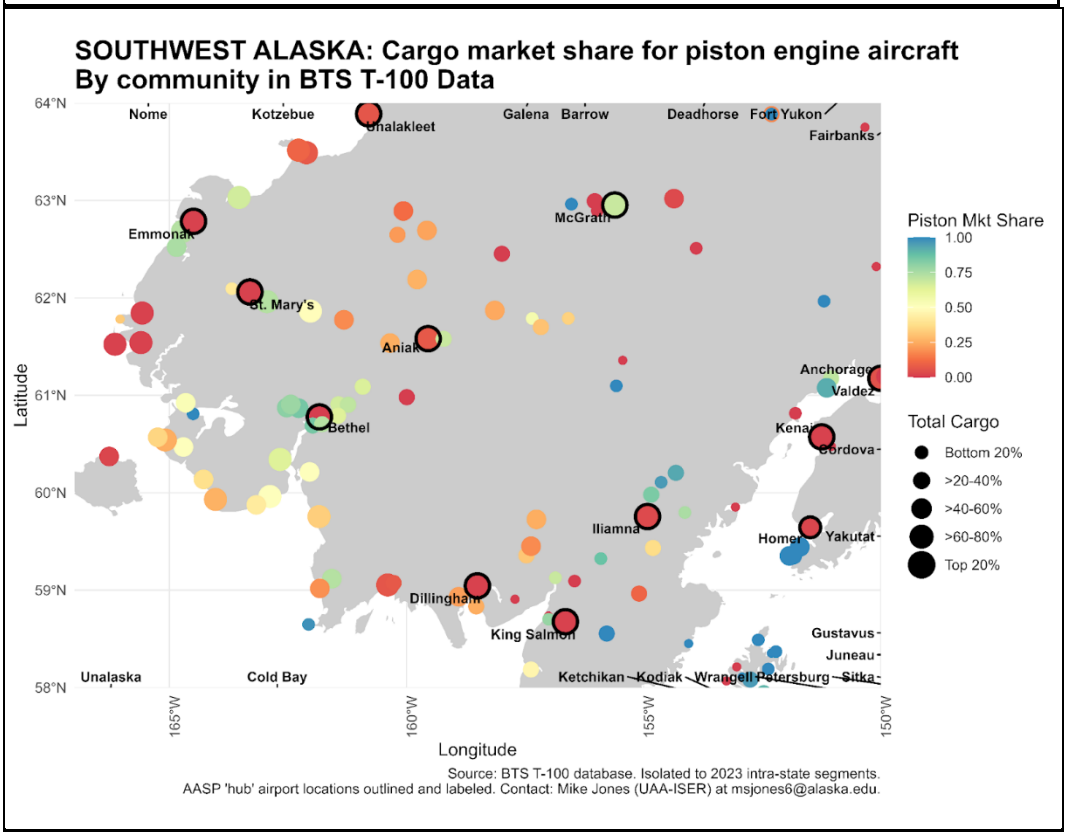


Fig. 11 & 12: Southwest region; Piston market shares for passengers (11) and cargo (12)





5 FURTHER CONSIDERATIONS FOR EAGLE INITIATIVE IMPACTS ON ALASKAN COMMUNITIES

The ultimate *net impact* on Alaska of the EAGLE initiative's directed transition to unleaded avgas will depend on many factors. The goals of the program center on generating health benefits from a transition to unleaded fuel, and this brief is not contesting that potential impact. If the evidence indicates that leaded avgas-powered aircraft activity raises lead in the environment to levels that are significant for health, then communities with a higher volume of piston engine activity could receive a higher health benefit from a reduction in local lead emissions. However, evaluating the emissions residue or health evidence in the Alaskan context, or an explicit analysis of the full 'net' benefit of this policy is beyond the scope or expertise of the current authors. This brief has simply outlined the economically significant and highly heterogeneous nature of Alaskan communities' reliance on piston engine aircraft in commercial supply chains. This reliance extends to the delivery of medicines, food, and patients to and from clinics in larger regional centers, and supply chain disruptions would almost certainly impact connectivity to this key goods and services. The Alaskan context is simply quite different than anywhere else in the U.S. and particular attention must be paid to ensuring no disruptions and supporting the processes to minimize economic burden to communities that this policy is intended to help.

The EAGLE initiative specifically aims to "[eliminate] lead emissions from piston-engine aircraft by the end of 2030, *without adversely impacting the safe and efficient operation of the existing fleet*" (USDOT, 2023; p2). A prospective financial analysis that empirically estimates the *extent* of potential disruption to supply chains and/or increased operating costs would likely need to include the following further steps:

1. If 100LL is phased out of other states ahead of Alaska:

    a. Project the capacity of existing distributors to continue servicing the Alaskan market. For Alaska to receive an extra 'bridge' period, private sector domestic entities will need to maintain incentives to continue supplying a limited market and/or pivot to (currently limited) international 100LL markets (e.g. East Asia). Given likely economies of scale in manufacturing and distribution, this is important to ensure but highly uncertain in outlook.

    b. Given continuation of production and delivery, we must project changes in the landed cost of 100LL avgas to Alaska in the intermediate bridge period. Reduced demand for 100LL outside of Alaska may put advantageous downward domestic pressure on prices. Conversely, restricting production for a limited market may increase average unit costs and put upward pressure on prices. Further, Alaska's near-reliance on a sole domestic refiner and their increased

market power will put upward pressure on prices. The international market may be able to fill this gap if logistical and policy hurdles are cleared, but it is unclear the extent to which shifts in global supply and demand would impact world prices.

c. Review benchmarks of unleaded fuel production and delivery capability. Plan to anticipate and mitigate supply disruptions, particularly as the goal for a complete fuel transition nears. With the ramp down of all domestic 100LL production, minimizing supply chain friction will require near seamless availability of the to-be-determined next generation fuel. This plan appears far from concrete at the time of writing. Particular focus should likely be placed on staging at refueling points for flights to destination communities which are heavily reliant on piston aircraft.

2. Analyze the landscape of 100LL fuel supply chains and storage capacity.

    a. Particular focus should be placed on the multi-modal and seasonally dependent nature of supply chains for fuel in the Alaskan environment. This is extremely unique for the United States.

    b. For example, marine and river barges to many communities have narrow summer windows of operation and barges may have constrained capacity to deliver any major pieces of infrastructure, e.g. if current fuel storage and delivery assets require replacement. Barge timing and availability is a constant challenge for any major infrastructure projects in rural Alaska.

    c. How and when will the ‘last’ shipments of 100LL flow to communities? How and when will the ‘first’ shipments of its replacement flow? Bulk fuel shippers rely on extremely high volume shipments of 100LL to the state (about 2M gallons per shipment), and reductions in their capacity to continue large scale shipments could translate into much higher unit costs for importation. This could widen the price differential avgas even more between Alaska and the Lower 48.

3. Project the pass through of potential fuel cost increases on standardized metrics such as average cost per ton-mile.

    a. As a template, the US DOT regularly collects cost data for the USPS Bypass Mail program on linehaul fuel, linehaul non-fuel, and terminal cost categories by carrier and (where applicable) by aircraft. These are published through Show Cause Orders and Quarterly Fuel Updates, and also drawn from F2 and 298C filings. UAA-ISER has ongoing research initiatives to digitize and streamline many years of cost data published through this program that could likely be leveraged for such an analysis.

i. For example, in small aircraft ‘bush’ carriers, fuel represents 16-21% of total linehaul costs, normalized by ‘revenue-ton-mile’ (see Suppl. Fig 2), and this figure could be isolated by aircraft type and more precisely estimated by route length and payload.

b. Fuel costs will depend on the remoteness of the fueling station as well as particular carrier agreements with suppliers. As an illustrative example, estimates in the 2023 bush carrier data for fuel $/gallon are found for the following aircraft groups (2022 & 2023 data found in Suppl. Table 2):
   i. Cessna C206/207/209/210 Stationair ($5.42 - 7.16/gal)
   ii. De Havilland DHC2 Beaver ($ 6.41 - 8.34/gal)
   iii. De Havilland DHC3 Otter ($4.65/gal)
   iv. Gipps Aero Ga8 Airvan ($7.00/gal)

c. Changes to overall costs through fuel transition mandates may manifest through per gallon cost differentials, changes in overall fuel economy, engine maintenance costs, and through replacement of physical assets for fuel storage.

4. Project further anticipated natural rates of decline of piston engine aircraft market share for commercial carriers, which may soften impacts of a mandate.

   a. Derive underlying drivers of this general decline, and any heterogeneity in fleet adjustments by carrier and community destination of transported passengers/cargo.

5. Bridge beyond impacts to the traditional commercial sector to understand the extent of impacts on private aviation, which is quite extensive in Alaska and a pillar of many off-road communities’ connectivity.

   a. Private aviators certainly use piston aircraft for recreational purposes, but Alaskans also use private aircraft for subsistence food harvesting and private transportation of retail goods from (cheaper) towns and cities to more isolated rural areas.

   b. Total demand estimations for an unleaded fuel alternative would require understanding the balance between commercial and non-commercial requirements, and any specialized fuel supply chain considerations for each.

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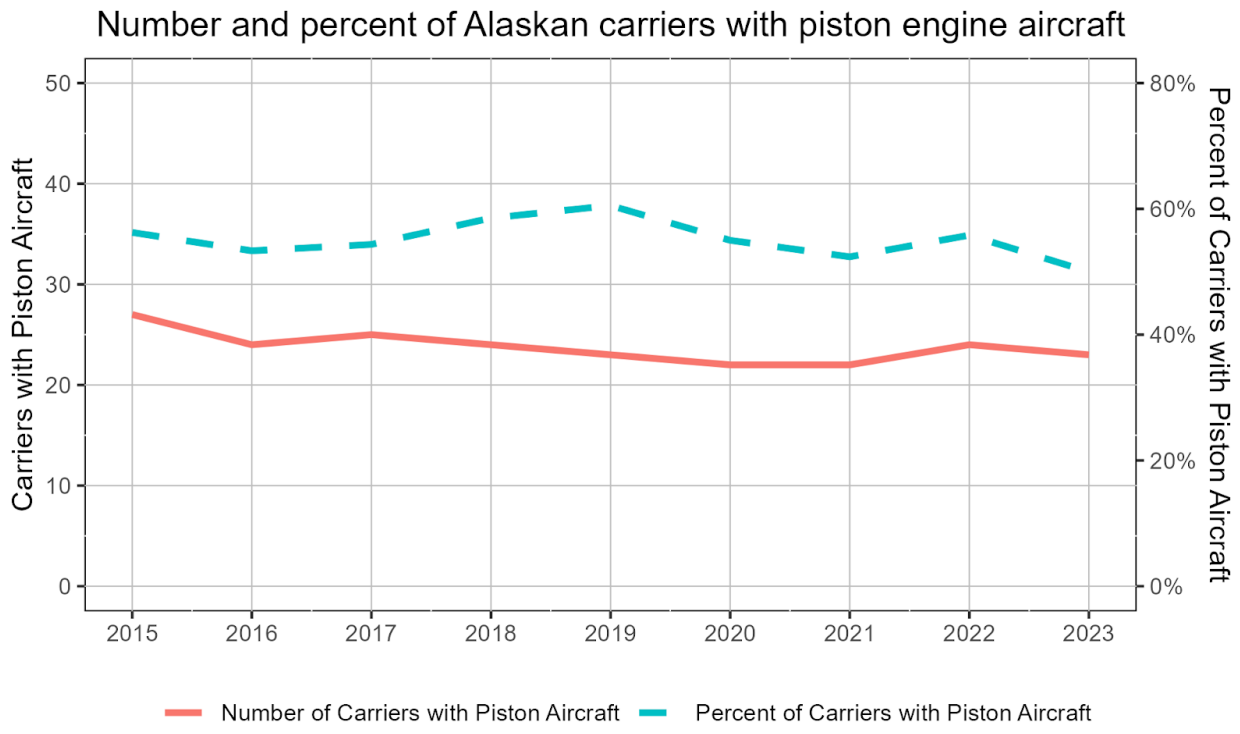
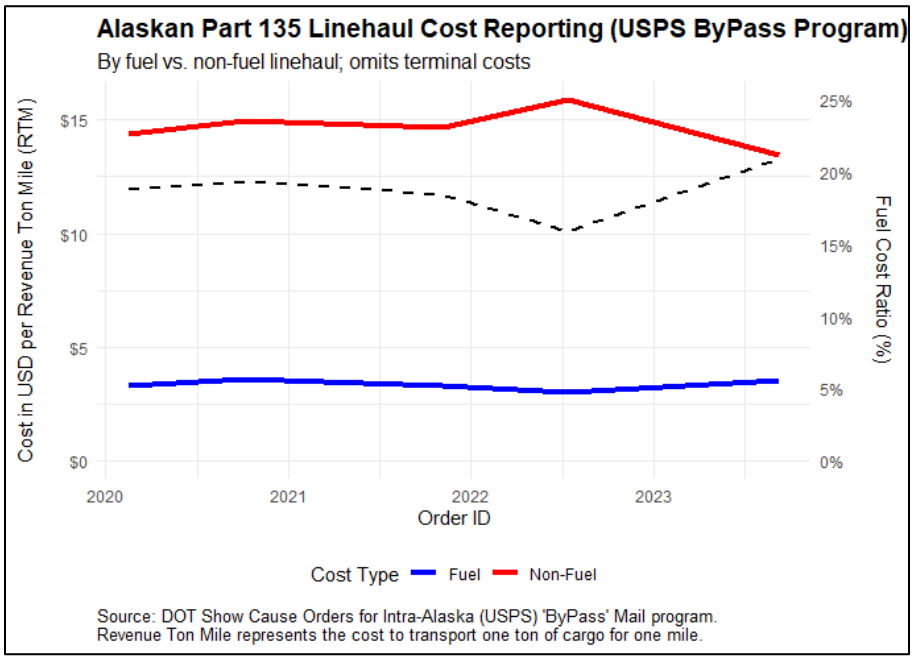
7 SUPPLEMENTAL FIGURES AND TABLES:

Supp. Fig. 1:



Supp. Fig. 2:



Supp. Table 1: (2023) Full destination/community breakdown of piston engine market share for flights, passengers, and cargo along with raw total deliveries across all engine types. *Sorted in descending order of piston flight market share and total flights. Multiple airports per BTS-defined destination 'city' name have been combined.*

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Kodiak Isl.	100%	100%	100%	1107	1408	5484
Brooks Lodge	100%	100%	100%	1040	5602	115971
Metlakatla	100%	100%	100%	816	548	451075
Healy	100%	100%	100%	688	1822	69594
McCarthy	100%	100%	100%	376	452	219144
Thorne Bay	100%	100%	100%	366	299	290655
Hollis	100%	97%	100%	211	146	178353
Skwentna	100%	100%	100%	158	105	65260
Kitoi Bay	100%	100%	100%	156	124	49772
Craig	100%	100%	100%	150	90	143830
Seal Bay	100%	100%	100%	145	161	19432
False Pass	100%	100%	100%	141	84	49869
Coffman Cove	100%	100%	100%	128	34	152030
Edna Bay	100%	100%	100%	125	75	120569
Chisana	100%	100%	100%	116	125	44121
Lazy Bay	100%	100%	100%	95	92	9554
Amook Bay	100%	100%	100%	94	84	14305
May Creek	100%	100%	100%	94	19	4569
Olga Bay	100%	100%	100%	91	172	5202
Whale Pass	100%	100%	100%	88	12	83416
Port Alexander	100%	100%	100%	84	107	3870

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Chinitna Bay	100%	100%	0%	82	297	0
Kizhuyak	100%	100%	100%	80	76	3026
Zachar Bay	100%	100%	100%	80	68	5082
Port Bailey	100%	100%	100%	74	79	8218
Naukiti	100%	100%	100%	72	24	35552
West Point	100%	100%	100%	72	94	7336
Port Protection	100%	100%	100%	71	23	59702
Port Williams	100%	100%	100%	70	35	5109
Mertarvik	100%	100%	100%	69	114	10904
Uganik	100%	100%	100%	69	72	9015
Hydaburg	100%	100%	100%	65	1	32794
Moser Bay	100%	100%	100%	64	81	4935
Hyder	100%	100%	100%	57	63	32765
Point Baker	100%	100%	100%	57	12	33001
Kasaan	100%	100%	100%	51	4	41224
Fairbanks/Ft. Wainwright	100%	100%	100%	47	91	2029
Kiliuda Bay	100%	100%	100%	45	91	2654
Pogo Mines	100%	100%	0%	44	48	0
Port Armstrong	100%	100%	100%	28	46	1285
Hallo Bay	100%	100%	100%	25	78	675
Meyers Chuck	100%	100%	100%	25	2	11856
Cooper Lodge	100%	100%	100%	21	45	1279

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Silver Salmon Creek	100%	100%	0%	21	76	0
Eagle Harbor	100%	100%	100%	20	21	1483
Onion Bay	100%	100%	0%	18	23	0
Dora Bay	100%	100%	100%	15	7	2819
Karluk Lake	100%	100%	0%	10	19	0
Little Port Walter	100%	100%	100%	10	12	237
Big Bay	100%	100%	100%	9	8	20
Baranof	100%	100%	100%	7	13	40
Blue Fox Bay	100%	100%	100%	7	3	910
Deerpark	100%	100%	100%	7	6	812
Afognak Lake	100%	100%	100%	6	1	406
Chomondely Sound	100%	100%	0%	6	14	0
Karluk Portage	100%	100%	0%	6	16	0
Lime Village	100%	100%	0%	6	20	0
Red Lake	100%	100%	0%	6	2	0
Kiavak	100%	100%	0%	5	5	0
Terror Lake	100%	100%	0%	5	4	0
Kantishna	100%	100%	0%	4	6	0
Malina Bay	100%	0%	0%	4	0	0
Naknek	100%	100%	0%	4	4	0
Port Vita	100%	100%	100%	4	2	1178
Village Islands	100%	100%	0%	4	7	0

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Ganes Creek	100%	0%	100%	3	0	53746
Hog River	100%	100%	0%	3	2	0
Laura Lake	100%	100%	100%	3	9	743
Red Fox Bay	100%	100%	100%	3	9	23
Minchumina	100%	100%	100%	2	2	11695
Sparrevohn	100%	0%	100%	2	0	24761
Wiseman	100%	0%	0%	2	0	0
Afognak Straits	100%	0%	0%	1	0	0
Funter Bay Alaska	100%	0%	0%	1	0	0
Port Hobron	100%	0%	0%	1	0	0
Tetlin	100%	100%	0%	1	2	0
Tracy Arm	100%	0%	0%	1	0	0
Seldovia	99%	99%	100%	2286	4512	339892
Nanwalek	99%	99%	100%	1619	3605	246570
Port Graham	99%	100%	100%	1479	3493	240910
Tyonek	99%	100%	92%	1218	1708	359668
Manley Hot Springs	99%	98%	100%	247	525	89089
Pack Creek	99%	100%	0%	122	319	0
Chicken	99%	100%	100%	102	42	12295
Deadhorse1	98%	100%	62%	44	13	86238
Atmautluak	97%	96%	85%	2108	3405	539913
Akiak	97%	99%	71%	1446	2248	178084
Tuluksak	97%	99%	65%	1353	2179	178450

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Tok	97%	89%	99%	1293	1005	81633
Napakiak	97%	99%	85%	1136	1169	232256
King Cove	97%	86%	100%	436	629	295358
Trading Bay	97%	100%	0%	267	294	24766
Central	97%	96%	100%	235	188	41173
Kasigluk	96%	96%	81%	2277	4019	321952
Napaskiak	96%	98%	73%	867	955	154640
Circle	96%	85%	99%	255	335	66399
Nelson Lagoon	96%	54%	100%	131	59	108241
Nunapitchuk	95%	94%	78%	2069	3704	284775
Akiachak	95%	98%	67%	1965	3148	238968
Ouzinkie	95%	85%	90%	936	1265	194549
Kwethluk	94%	95%	64%	1611	2696	220176
Port Lions	93%	84%	83%	894	1184	202673
Danger Bay	93%	73%	96%	398	387	109927
Goodnews Bay	92%	99%	73%	954	911	571507
Nikolski	91%	91%	96%	137	150	81111
Rampart	90%	81%	88%	336	751	113120
Chuathbaluk	90%	79%	69%	244	272	91202
Platinum	89%	96%	19%	437	524	323986
Minto	89%	80%	94%	271	675	119634
Port Alsworth	87%	41%	93%	410	432	96380
Stevens Village	87%	90%	83%	203	546	77378
Sheldon Point	86%	64%	75%	1317	1705	468124

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Beaver	86%	87%	91%	397	1095	174177
Sitkinak	86%	64%	70%	22	25	3964
Alakanuk	85%	63%	73%	2625	3772	1164954
Pedro Bay	85%	40%	75%	111	102	27540
Tuntutuliak	84%	73%	64%	4228	7318	1768964
Ugashik	84%	74%	60%	394	224	81966
Igiugig	84%	53%	87%	277	239	60204
Pilot Station	81%	60%	73%	2602	4072	1304962
Coldfoot	81%	84%	3%	1225	6989	90790
Newtok	81%	70%	53%	1190	2003	533980
South Naknek	81%	49%	79%	234	204	77799
Kotlik	80%	50%	67%	2627	3800	1482444
Russian Mission	79%	93%	18%	1463	2327	878056
Nondalton	77%	24%	84%	364	497	109344
Karluk	77%	54%	64%	240	274	90414
Stony River	77%	87%	34%	105	76	48537
Red Devil	76%	79%	55%	91	47	39284
Cape Newenham	76%	47%	98%	33	30	29693
Emmonak	75%	46%	1%	6051	10085	5404251
Marshall	75%	57%	49%	2113	3819	1039203
Excursion Inlet	75%	67%	49%	12	18	1818
Eek	74%	54%	51%	1987	4190	785298
Beluga	74%	75%	71%	943	1344	238329

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Ketchikan	72%	7%	8%	17997	102410	8087524
Kalskag	72%	73%	25%	1457	2383	846600
Pilot Point	72%	51%	54%	702	694	325590
Crooked Creek	71%	73%	24%	652	554	568042
Akhiok	70%	49%	51%	373	691	126798
Levelock	70%	40%	69%	364	600	75436
Sleetmute	70%	70%	30%	242	219	130933
Kongiganak	69%	44%	51%	1950	3782	1052461
Old Harbor	69%	43%	54%	926	2197	327041
Larsen Bay	68%	42%	53%	1165	2958	278591
Nightmute	68%	49%	51%	948	2169	358463
Homer	67%	23%	2%	6357	30791	801581
Egegik	65%	45%	46%	581	916	192941
Bethel	64%	26%	0%	38946	159381	47901178
St. Mary's	64%	21%	1%	2892	6889	4754625
Kwigillingok	64%	43%	42%	1536	3155	853951
Cape Romanzof	62%	28%	32%	32	39	703
Keyes Point	62%	4%	96%	13	26	56841
Tununak	60%	40%	35%	1230	2455	793317
Holy Cross	59%	53%	26%	483	499	406700
Quinhagak	58%	38%	33%	2496	5521	1535583
Kodiak	57%	6%	14%	6427	84996	5594542
Mountain Village	57%	37%	41%	1452	4232	51504

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Anvik	55%	33%	21%	274	486	175579
Grayling	54%	57%	12%	459	450	398021
Chefornak	53%	29%	38%	1711	4279	915926
Gulkana	53%	48%	64%	357	363	4040
Shageluk	53%	45%	23%	349	364	297673
Port Moller	52%	2%	89%	101	295	19308
Toksook	50%	32%	25%	1812	3824	1611517
Northway	50%	33%	0%	2	12	0
Kipnuk	48%	25%	26%	2086	5302	1516105
Cold Bay	47%	8%	3%	1502	7762	1377680
Aniak	46%	22%	7%	3073	5213	5065223
Koliganek	46%	31%	25%	671	1468	302948
Ekwok	46%	28%	31%	588	1378	245787
King Salmon	41%	16%	1%	5554	39457	7865722
Manokotak	41%	25%	22%	898	1759	790254
Iliamna	40%	10%	3%	1772	3258	1341583
Clarks Point	40%	27%	25%	472	1115	91665
Elfin Cove	40%	22%	16%	265	382	49060
Candle	40%	0%	96%	5	0	52136
Kokhanok	39%	9%	37%	539	1585	204187
Pelican	39%	25%	26%	531	1228	139096
Tenakee	39%	23%	25%	358	752	108112
New Stuyahok	36%	23%	18%	976	2144	738563
Angoon	35%	21%	24%	816	2138	199505

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Lake Minchumina	35%	13%	17%	129	221	97519
Kulik Lake	34%	22%	10%	261	787	94016
Soldotna	31%	0%	0%	13	26	0
Akun	30%	41%	77%	1585	2295	190661
Dillingham	27%	7%	1%	5968	34738	12902303
Deadhorse	25%	1%	2%	3124	83850	8170149
Unalaska	25%	5%	0%	2533	17972	2113501
Utopia	25%	0%	50%	8	10	15637
Nenana	25%	0%	0%	4	6	645
Nuiqsut	24%	8%	17%	7116	22314	6511878
Bornite/Ruby Creek	24%	25%	3%	25	16	15381
Tatalina	23%	4%	0%	22	47	27890
Ivotuk	23%	37%	8%	13	30	6343
Chandalar	21%	11%	0%	29	73	18130
Fairbanks	20%	3%	40%	16443	232496	8570404
Palmer	20%	0%	0%	5	4	0
Port Heiden	19%	4%	11%	477	810	468711
Flat	18%	100%	0%	11	5	150714
Scammon Bay	17%	13%	1%	1643	4843	1418311
Unalakleet	16%	1%	6%	3349	10726	6842513
Mekoryuk	16%	15%	2%	468	1254	512894
Seward	14%	0%	0%	7	7	90
Hooper Bay	13%	9%	1%	2154	5676	2616644

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Chevak	13%	10%	1%	2020	6127	2274124
Togiak	13%	7%	6%	1272	3249	1525229
Stebbins	13%	0%	10%	1260	3864	1192889
Twin Hills	12%	6%	7%	571	1744	162841
Dahl Creek	12%	1%	79%	88	263	228919
Nyac	12%	27%	0%	24	15	131260
St. Michael	11%	1%	7%	1297	4065	1499135
Shaktoolik	11%	1%	10%	1036	2640	800871
Kenai	10%	4%	1%	9106	64463	2343180
Prospect Creek	10%	0%	0%	134	743	3085
Hoonah	9%	2%	3%	1384	6065	774971
Koyuk	9%	1%	8%	1083	3219	963836
McGrath	9%	1%	69%	765	2679	1455743
Hughes	9%	3%	2%	470	1909	421532
Chalkyitsik	9%	3%	0%	235	952	222547
Umiat	9%	3%	8%	45	77	24435
Anchorage	8%	1%	5%	38033	873569	32554423
Juneau	8%	1%	0%	13651	266206	19641989
Galena	7%	2%	58%	2807	12462	3175716
Fort Yukon	7%	7%	4%	1666	6797	1432804
Kaktovik	7%	0%	9%	856	2167	993836
Allakaket	7%	1%	15%	662	2658	707666
Bettles	7%	1%	5%	641	2998	345502
Tanana	7%	2%	1%	465	2013	353465

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Birch Creek	7%	3%	1%	220	806	156886
Donlin Creek Mine	7%	100%	0%	15	2	379486
Skagway	6%	1%	0%	1305	5327	926342
Gustavus	6%	1%	1%	1234	9112	494744
Koyukuk	6%	2%	11%	353	1397	250371
Venetie	5%	1%	30%	842	2917	1392490
Eagle	5%	2%	0%	253	609	217208
Kavik River	4%	0%	0%	51	89	24617
Ruby	3%	1%	1%	793	3378	444510
Arctic Village	3%	1%	24%	756	2455	725101
Kaltag	3%	1%	0%	556	2031	392651
Takotna	3%	2%	0%	196	503	132798
Port Clarence	3%	0%	0%	33	51	6146
Sitka	2%	0%	0%	4330	97523	10418791
Haines	2%	1%	0%	1647	7709	1028509
Anaktuvuk Pass	2%	0%	12%	1040	3545	1561873
Huslia	2%	1%	0%	1009	3805	766876
Nulato	2%	1%	0%	844	3409	579529
Chignik	2%	2%	0%	542	778	384600
Nome	1%	0%	0%	9331	77900	27882554
Barrow	1%	0%	0%	3880	41629	18642852
Petersburg	1%	0%	0%	1596	55388	2099915
Shishmaref	1%	1%	0%	1246	3842	1758378

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Elim	1%	1%	0%	1151	3829	1058844
Kake	1%	0%	0%	1133	3886	346510
Brevig Mission	1%	1%	0%	1105	3571	1084302
Golovin	1%	1%	0%	965	3523	675088
White Mountain	1%	2%	0%	941	3503	760239
Teller	1%	1%	0%	819	2908	638824
Kobuk	1%	0%	3%	749	2845	827360
Wales	1%	0%	0%	691	2262	759647
Point Lay	1%	0%	1%	623	1544	814834
Galbraith Lake	1%	1%	0%	67	665	2126
Kotzebue	0%	0%	0%	10269	77499	23829505
Klawock	0%	0%	0%	3263	17500	814256
Wainwright	0%	0%	0%	2864	8234	4443334
Point Hope	0%	0%	1%	1602	4558	2673453
Selawik	0%	0%	0%	1439	4619	2101207
Noorvik	0%	0%	0%	1401	4920	1539880
Buckland	0%	0%	0%	1357	4427	1603617
Savoonga	0%	0%	0%	1277	4707	1974488
Noatak	0%	0%	0%	1265	4561	1515810
Gambell	0%	0%	0%	1241	4575	1895788
Kivalina	0%	0%	0%	1230	4456	1375943
Wrangell	0%	0%	0%	1224	59845	1649332
Kiana	0%	0%	0%	1191	4686	1009752
Cordova	0%	0%	0%	1110	34532	2616958

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Akutan	0%	0%	0%	1047	1311	138839
Yakutat	0%	0%	0%	1047	27121	2505619
Sandpoint	0%	0%	0%	996	7092	1932276
Ambler	0%	1%	0%	969	3606	725492
Atqasuk	0%	0%	6%	969	3702	908486
Shungnak	0%	0%	0%	949	3310	805303
Red Dog	0%	0%	0%	899	15217	6036623
Wasilla	0%	0%	0%	882	1512	0
Deering	0%	0%	0%	825	3053	569030
Delta Junction	0%	0%	0%	504	768	26940
St. Paul	0%	0%	0%	380	1932	782043
Nikolai	0%	0%	3%	322	1148	256949
Valdez	0%	0%	0%	285	4238	20334
Tatitlek	0%	0%	0%	231	588	140488
St. George Island	0%	0%	0%	222	332	125722
Perryville	0%	0%	0%	219	299	218478
Alpine	0%	0%	0%	218	0	7620963
Chignik Lagoon	0%	0%	0%	212	188	169457
Atka	0%	0%	0%	194	336	128866
Chenega	0%	0%	0%	190	519	68762
Chignik Bay	0%	0%	0%	177	176	122715
Adak Island	0%	0%	0%	113	2184	187395
Cape Lisburne	0%	0%	0%	61	127	99471
Lost River	0%	0%	0%	51	80	114190

Destination City Name	Piston % Flights	Piston % Passengers	Piston % Freight/Mail	Total Flights (All Engines)	Total Pax (All Engines)	Total Freight/Mail (All Engines)
Tin City	0%	0%	0%	49	166	13369
Diomede Island	0%	0%	0%	46	213	10095
Katmai Lodge	0%	0%	0%	20	245	23556
Kougarok	0%	0%	0%	19	0	57201
Paxson	0%	0%	0%	10	7	0
Corner Bay	0%	0%	0%	8	12	0
Middleton Island	0%	0%	0%	6	19	7071
Livengood	0%	0%	0%	5	4	330
Talkeetna	0%	0%	0%	5	9	0
Dry Bay	0%	0%	0%	3	0	11210
Farewell	0%	0%	0%	3	0	11743
Illinois Creek	0%	0%	0%	3	0	126941
Kuparuk	0%	0%	0%	3	0	13080
Bible Camp	0%	0%	0%	2	0	2388
False Island	0%	0%	0%	2	2	0
Lonely	0%	0%	0%	2	5	630
Portage Creek	0%	0%	0%	2	0	0
Hogatza	0%	0%	0%	1	0	1850
Nixon Fork Mine	0%	0%	0%	1	0	3051
Tintina	0%	0%	0%	1	0	2608

Suppl. Table 2: Per gallon fuel cost estimates for piston aircraft, as estimated from DOT Show Cause Orders and Quarterly Fuel Updates for the Intra-Alaska Bypass Mail Program

OrderID	Sub-cat	Cost Type	Cost subtype	Carrier ID	Aircraft Desc	Model	Total Fuel ($)	Total Fuel (gal)	Est ($/gal)
2023-09-08	Part135	Linehaul	Fuel	1	Cessna C206/207/209/210 Stationair	C-207	$661,601	92,347	$7.16
2023-09-08	Part135	Linehaul	Fuel	2	Cessna C206/207/209/210 Stationair	C-207	$669,738	101,383	$6.61
2023-09-08	Part135	Linehaul	Fuel	3	Cessna C206/207/209/210 Stationair	C-207	$1,332,976	245,990	$5.42
2023-09-08	Seaplane	Linehaul	Fuel	4	De Havilland DHC2 Beaver	Beaver	$272,605	38,838	$7.02
2023-09-08	Seaplane	Linehaul	Fuel	5	De Havilland DHC2 Beaver	Beaver	$494,465	59,280	$8.34
2023-09-08	Seaplane	Linehaul	Fuel	6	De Havilland DHC2 Beaver	Beaver	$278,080	43,364	$6.41
2023-09-08	Seaplane	Linehaul	Fuel	6	De Havilland DHC3 Otter	Otter	$232,284	49,946	$4.65
2023-09-08	Part135	Linehaul	Fuel	1	Gipps Aero Ga8 Airvan	GA 8	$864,655	123,459	$7.00
2022-07-15	Part135	Linehaul	Fuel	1	Cessna C206/207/209/210 Stationair	C-207	$635,901	94,628	$6.72
2022-07-15	Part135	Linehaul	Fuel	2	Cessna C206/207/209/210 Stationair	C-207	$598,042	99,488	$6.01
2022-07-15	Part135	Linehaul	Fuel	3	Cessna C206/207/209/210 Stationair	C-207	$1,087,682	153,595	$7.08

OrderID	Sub-cat	Cost Type	Cost subtype	Carrier ID	Aircraft Desc	Model	Total Fuel ($)	Total Fuel (gal)	Est ($/gal)
2022-07-15	Seaplane	Linehaul	Fuel	4	Cessna C206/207/209/210 Stationair	C-206/7/8	$79,452	15,922	$4.99
2022-07-15	Seaplane	Linehaul	Fuel	4	De Havilland DHC2 Beaver	Beaver	$181,657	35,857	$5.07
2022-07-15	Seaplane	Linehaul	Fuel	5	De Havilland DHC2 Beaver	Beaver	$289,360	52,286	$5.53
2022-07-15	Seaplane	Linehaul	Fuel	6	De Havilland DHC2 Beaver	Beaver	$171,234	42,548	$4.02
2022-07-15	Seaplane	Linehaul	Fuel	6	De Havilland DHC3 Otter	Otter	$83,393	33,658	$2.48
2022-07-15	Part135	Linehaul	Fuel	1	Gipps Aero Ga8 Airvan	GA 8	$665,239	98,993	$6.72
2022-07-15	Part135	Linehaul	Fuel	7	Piper PA-31 (Navajo)/T-1020	Navajo	$345,582	73,709	$4.69