Considering Feasibility of Electric Aircraft at a Regional Scale

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Abstract

As interest in electric aircraft accelerates across industry and government, understanding where and how these systems can be feasibly deployed is essential for guiding infrastructure investment and regulatory planning. This paper presents a regional-scale feasibility analysis of electric aircraft adoption, using data from FAA aircraft registrations, ADS-B flight logs, and airport power availability metrics in the state of Utah. We evaluate the suitability of electric aircraft for various use cases, including recreational, instructional, air taxi, and small cargo operations. Our findings indicate that instructional aviation is the most immediately viable application, with current electric aircraft capable of fulfilling the majority of relevant flight routes using infrastructure at a single airport. We further identify regional airports with favorable energy and capacity profiles to support near-term deployment. By combining real-world operational data with infrastructure analysis, this study provides a practical framework for identifying high-leverage opportunities in early-stage electric aviation.

1 Introduction

The electrification of aviation presents an emerging opportunity to reshape regional air transportation, reduce emissions, and improve operational economics. While several companies are advancing electric aircraft across light sport, air taxi, and commuter segments, the widespread adoption of these technologies hinges on the readiness of supporting infrastructure and informed decision-making by airport operators and policy stakeholders. As electric aircraft transition from prototype to production, regional airports and aviation schools are uniquely positioned to serve as early adopters and testing grounds for commercial viability.

To facilitate effective planning, airport authorities and regulators must anticipate the infrastructure needs associated with electric aviation, including power delivery capacity, charging logistics, and integration with existing flight operations. Additionally, understanding where electric aircraft can feasibly operate today-and which use cases offer the clearest path to adoption-is essential for aligning investment priorities with near-term benefits [1].

We aim to support those planning efforts by evaluating the feasibility of electric aircraft adoption through a regional lens. Drawing on analogies from the early adoption of electric vehicles (EVs) in the 2010s, we examine patterns of technology diffusion and identify where similar trends may emerge in aviation. Like EVs, electric aircraft face challenges in range, cost, and support infrastructure, but also offer compelling advantages in operational simplicity, noise reduction, and reduced emissions. Technology adoption in these contexts often follows a characteristic S-curve, where early adopters trigger broader interest until the market eventually matures and saturates [2], [3].

We anchor our analysis in the context of Utah's regional airport system, using FAA registration data, ADS-B flight logs, and local infrastructure rankings to estimate the current readiness for electrification. In particular, we identify *flight training and instructional aviation* as a high-potential entry point for deploying electric aircraft. These operations are typically short-range, originate and return to a single location, and are cost-sensitive, making them well-suited for the operational characteristics of today's electric aircraft.

By focusing on infrastructure readiness, aircraft use cases, and adoption dynamics, this study provides actionable insights for airport planners, public utilities, and industry stakeholders seeking to make informed investments in the next generation of aviation.

2 Feasibility of Electric Aviation

Feasibility studies on electric aircraft span a wide methodological spectrum from engineering models and range simulations to high-level infrastructure assessments. This section reviews prior work that informs the technical constraints, use case feasibility, and infrastructure requirements relevant to regional electric aviation.

Kammermann et al. [7] conducted one of the foundational modeling studies examining both hybrid and fully electric aircraft. Their work evaluated aircraft configurations based on component weight, power consumption, and achievable range. Their work concluded that, as of 2020, the technology was not yet feasible for broad commercial deployment without major improvements in energy storage density.

Zilliac et al. [8] extended this analysis to large-scale commercial aviation by assessing a 150-passenger electric aircraft. Their study modeled future battery innovation curves and aircraft configurations to estimate the viability of high-capacity, long-range electric aircraft, emphasizing the dependency on substantial improvements in watt-hours per kilogram performance.

On a smaller scale, Estrada Rodas et al. [9] investigated the feasibility of air taxi operations using electric aircraft with capacities ranging from 2 to 6 passengers. Their vehicle-sizing analysis found that while two-seat electric aircraft were viable under existing battery constraints, four- and six-seat models would require prohibitively large batteries, severely limiting their practicality.

From an infrastructure perspective, Doctor et al. [10] explored the implications of electric aircraft on airport operations. Using simulation tools, they modeled charger allocation strategies to support various traffic loads, highlighting the spatial and power planning required for electrified aviation.

Schäfer et al. [11] conducted a first-order environmental and economic assessment of all-electric aircraft. Their work underscored benefits such as reduced noise pollution and direct emissions, and notes that widespread adoption would require significant improvements. These are primarily due to battery energy density, relatively low jet fuel costs, and shifting the economic balance away from traditional combustion-based aviation.

Together, these studies outline the key technical and infrastructural thresholds that must be addressed to enable viable electric aviation. However, few works to date have applied these insights at a regional planning scale or evaluated feasibility by integrating current aircraft capabilities, airport readiness, and real-world flight behavior. Our work aims to fill that gap by using Utah's airport network and flight patterns as a case study for near-term adoption potential.

Figure 1: In development and currently available electric aircraft. From left to right, Bye eFlyer2 [4], Beta CTOL [5], Electra EL9 [6], and the CCS charging interface for a BETA aircraft [5].

3 Adoption Dynamics and Early Market Signals

3.1 Lessons from Early Electric Vehicle Adoption

The emergence of electric aviation mirrors the trajectory of electric vehicles (EVs) in the late 2000s and early 2010s. Both industries must overcome skepticism about reliability, range, and infrastructure while operating in highly regulated and safety-sensitive domains. Tesla's Model S launch serves as a landmark case of how effective product positioning and brand identity can accelerate adoption. Tesla's early adopters were environmentally motivated and willing to pay a premium for cutting-edge technology, even in the absence of widespread charging infrastructure [12].

Electric aircraft companies such as BETA Technologies, Electra, and Joby Aviation are beginning to occupy a similar space. These firms are targeting performance, innovation, and operational simplicity over mass affordability. However, they must still address longstanding concerns such as range anxiety, component longevity, repairability, and total cost of ownership [13]. These will be particularly relevant for operators like aviation schools and air-taxi services that rely on tightly scheduled, high-utilization vehicles.

3.2 Indicators from Failed EV Companies

Historical failures in the early EV market offer cautionary lessons for aviation. Companies like Fisker and Modec entered the market with ambitious plans but failed due to a combination of technical immaturity, high production costs, and weak demand. Fisker's Karma-a plug-in hybrid sports car-faced battery failures and an unclear market niche despite substantial funding [14], [15]. Modec, focused on commercial delivery vans, produced only a few hundred units before collapsing due to low sales volume and expensive production [16].

These cases underscore the difficulty of bridging R&D and scalable manufacturing in a new market. For electric aviation, early deployments must match product capability with operational demand, particularly in segments like flight instruction, where lower speed, short-range aircraft are both appropriate and cost-effective.

3.3 Current Electric Aircraft Offerings

Most electric aircraft currently in development fall into the light sport or short-haul class (Table 1). With flight durations between 1-4 hours and small passenger capacities, these aircraft are well-suited for use in training, private instruction, and short-range point-to-point services.

Table 1: Electric aircraft in development or available.

Make-Model	Payload	Flight-time	Source
LGAA RX1E-A/S	2 passengers	1.5 hr	[17]
LGAA RX1E	2 passengers	1 hr	[18]
LGAA RX4E	4 passengers	1.5 hr	[19]
Pipistrel Velis Electro	2 passengers	50 min	[20]
Diamond Aircraft eDA40	2-3 passengers	1.2 hr	[20]
Beta ALIA A250 VTOL	5 passengers	N/A	[5]
Beta ALIA CX300 CTOL	5 passengers	3.6 hr	[5]
Bye Aerospace eFlyer 2	2 passengers	3.5 hr	[4]
Bye Aerospace eFlyer 4	4 passengers	4 hr	[4]
Electra EL9	9 passengers	N/A	[6]

Notable offerings include the Bye Aerospace eFlyer 2 (3.5 hours), Diamond Aircraft eDA40 (1.2 hours), and Pipistrel Velis Electro (50 minutes). Some, such as the BETA ALIA series and Electra EL9, target emerging air taxi and regional mobility markets.

Flight schools represent a desirable early market. Their predictable operations, short route profiles, and single-airport infrastructure needs make electrified fleets logistically and economically viable. The lower operational costs and maintenance burden of electric propulsion, combined with potential exemptions from FAA noise constraints [21], [22], further strengthen this case. Regional airports that host flight training programs can serve as strategic starting points for the deployment of electrified aviation.

4 Analysis of Regional Aviation Electrification

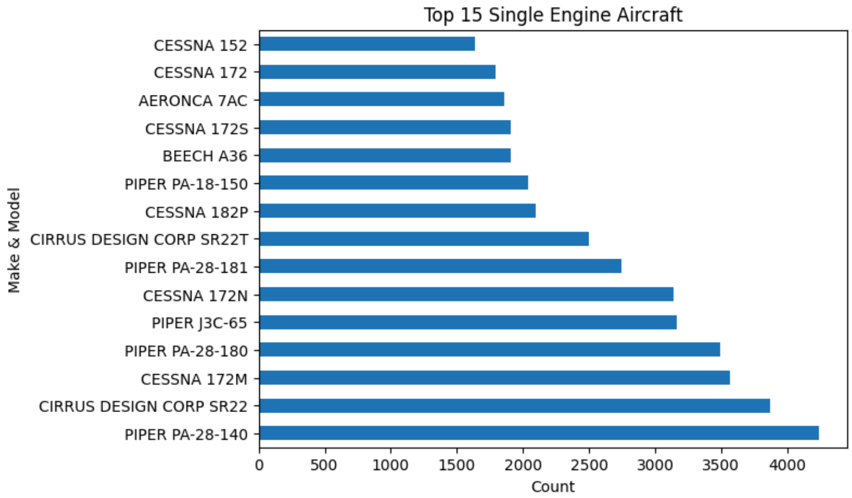
To assess the near-term feasibility of electric aircraft adoption, we examine the current landscape across three domains: (1) aircraft registrations and market segmentation, (2) flight activity patterns relevant to regional aviation, and (3) power availability at regional airports. These analyses provide insight into which use cases and geographies offer the clearest opportunities for electrified aviation adoption.

4.1 Current Aircraft Registrations

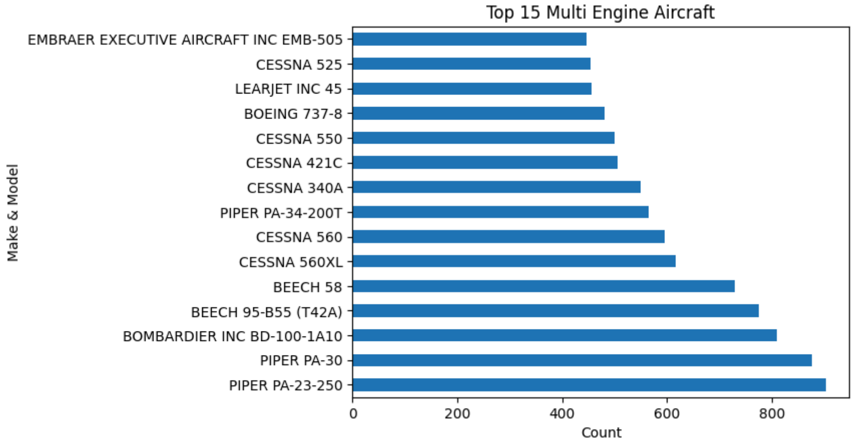
Understanding the distribution of currently registered aircraft provides essential context for identifying realistic pathways to the adoption of electric aircraft. We use FAA aircraft registration data [23] to examine fleet composition across the United States and determine which market segments are most relevant for electrification efforts.

Figure 2 displays the top 15 aircraft by registration count in the single- and multi-engine classes. The fixed-wing single-engine category dominates in volume, accounting for over 70% of the total registered fleet. This segment is primarily composed of hobbyist and instructional aircraft, which are relatively affordable and easier to maintain. Multi-engine aircraft, while less common, support operations such as charter and regional freight. Most of the aircraft in these top categories are 20-40 years old (see Figure 4) and use conventional fuel systems, indicating long asset lifespans and the market's resistance to rapid fleet turnover. Nonetheless, these categories present a feasible target for electrification if supported by cost-effective infrastructure and suitable aircraft offerings.

Electric aircraft currently represent just 2.5% of all FAA-registered aircraft, with most in the rotorcraft category. Adoption of fixed-wing electric aircraft, such as the Pipistrel Velis Electro, remains



(a) Top 15 single-engine aircraft by registration count.



(b) Top 15 multi-engine aircraft by registration count.

Figure 2: Top 15 aircraft by registration count in the single- and multi-engine aircraft classes. Most aircraft represented have a manufacture date from 20-40 years ago, showing the expected lifespan of aircraft in these classes. Additionally, all aircraft represented have highly conventional designs and utilize traditional aircraft fuel.

limited. Notably, most of these early electric aircraft are registered to LLCs, suggesting either high entry costs or low demand among private individuals.

The dominance of single-engine fixed-wing aircraft, particularly among flight schools, reinforces their potential as a launch point for electric aircraft adoption. These aircraft operate in short, repeatable patterns and are serviced from a single airport, making them ideal candidates for early infrastructure investment. Proportions of aircraft types can be observed in Figure 3.

4.2 Flight Electrification Analysis

Using data collected from ADS-B records, we were able to collect many flight logs from aircraft arriving at Utah airports. Our dataset covers instructional, recreational, commercial, and cargo transport flights between March 18, 2024 and March 24, 2024. With these parameters, we obtained 5,911 records. After filtering out flights that exceeded 5,000 miles in length, we were left with 5,736 records. Using this dataset, we can derive

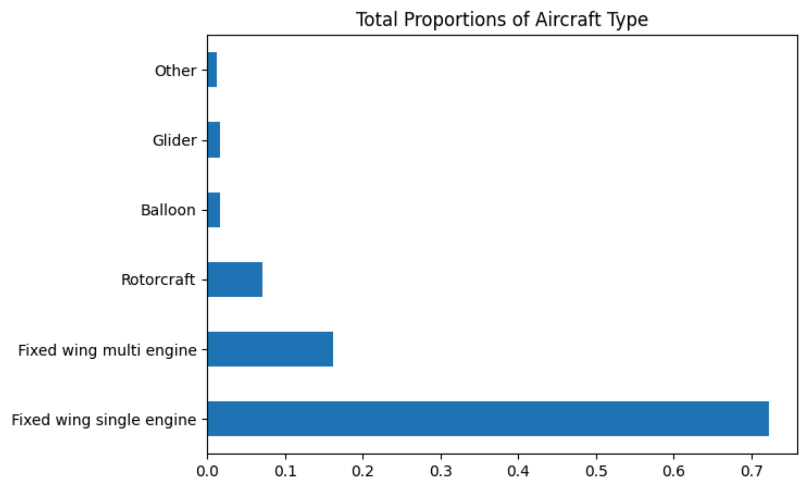


Figure 3: Distribution of aircraft type across the entire FAA registration dataset. Total aircraft registered in the dataset is 299,888. Of those registrants, 216,520 are fixed-wing single-engine, 48,447 are multi-engine, 21,383 are rotorcraft, and 5,082 are balloons.

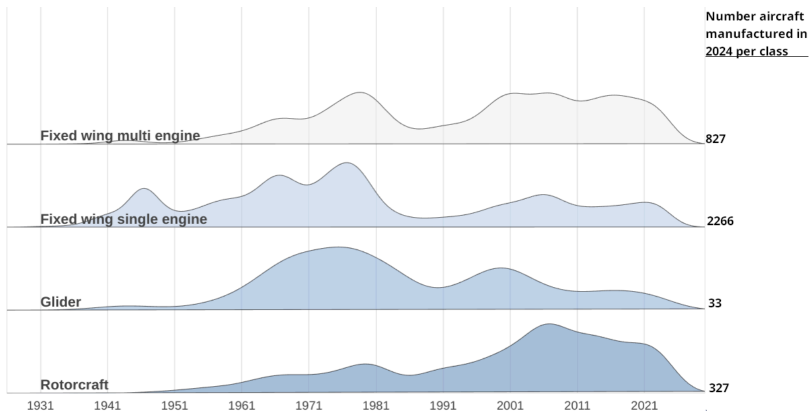


Figure 4: Distribution of aircraft age present in the FAA registration dataset for aircraft classes currently targeted by electrification efforts. The size of each distribution displayed is relative to its own range. We can observe a dip in manufacturing across all classes shown between the late 1980s and early 1990s.

some metrics on the feasibility of electrifying existing flight routes.

When reviewing the entire dataset as shown in Figure 5, we see that the aircraft with the highest proportion of flights recorded was the BETA CTOL, which could theoretically perform 57% of the 5,736 flights under consideration (assuming all infrastructure is in place to facilitate the route). This is an optimistic figure and represents the best-case scenario with present-day technology. Looking at aircraft that follow the traditional fixed-wing single-engine design, we see the Diamond eDA40 could facilitate 38% of flights, and the Bye eFlyer 2 has sufficient range for 53% of all flights considered.

We specifically examined the instructional aviation use case, as these flights typically begin and end at the same airport, making them uniquely suited for early electrification, requiring infrastructure installation at only one location. Leveraging the FAA registration dataset, we identified 191 aircraft associated with flight instruction based on their N-numbers (as seen in Figure 6). Filtering our ADS-B flight log dataset to include only flights operated by this instructional fleet, we isolated 924 flight records that likely correspond to training activities. Based on current electric aircraft specifications, we estimate that the BETA CTOL could feasibly perform 98% of these flights, while the Diamond eDA40 and Bye Aerospace eFlyer 2 could cover 68% and 94% of the routes, respectively. These results highlight the high

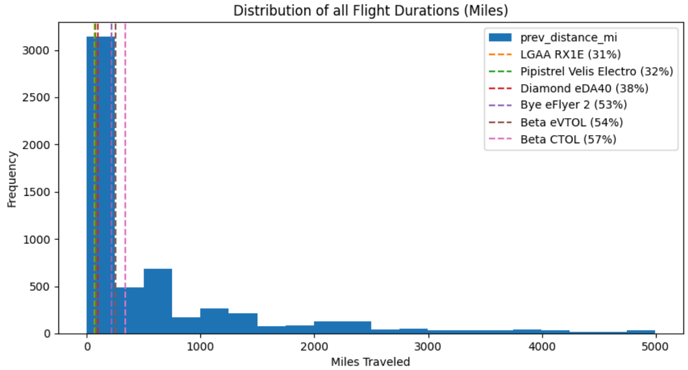


Figure 5: Distribution of distance for all flights considered. Vertical dotted lines represent the range of each respective aircraft. As indicated by this plot, anything beyond regional travel will not be feasible for current electric aircraft. When range is not provided by the manufacturer, it is approximated as the product of the cruise speed and flight duration.

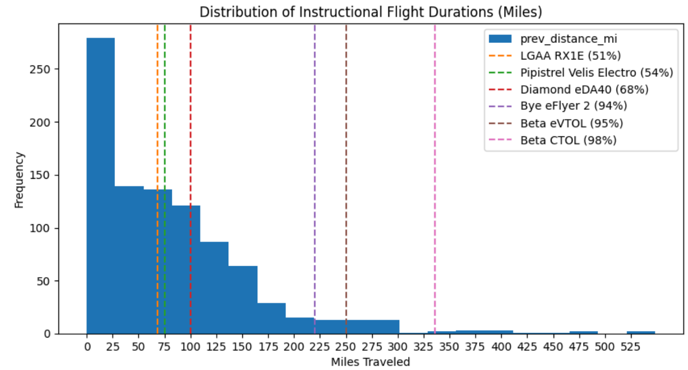


Figure 6: Instructional flights present in our database. Vertical dotted lines represent the range of each aircraft. When range is not provided by the manufacturer, it is approximated as the product of the cruise speed and flight duration. When only considering instructional flights, we can see all aircraft are able to cover a greater proportion of the total flights when compared to all flights in the dataset. This indicates a higher feasibility for electric aircraft in this use case.

compatibility of existing electric aircraft with the operational demands of flight training.

4.3 Airport Electrification Feasibility

To evaluate the infrastructure readiness of Utah's airports for electric aircraft deployment, we examined data provided by Rocky Mountain Power on peak power capacity and daily energy throughput for a range of regional airports. Our results can be seen in Table 2. These two metrics-peak capacity (representing the maximum instantaneous power delivery) and daily energy availability (indicating sustained throughput over time)-provide a foundational view of how well an airport can support electric aviation operations. The table presents these metrics alongside derived rankings (*p*-rank and *e*-rank) for 23 airports in the state.

Interestingly, while SLC leads in instantaneous power availability, it ranks only fourth in daily energy delivery. In contrast, BTF and U42 lead in energy throughput, suggesting they may be better suited for high-frequency, low-power applications such as flight instruction or light cargo operations. These rankings highlight the need to match use cases with infrastructure profiles. In some cases, airports with high energy availability but lower peak capacity may be ideal for slower charging electric aircraft.

Table 2: Airport energy and capacity rankings of regional airports in Utah. *p*-rank represents the relative ranking of power availability; *e*-rank represents the relative ranking of energy capacity.

Airport	Peak Capacity	Daily Energy	*p*-rank	*e*-rank
SLC	1	0.68	1	4
OGD	0.74	0.5	2	6
BTF	0.34	1	3	1
U42	0.33	0.99	4	2
CDC	0.25	0.75	5	3
VEL	0.19	0.58	6	5
LGU	0.12	0.35	7	7
HIF	0.08	0.24	8	8
RIF	0.072	0.21	9	9
42U	0.027	0.08	10	10
16UT	0.008	0.024	11	11
UT53	0.0076	0.023	12	12
BDG	0.007	0.021	13	13
U14	0.0064	0.004	15	20
12UT	0.0064	0.019	14	14
TVY	0.0063	0.019	16	15
1L9	0.0062	0.018	17	16
69V	0.0036	0.011	18	17
PUC	0.0034	0.01	19	18
DTA	0.0018	0.0054	20	19
U34	0.0012	0.0036	21	21
CNY	0.0006	0.0018	22	22
21UT	0.0006	0.0018	22	22
UT89	0.00024	0.00072	23	23

Conversely, airports such as Richfield (RIF), Delta (DTA), and Moab Canyonlands (CNY) rank near the bottom in both capacity and energy. These locations would likely require significant infrastructure investment-such as substation upgrades or localized battery storage-to support even moderate levels of electric aircraft operations. For these facilities, electrification planning should be paired with long-term funding or phased deployment strategies.

5 Use Cases

To further understand where electric aircraft adoption may be most viable, we segment our analysis into common regional aviation use cases. We exclude long-haul commercial and charter operations, as our data and analysis focus on short-to-medium range flights where current electric aircraft capabilities are more applicable.

5.1 Individual (Recreational) Use

Individuals represent the largest share of aircraft registrations; however, they also operate at the smallest scale, as most individuals fly older fixed-wing single-engine planes (according to our analysis of aircraft registrations). Assuming parts and service manuals are freely available, maintenance of an electric aircraft could potentially be easier to perform due to the streamlining of the drivetrain and the relative simplicity of electric motors, which could lower ongoing costs of ownership. Despite electric aircraft having lower operational costs, these savings would likely never make up the difference created by the increased initial cost. Refueling could also be done off-site from the airport, as most electric aircraft use the conventional CCS charging interface. With current market offerings, the feasibility of these aircraft decreases dramatically due to the significantly increased initial cost of the aircraft.

5.2 Instructional Use

Flight training represents the most feasible and immediately actionable use case for electric aircraft adoption. Our analysis shows that existing aircraft, such as the Bye Aerospace eFlyer 2 and the Diamond eDA40, can cover the vast majority of training flights in our dataset, primarily when those flights originate and terminate at the same airport. Because only one infrastructure node is required (rather than both origin and destination), deployment is simpler and less costly.

Moreover, electric aircraft offer advantages in training contexts: reduced fuel and maintenance costs, quieter operation, and potential exemptions from certain noise-based flight restrictions. For high-frequency, short-duration training missions, the operational economics align well with electric propulsion. Regional airports hosting flight schools with favorable power rankings (as shown in Table 2) represent ideal launch sites for electric aircraft deployment.

5.3 Air-Taxi Use

An air taxi is similar to a charter flight, allowing individuals or small groups of people to request a flight on demand. Air-taxis are used for short-distance travel on smaller aircraft designed to carry two to six people. Assuming similar flight paths to instructional flights, electrification of air-taxi services is somewhat feasible if adequate infrastructure exists at both the origin and destination of the flight. Aircraft such as the BETA VTOL offer vertical takeoff technology, allowing both the origin and destination to bypass traditional runways. This may improve feasibility, as flights do not need to be restricted to conventional airports.

5.4 Cargo Flights

Cargo flights vary widely in scale, from light medical deliveries to mid-size freight transport. At the smaller end, electric aircraft could feasibly support scheduled or emergency cargo routes, particularly in medical or government sectors. These flights tend to be shorter and more predictable, with infrastructure that can be controlled at both endpoints.

However, feasibility drops off rapidly as payload requirements increase. Larger batteries introduce significant weight penalties, and the need for frequent charging locations drives up infrastructure costs. As noted by Kammermann et al., current battery energy density remains a bottleneck. Until technological advances enable lighter batteries or fast in-route charging, the electrification of medium-to-large cargo flights will remain impractical.

6 Conclusion

This study provides a comprehensive regional-scale assessment of electric aircraft feasibility, integrating aircraft capability, flight behavior, and infrastructure readiness. By analyzing FAA registration data, ADS-B flight records, and power availability at Utah airports, we identify high-leverage opportunities for early adoption of electric aviation.

Our findings indicate that instructional aviation is the most immediately viable use case. Current electric aircraft, particularly in the two-to-four seat range, are capable of serving the vast majority of flight training operations, primarily when flights are confined to a single airport. Additionally, several regional airports already possess sufficient power and energy availability to support electrified operations with minimal infrastructure upgrades, making them ideal launch points.

Other use cases, such as air taxi and light cargo services, show promise but are more dependent on networked infrastructure at both endpoints and further improvements in battery energy density. Recreational and mid-scale cargo use cases remain less feasible in the near term due to cost, payload, and infrastructure limitations.

Beyond the feasibility assessments, we hope this work contributes a scalable framework for evaluating electric aircraft deployment through real-world data. It demonstrates how data from aviation activity, aircraft specifications, and energy infrastructure can be synthesized to inform policy and investment strategies.

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