International Test Arena Demonstration Programme

Final Report of Bristow Norway AS and BETA Technologies' eCTOL operations

August 1, 2025 – January 31, 2026

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The demonstration at a glance

126 FLIGHTS

6 MONTHS OF OPERATIONS

7 AIRPORTS

VFR + IFR

ALL-WEATHER CONDITIONS

ENGAGED ECOSYSTEM

Executive Summary

The International Test Arena Demonstration Programme is established as Norway's overarching framework for coordinated, end-to-end operational demonstrations of zero- and low-emission aviation. The Programme brings together aircraft, operator, airport infrastructure and regulatory oversight in a structured setting designed to generate shared learning across the aviation ecosystem.

Between 1 August 2025 and 31 January 2026, the programme hosted its first practical demonstration project, carried out in collaboration with BETA Technologies (BETA), Bristow Norway AS (Bristow), the Civil Aviation Authority Norway (CAA) and Avinor AS (Avinor). As the inaugural project under the International Test Arena Programme, demonstration aimed to generate practical evidence and transferable insights to support preparations and the aviation ecosystem for future commercial air transport using zero- and low-emission aircraft.

The demonstration centred on BETA ALIA, an electric conventional take-off and landing (eCTOL) aircraft. Operating from Stavanger Airport Sola (SVG) as the primary base and Bergen Airport Flesland (BGO) as a secondary location, the programme executed 126 flights across seven regional airports[1] in south-west Norway, under both visual and instrument flight rules and in various weather conditions.

- BETA is a U.S. aerospace original equipment manufacturer developing battery-electric aircraft and charging solutions. In this programme BETA provided the ALIA demonstrator aircraft, technical support, and pilot/technician training.
- Bristow, part of the Bristow Group, a worldwide aviation operator with established operational change to procedures and safety systems, supplied qualified flight and maintenance personnel and ran day to day management Operational Control remained with BETA from its Operational Control Centre at SVG. Avinor is Norway's state-owned airport operator and air navigation service provider, and coordinated airport stakeholders and delivered the required charging and operational facilitation at participating airports. CAA is the national aviation safety regulator and enabled a regulatory sandbox, issued and oversaw the traffic permission, and ensured that safety and reporting mechanisms supported learning without compromising compliance.

Overall, the flights demonstrated that a battery-electric aircraft can be integrated into routine airport and airspace operations with limited disruption when roles, interfaces and operational limits are clearly defined. The aircraft's performance was stable in low temperatures, and the project validated practical operating routines for dispatch, charging, ground handling and coordination with air traffic services. Just as importantly, the project tested how infrastructure, organisational processes and regulatory frameworks interact when a new propulsion technology is introduced into a live operational environment.

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1) Stavanger Airport Sola, Bergen Airport Flesland, Arendal Airport Gullknapp, Florø Airport, Haugesund Airport, Kristiansand Airport Kjevik, Stord Airport

Key Learnings and experiences from the demonstration project

1	**Operational normalisation is achievable**	After initial familiarisation and training, flight execution became increasingly comparable to conventional operations, provided that charging and energy planning are treated as part of standard operations
2	**Existing IFR structures are not optimised for electric aircraft**	Standard climb profiles and procedure design are tailored to turbine performance. Future work should explore more direct, lower-altitude routings (“e-routes”) and arrival/departure concepts better aligned with electric aircraft characteristics
3	**Energy margins drive operational robustness**	Holding, weather, alternates and indirect routings have a disproportionate impact on limited-range aircraft, making predictable access to alternates and efficient routings critical to regularity
4	**Charging infrastructure must be airport-ready, interoperable and publishable**	Fast charging can be made to work in Nordic conditions, but solutions must account for apron obstacle constraints, snow/ice, drainage, cable handling and clear operational information (location, power availability, connector standards) through established aeronautical information channels
5	**Grid constraints can be managed with flexible solutions**	Battery-buffered chargers and flexible charging strategies can enable early operations where grid capacity is limited, but long-term scaling will require significant power upgrades and coordinated energy planning
6	**Safety governance and learning culture are decisive enablers**	A low threshold for reporting, joint safety review forums, and clear stop-work authority supported safe exploration of “unknown unknowns” typical of innovation settings
7	**Whole-ecosystem coordination reduces risk and accelerates learning**	Bringing operator, OEM, airport operator/ANSP and regulator into one shared programme enabled faster issue resolution, clearer interfaces, and more actionable lessons than isolated trials

> *“The Test Arena enabled us to fly the ALIA in the real-world, to learn the best ways of safely operating an electric aircraft in the aviation ecosystem, and to prepare for future commercial operations. What was most important to note was that, after the initial training phases, the operation became ‘normal’ and flights were carried out just as we would for any commercial flight. Yes, there are procedures that will mature and become more efficient, but the baseline was straightforward to achieve”.*
>
> - Simon Meakins, Director of Advanced Air Mobility EAMEA, Bristow Group.

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Abbreviations & Glossary

Abbreviation	Term	Explanation
ALIA	ALIA CX300	Demonstration aircraft Provided by BETA Technologies Inc.
AOC	Air Operator Certificate	Authorization for commercial aviation operators
ATC	Air Traffic Control	Ensure safe separation of aircraft during flight and on the ground
BETA	BETA Technologies Inc.	Provided demonstrator aircraft
BGO/ ENBR	Bergen Airport, Flesland	IATA/ ICAO code for Bergen Airport Flesland
Bristow	Bristow Norway AS	Provided the pilots and technician to fly and maintain the aircraft during demonstration in Norway
Bristow OCC	Bristow Operations Command Centre	Monitoring Bristow operations continously
CAA	Civil Aviation Authority Norway	Norway's Civil Aviation Authority
EASA	European Union Aviation Safety Agency	EU's Aviation Safety Authority
FAA	Federal Aviation Administration	United States' Aviation Safety Authority
FRO/ ENFL	Florø Airport	IATA/ ICAO code for Florø Airport
HAU/ ENHD	Haugesund Airport	IATA/ ICAO code for Haugesund Airport Karmøy
ICAO	International Civil Aviation Organization	UN agency that sets global standards, policies, and recommended practices for aviation safety
IFR	Instrument Flight Rules	Rules for instrument flights
IMC	Instrument Meteorological Conditions	Weather conditions requiring IFR flights
KRS/ ENCN	Kristiansand Airport, Kjevik	IATA/ ICAO code for Kristiansand Airport Kjevik
NCO	Non-Commercial Operations	Operations without commercial intent
NOTAM	Notice To Airmen	A notice filed to aircraft pilots regarding hazards or information along flight routes or locations
PART-CAT	Commercial Air Transport	EASA regulations for commercial air transport
PART-NCO	Non-commercial operations with other than complex-motor-powered aircraft	EASA regulations for non-commercial flights other than complex motor-powered aircrafts
PSO	Public Service Obligation	Government subsidized transport route
RFFS	Rescue and Fire Fighting Services	Specialized airport emergency units for rescue and firefighting service
QCG/ ENGK	Arendal Airport, Gullknapp	IATA/ ICAO code for Arendal Airport Gullknapp
SAG	Safety Action Group	Responsible for monitoring safety at an operational level, made up of safety representatives from each project partner and main airports in this project
SID	Standard Instrument Departure	A published IFR departure procedure that guides an aircraft from takeoff to the en-route structure
SRB	Safety Review Board	Top-level board responsible for safety, convened as part of the Test Arena Steering Committee in this project
SRP/ ENSO	Stord Airport	IATA/ ICAO code for Stord Airport Sørstokken
STAR	Standard Terminal Arrival Route	A published IFR arrival procedure that guides an aircraft from the en-route phase into the terminal area
SVG/ ENZV	Stavanger Airport, Sola	IATA/ ICAO code for Stavanger Airport Sola
VFR	Visual Flight Rules	Rules for visual flights
VMC	Visual Meteorological Conditions	Weather conditions allowing VFR flights

1. Introducing the International Test Arena Demonstration Programme

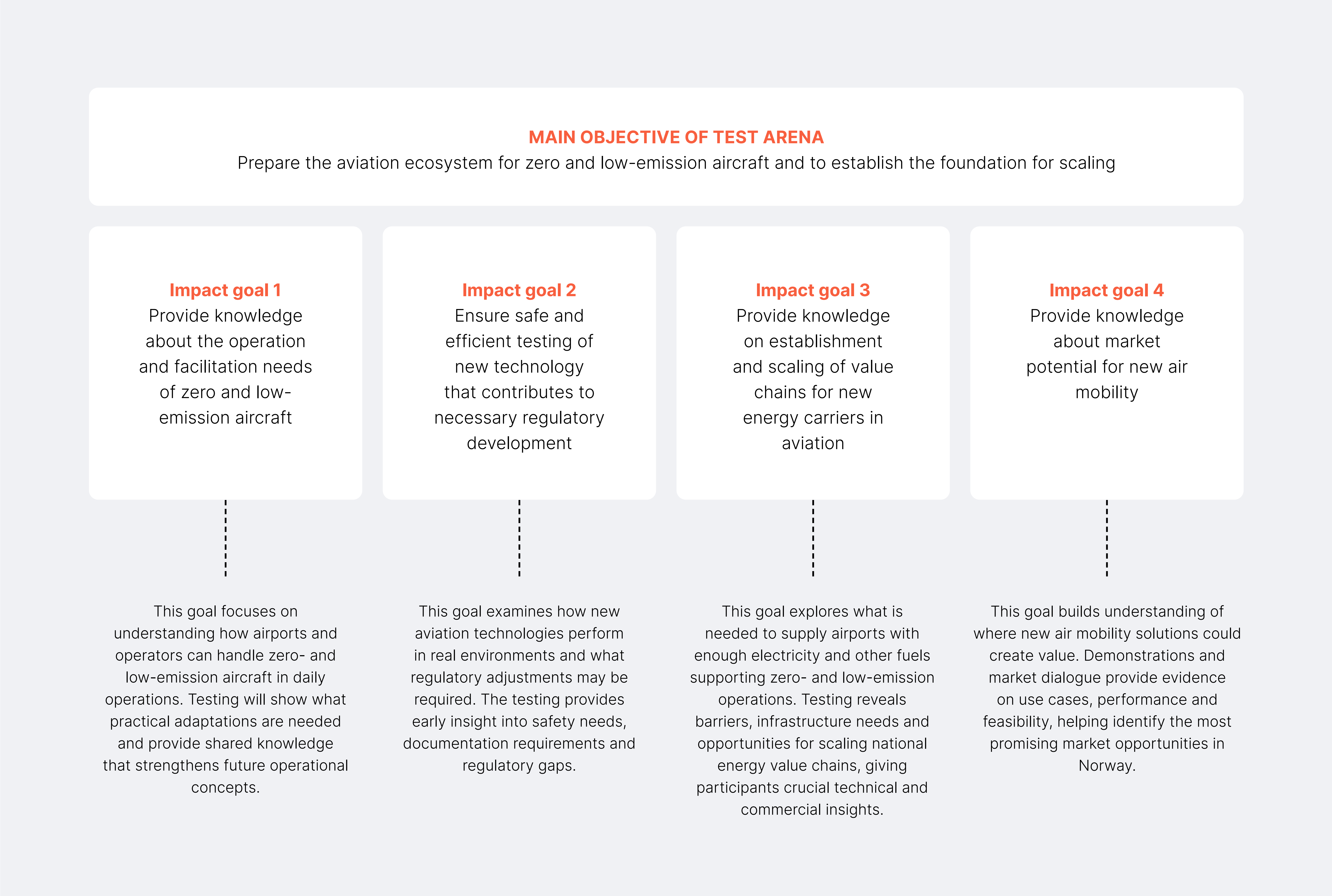
The International Test Arena, hereafter referred to as “Test Arena”, is a partnership between the Civil Aviation Authority Norway (“CAA”) and Avinor with the purpose to demonstrate and prepare the ecosystem for zero-and low-emission aviation. The initiative responds to the Norwegian Government’s goal of accelerating the introduction of zero-emission aircraft by developing the necessary infrastructure, regulations, operational knowledge, and energy value chains. Introducing zero- and low-emission aircraft requires system-level transformation and strong strategic cooperation. The Test Arena is a key tool for coordinating this work and scaling future solutions. While Avinor prepares airports for new energy carriers, the CAA provides support to ensure safe and sustainable operations in line with national and international regulations and standards. The Test Arena with its demonstrations provides essential real-world experience and knowledge for all actors involved.

1.1. Aim and scope of the project

The intention of this programme was to demonstrate a specific cargo use case utilizing BETA Technologies’ ALIA CX300 electric Conventional Take-off and Landing (eCTOL) aircraft, herein referred to as the “demonstrator aircraft” or “ALIA”. This first demonstration programme in the Test Arena involved BETA, and Bristow Norway AS, as well as Avinor and CAA as partners (hereinafter referred to as the “Project Partners”). The aim was to explore the specific use case utilizing the Demonstrator Aircraft as an electric conventional take-off and landing airplane (eCTOL), and to conduct flight demonstrations with the ALIA in the western region of Norway, mainly between Stavanger Airport Sola ENZV (SVG) and Bergen Airport Flesland ENBR (BGO). Further details about the concept of operations (CONOPS) are provided in Chapter 2.

1.2. Background

This report is based on the Appendices to the Research Agreement between regarding the International Test Arena (hereinafter referred to as “the Demonstration Programme” or “Test Arena”), dated March 4th 2025.



MAIN OBJECTIVE OF TEST ARENA

Prepare the aviation ecosystem for zero and low-emission aircraft and to establish the foundation for scaling

Impact goal 1

Provide knowledge about the operation and facilitation needs of zero and low-emission aircraft

This goal focuses on understanding how airports and operators can handle zero- and low-emission aircraft in daily operations. Testing will show what practical adaptations are needed and provide shared knowledge that strengthens future operational concepts.

Impact goal 2

Ensure safe and efficient testing of new technology that contributes to necessary regulatory development

This goal examines how new aviation technologies perform in real environments and what regulatory adjustments may be required. The testing provides early insight into safety needs, documentation requirements and regulatory gaps.

Impact goal 3

Provide knowledge on establishment and scaling of value chains for new energy carriers in aviation

This goal explores what is needed to supply airports with enough electricity and other fuels supporting zero- and low-emission operations. Testing reveals barriers, infrastructure needs and opportunities for scaling national energy value chains, giving participants crucial technical and commercial insights.

Impact goal 4

Provide knowledge about market potential for new air mobility

This goal builds understanding of where new air mobility solutions could create value. Demonstrations and market dialogue provide evidence on use cases, performance and feasibility, helping identify the most promising market opportunities in Norway.

Figure 2: Main objective of Test Arena and impact goals

1.3. Responsibilities of the Project Partners

The responsibilities of the Project Partners are described as followed:

- Avinor AS is a co-owner of the International Test Arena, and responsible for coordination at the airports. Avinor served as the point of contact with air traffic control, airport fire and rescue services, the airport safety manager, and other relevant units.
- CAA is a co-owner of the International Test Arena. It is responsible for the Regulatory sandbox, regulatory challenges, integrations and solutions, the overall safety and risk management model, as well as contact with other regulatory entities such as the European Aviation Safety Agency (EASA).
- BETA Technologies Inc: ("BETA") An aerospace original equipment manufacturer (OEM) focused on developing sustainable advanced air mobility aircraft and the ecosystem to enable their success. BETA was responsible for providing the Demonstrator Aircraft with appropriate regulatory approval as well as providing Pilot and Technician training, operational oversight, and technical product support throughout the project.
- Bristow Norway AS ("Bristow"): Part of the Bristow Group - the global leader in sustainable vertical flight solutions. Bristow, as a highly experienced and certified holder of a Norwegian Air Operator Certificate (AOC), was responsible for providing pilots and technicians to fly and maintain the aircraft, safety management expertise, safety systems, dispatch and flight monitoring systems, emergency response systems, and knowledge of operational processes and procedures required for future EASA commercial operations ("Part-CAT").

The project partners had a mutual responsibility to contribute to knowledge development about operational, regulatory and market potential related to the introduction of zero- and low-emission aircraft for the aviation ecosystem. Emphasising a systemic approach, the demonstration programme allows dissemination of the results and insights gained on a systemic level, yet being considerate to confidential or sensitive information e.g. of commercial purposes.

Image 1: Delegation looking at the underground fast charger at Stavanger airport. Photo: T. Bernhardsen / CAA Norway

2. Concept of Operations

The Concept of Operations (CONOPS) was developed in partnership between BETA and Bristow to benefit from the combined experience of each party, whilst ensuring safety and the most effective and compliant regulatory structure and compliance.

BETA's ALIA eCTOL is an experimental pre-certification aircraft that is designed as a fully-electric, battery powered, high-performance single-engine aircraft and is being certified under the approval of the United States Federal Aviation Administration (FAA). It was operated within the limitations of its FAA Multipurpose Special Airworthiness Certificate for Experimental Research & Development, Market Survey, and Crew Training ("FAA-Special Airworthiness Certificate"), which was recognised by the CAA who issued the Traffic Permission. This enabled the aircraft to be flown by BETA in Norway.

Bristow pilots and technicians were contracted by BETA to fly and maintain the aircraft, on behalf of BETA on completion of their training. The Demonstrator Aircraft did not carry out any Commercial Air Transport operations and, therefore, did not formally form part of an AOC operation. The day-to-day management of flight activities was delegated to Bristow's Operational Control Centre (OCC) located at SVG. Each stage of the project had specific milestones and deliverables to enable progression between these stages. These were reviewed and accepted by each party prior to moving to the next stage of operations. The operational stages are indicated in figure 3.

PHASE 1:
OPERATIONAL FAMILIARIZATION

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PHASE 2:
OPERATIONAL MATURATION

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PHASE 3:
OPERATIONAL GROWTH

PHASE 1: OPERATIONAL FAMILIARIZATION	PHASE 2: OPERATIONAL MATURATION	PHASE 3: OPERATIONAL GROWTH
A-A VFR (day & night) Ground Operations & Integration Flight Planning & Dispatch Charging Procedures Basic Cargo Loading	A-B Flight Planning (VFR day & night) SVG-BGO route familiarization and validation for Bristow and potential customer(s) in live operational environment Build up from minimal payload to maximum cargo payloads Build up from day & night VFR in VMC Emergency procedures training and operational scenario development	Starting with A-B IFR flights (day & night) Progressing to A-B-C flights including MAPP & Divert flights Includes RON (remain overnight) recharge operations Initially limited to VMC before progressing to IMC. IMC is limited to no known icing conditions or simulated IMC Network expansion beyond Maximum cargo payload and/or maximum range missions
PERSONNEL		
Demonstration of required competency as per syllabus (if not achieved in US during Preparation Phase) • A-A VFR day operations • A-A VFR night operations	• Competency in A-B flight planning • A-B VFR day and night operational competency • Cargo handling capability • Aircraft handling & charging at secondary location • Dual and single-pilot operations • Emergency exercises	• IFR / IMC competency • Diversion and MAPP competency • Aircraft handling at tertiary location • Minimum turnaround time operations • Continued emergency exercises

Figure 3: Flight Phase Progression - Overview over the three operational phases: Familiarisation, maturation, growth

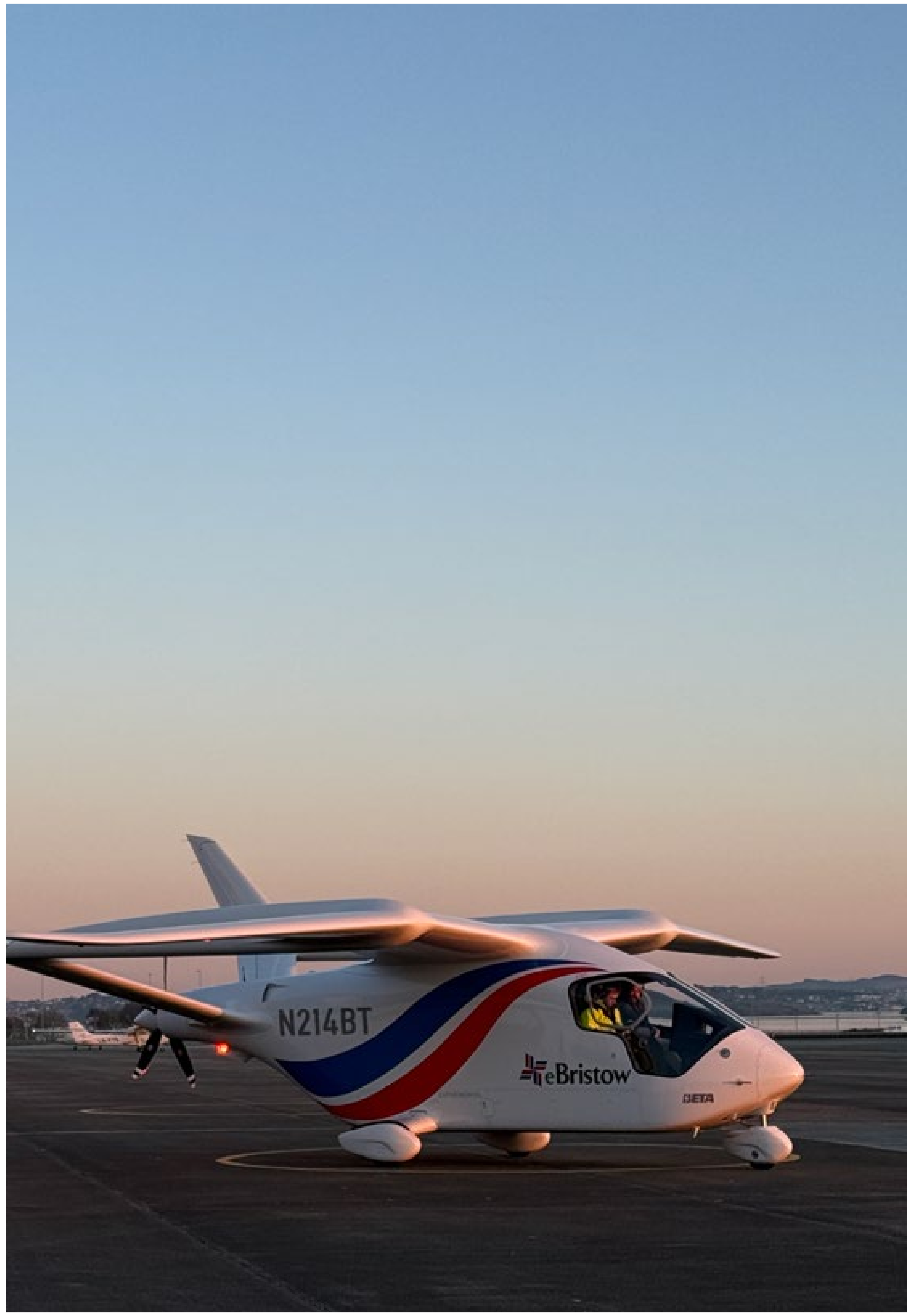


Image 2: Demonstration aircraft at Stavanger airport. Photo: T.Bernhardsen / CAA

2.1. Operating Regimes

The FAA Special Airworthiness Certificate enabled single-pilot and dual-pilot operations in both Visual Flight Rules (VFR) and Instrument Flight Rules (IFR), both by day and night. The aircraft was not approved for flight in icing conditions and was equipped with features to mitigate the danger of inadvertently flying into unexpected icing conditions. A controlled progression between VFR and IFR regimes was planned through the project stages and operating regimes were only changed once the required competency was achieved.

The primary operating location was SVG, which served as the primary base of operation. Crew bases, night parking and engineering/ maintenance were carried out in a designated facility including hangar at this location. BGO served as the secondary operating location, where Bristow provided hangar space available for overnight flights and in case of need for maintenance.

2.2. The BETA ALIA CX300 aircraft

The demonstrator aircraft utilized was BETA's Experimental ALIA CX300, registered as N214BT. This electrically powered, single-pilot, single-engine airplane is equipped to carry cargo and occupants between airports, operating with high reliability, zero emissions, and a low noise footprint. The ALIA is a normal category, level 2, low-speed, conventional take-off and landing (CTOL) aircraft. It has a high-wing design, fixed tricycle landing gear, and a tail-mounted pusher electric engine.

BETA maintains a fleet of ALIA experimental aircraft used to progress their type certification programme and conduct market survey operations such as this project. This enables BETA and operators such as Bristow to learn what the opportunities and challenges of integrating a new technology into service will be prior to type certification and commercial operations.

While the data collected using this demonstrator aircraft is a good representation of the technology we have today, it is important to remember the ALIA used in this project is not the final type certified product and therefore will differ from the expected performance and features of the future type certified aircraft. For example, the demonstrator aircraft used in this project did not have an operational environmental control system or autopilot as those are still under development and testing. However, in the type certified aircraft those systems will be fully operational.

2.3. Milestones and Progress

Figure 4: Milestones in the International Test Arena demonstration project

April 24 2024
Avinor and CAA sign agreement on establishing the Test Arena.

January 24 2025
Launch of public tender for charging equipment.

March 4 2025
Contract signed between the project partners.

June 2025
BETA's ALIA eCTOL arrives in Europe.

July 7 2025
BETA obtains Traffic Permission from CAA.

July 2025
Initial training of Mechanical/Engineer and pilots.

August 2025
Fast charging facilities at SVG established.

August 8 2025
First flight SVG and entering Operational stage I.

August 13 2025
Demonstration flight at Arendalsuka, incl. panel discussions with project partners.

September 9 2025
First flight to BGO.

September 2025
Fast charging facilities at BGO established.

October 1 2025
Entering Operational stage II.

October 23 2025
Presentation at Zero Emission in Regional Aviation Conference (ZERAC).

October 24 2025
CAA and EASA signs a collaborative innovation contract.

December 9 2025
First IFR.

December 7 2025
Entering Operational stage III.

December 2025
Flight #100.

January 20 2026
“Regulatory Day”: A collaborative workshop including the project partners and EASA.

January 22 2026
First and northernmost flight to FRO at 61,6°N.

January 31 2026
126 flights performed. End of demonstration project.

2.4. Charging Facilities and Infrastructure

SVG and BGO were equipped with fast-charging devices. Avinor led the procurement of fast-charging equipment following standard Norwegian public procurement regulations.

At SVG, Avinor constructed a new transformer station that would supply grid connection to the charger. The transformer station and main charger hardware were placed in the demarcated area. The charging cable became implemented in a cable pit with a hatch on the apron, easily accessible when necessary, and without creating a physical obstacle on the apron when not in use.

At BGO, there was limited capacity in the local grid, meaning that only a 125A/400V connection was available during the test period. To compensate for this, the procurement requested a battery-based solution that could charge slowly throughout the day and/or overnight and then use the energy stored in the batteries to deliver at least 300 kW when an aircraft connected.

Avinor required a reliable, airport-ready system that enables charging to start quickly after parking and withstands Nordic weather year-round. The chargers must also tolerate the coastal climate at the airports, with temperatures from –10 to 27°C, heavy rainfall, and strong wind gusts. It was left to the suppliers to find a creative solution that could combine the charging equipment in a feasible way that would also satisfy the strict regulations on obstacles on or near apron and aircrafts.

Additionally, BETA provided two mobile Minicube 65kW DC chargers to be utilized for charging at alternate locations without installed charging infrastructure and overnight in the hangar. BETA’s Minicube charger is designed to work with already existing infrastructure that is commonly used at airports to operate using conventional aircraft ground power units. This enabled additional airports to be added to the test arena as well as optionality for alternate and diversion planning. The Minicube was also utilized for charging inside of hangars for overnight charging.

BETA provided a Mobile Battery Thermal Management System (TMS) at SVG to be tested and utilized to assess operational cadence with this additional ground support equipment. The demonstrator aircraft only requires thermal management when using fast charging after multiple full charge events in a single day, so this has been packaged into ground support equipment rather than integrated into the aircraft. This improves aircraft range and payload capability giving operators flexibility to utilize thermal management only when and where their operations require it and not sacrifice operational range and payload on every flight. This system used was a miniaturized mobile version of BETA’s Battery Thermal Management Cube which is a ground-based system that can be installed along with fast chargers.

2.5. Regulatory Framework

The regulatory framework of the demonstration programme was based on ALIA’s Special Airworthiness Certificate issued by the FAA. It required any operations outside of United States airspace to obtain permission from the governing authority of that airspace. Consequently, BETA applied an appropriate traffic permission from the CAA for all flights in Norway. By recognising the FAA-issued Special Airworthiness Certificate, CAA issued a traffic permission covering the entirety of the programme with the primary purpose to conduct market survey operations. A central condition within this regulatory framework was that BETA would try to adhere to CAT regulations to the extent possible. Where not possible, as a minimum BETA had to comply with the requirements listed in Part-NCO. Hence, throughout the phases, the aircraft was operated within the requirement of EASA Part-NCO regulations and assessed against suitability to carry out EASA Part-CAT operations.

2.6. Safety and Risk Management

One of the most important aspects of the Test Arena is integrating effective aviation safety management procedures into the projects, whilst recognizing the specific challenges of operating in an innovative setting using an aircraft in development. The innovation setting introduces a different risk scheme, where it is useful to distinguish between risk, uncertainty and true uncertainty. Whereas risk refers to situations where outcomes are known, uncertainty relates to known outcomes with an unclear likelihood to occur (“known unknowns”). In innovation however, “true uncertainty”, often referred to as Knightian uncertainty, describes situations where we cannot calculate risk as we are not aware of what we do not know (“unknown unknowns”). This demonstration project included elements of true uncertainty and unknown unknowns, thus requiring a more exploratory and adaptive approach.

Consequently, it was necessary to ensure that BETA’s Safety Management System (SMS), which was developed to manage aircraft development and flight test risk, was integrated into Bristow’s operational SMS. This ensured that the safety risk was well understood and mitigated for both the “normal” operational risks as well as expanding slowly and deliberately into the “unknown” risks that come from operating a new type of aircraft in a new setting. The foundation of this strategy was a safe well tested demonstrator aircraft and clearly defined operational limits, enabling a phased progression from limited day VFR local operations to IFR/IMC operations.

Therefore, it was decided that Bristow’s SMS would be used to manage the risks specific to flying the ALIA within the Test Arena, with the following principles utilised:

2.6.1. Enterprise / Project Risk Management

The following principles and tools were used to ensure that the project was managed safely, effectively and delivered to its goals and relevant timelines:

a. Steering Committee – meeting regularly and attended by senior representatives from each participant responsible for project delivery, the Steering Committee ensured that the Test Arena progressed as per the requirements of the Project Agreement.
b. Management of Change process – the principles of management of change were followed to ensure that all relevant preparations were carried out ahead of initial Test Arena flight operations.
c. Project Management principles – the overall project was managed and monitored utilising project management tools.

2.6.2. Safety Risk Assessment (ALARP principle)

A joint Risk Assessment was developed based on recognised standards and the Bristow Safety Management System. Each risk was identified and mitigated to ensure that it was "As Low As Reasonably Practicable" (ALARP). This Risk Assessment was continually updated based on learnings and experience through the flight operations.

2.6.3. Safety Review Boards

Safety Review Boards (SRB), attended by top-level representatives from each organisation, were carried out regularly both before and during the flight operational phases. The Boards reviewed selected reports highlighted by the Safety Action Group (SAG), who were responsible for monitoring safety at the operational level. Terms of Reference (TORs) were produced. The agenda for the SRB can be viewed in Table 1.

2.6.4. Bristow BeSafe System

The Bristow BeSafe system is a database of all reports or observations that is used to control, assess, monitor and correct any reports that are received. This was an essential tool to ensure follow-up and effective responses to reports.

2.6.5. Pre-Flight Risk Assessment

As an additional layer of assurance, a Pre Flight Risk Assessment process was developed to review each flight ahead of dispatch to ensure that it was achieved with the right level of oversight.

2.6.6. Emergency Response

It was necessary to implement procedure in the event of a serious incident or accident. Given that the aircraft was being dispatched by Bristow, it was decided that the most effective methodology would be to integrate into the Bristow Emergency Response Procedures. Therefore, a bridging document was produced and agreed, and personnel from BETA were added to the Bristow notification system. This was tested and proved to be effective.

In addition, in-flight monitoring was carried out by integrating the aircraft into the Bristow Operational Control Centre (OCC) procedures.

Image 3: From left: Programme manager Mats Bye, Stavanger Airport Director Anette Sigmunstad, Minister of Climate and Environment Andreas Bjelland Eriksen and DriiV Manager Kristoffer Hurv during the fast charger launch.
Photo: Ø. Løwer / Avinor

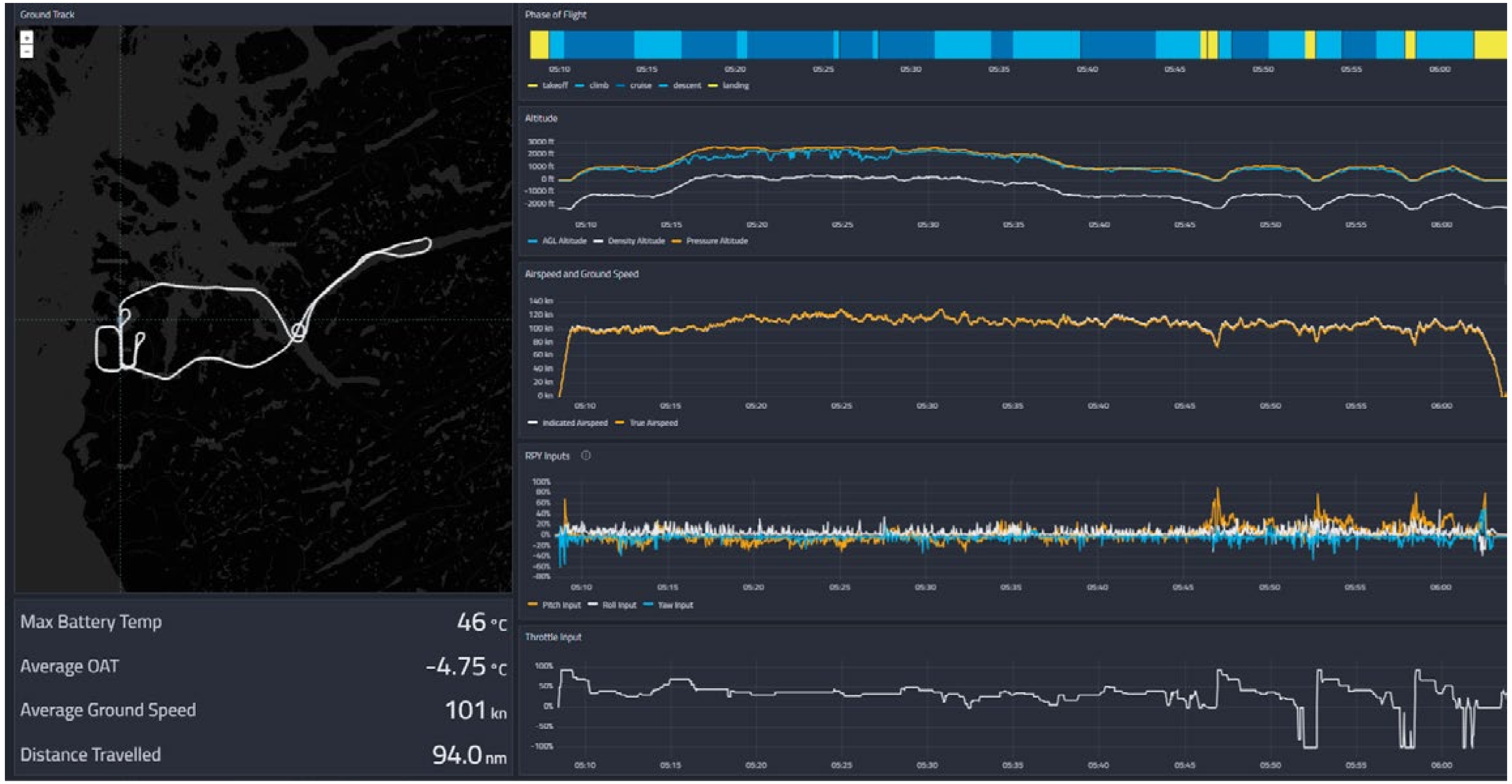
Table 1: Safety Review Board agenda

Serial	Agenda Item	Detail
1	Safety Report Review	Review selected reports highlighted from SAG
2	Safety Risk Assessment Review	Review Risk Assessment and accept risk level
3	Trends	Review and consider impact of any trends in events
4	Investigations	Review investigation recommendations
5	Risk Level Review	Review and accept Risk Level recommendation from SAG
6	Test Arena Objectives Review	Review Test Arena objective and authorise move between Test Arena stages (or further requirements before moving)
7	Lessons Learnt / Action Plan	Confirm action plan to ensure all lessons learnt are documented and actioned
8	Safety Recommendations and Communication	Communicate Safety recommendations to all Test Arena personnel
9	Any Other Business	

2.7. Principles of data protection, collection and sharing

With the objective that the activities within the Test Arena should generate knowledge and learning throughout the entire ecosystem and contribute to knowledge sharing beyond the participants in the specific test and demonstration activities, the project partners agreed to share and make certain relevant results, knowledge, information and data publicly available. Thus, activities for involvement of external parties and knowledge sharing were developed and maintained throughout the project. This detailed report was part of the knowledge dissemination following the demonstration programme, addressing and reflecting the specific project goals. Other relevant information, data, assessments, and evaluations necessary to achieve the main objective of Test Arena, the four impact goals, and the project goals were shared among the project partners. Relevant data was defined as data or aggregated data and/or statistics, such as feedback regarding the operations and activities conducted, including but not limited to, experiential takeaways and general operational information, information learned about the functionality and potential success of the ALIA's potential use for commercial cargo purposes in Norway, general information about charging of the aircraft and energy consumption, bugs, suggestions for improvements, modifications, and enhancements. However, this did not include commercially sensitive information, nor any information barred from being shared by any confidentiality restrictions in place.

Data from the demonstration programme was collected from a wide range of participants. Surveys and reports were conducted by the Pilots, and Air Traffic Controllers were asked to collect reports, log information and capture observations. In addition, qualitative semi-structured interviews were conducted with 22 individuals holding key roles related to the demonstration project. Following the workshop "Regulatory Day", a focus group interview with seven CAA experts captured additional information. Moreover, data from the Bristow eFlight flight tracking system, safety reporting system, as well as digital data collection via onboard systems in the aircraft was also collected.



Max Battery Temp 46 °C

Average OAT -4.75 °C

Average Ground Speed 101 kn

Distance Travelled 94.0 nm

Figure 5: Example of BETA's Data Dashboard

ALIA's integrated Aircraft Monitoring Unit allows for a tremendous amount of precise data collection and monitoring. BETA collects more than 25,000 unique parameters on the aircraft ranging from individual temperatures of various components to pilot control inputs. This data is automatically offloaded from the aircraft and allows BETA to monitor the status, health and usage of the aircraft. The aircraft data is also processed on a web application that allows for quick and easy visualization of the information to be useful in an operational way. A subset of this data and visualization dashboard is provided to Operators like Bristow to enable their monitoring and understanding of how the aircraft will be operated in the future, as well as being able to accurately see how it is performing in the real world. This data is used throughout this report to inform the observations and conclusions within it.

3. Findings & Key learnings

Image 4: Demonstration aircraft
charging at Florø airport.
Photo: Ø. Løwer / Avinor

3.1. Impact Goal 1: Knowledge about the operation and facilitation needs of zero and low-emission aircraft

Throughout the phases of preparation and flight operations, assessments were carried out as to the suitability of electric aircraft to operate both non-commercial (Part-NCO) and future commercial (Part-CAT) flights in the Norwegian eco-system within the EASA regulatory structure. While the ALIA was utilized it should be noted that it is not 100% representative of a future type certified ALIA, and therefore the results have been 'normalized' to enable the assessments to be relevant to the overall eco-system rather than the specific aircraft.

As per the agreed impact goals, the assessment can be split into the following topics: Training and licencing, airspace integration, charging and energy management, engineering requirements, aircraft delivery and inspection, national CAA traffic permission and operational control, operator safety risk management, air traffic management, and economics of electric aircraft.

3.1.1. Training and Licensing

Training requirements
Due to the experimental status of the aircraft, it should be noted that personnel could not be issued with a formal 'type-rating' for the aircraft. However, the training activity followed the template of an expected type-rating course and therefore should be considered to be equivalent.

Identification of suitably qualified personnel
It was necessary to source pilots who had specific experience relevant to flying the aircraft in conditions representative to the expected Norwegian conditions. In particular, single-pilot IFR experience in a commercial environment was considered to be essential. This proved to be a challenge as most local pilots in Norway were multi-pilot qualified as there are only limited single-pilot IFR operations in the region.

To ensure that pilots had the required experience, Bristow set a minimum experience level and carried out its standard aptitude testing and psychological screening ahead of employment.

For technicians, an FAA Airframe and Powerplant (A&P) license was required, due to the aircraft's FAA registration.

Factory training and in-country training
Initial training for both pilots and maintenance technicians was carried out at BETA's facilities in Burlington, Vermont, USA. Training consisted of both ground-school and practical exercises to familiarize personnel with the ALIA aircraft. This training was completed utilizing BETA's Formal Training Course which is being developed to meet all requirements for FAA Part 135 Operations. This course was mapped to the EASA Part-FCL requirements for differences training (the extra aircraft-specific ground and flight training needed when a pilot transitions to a new variant) to ensure there were no gaps in training. CAA was provided a copy of the training syllabus, completion records as well as the FAA certified flight instructor credentials that delivered the training.

Once the aircraft was in Norway, BETA provided instructors to complete flying training with Bristow pilots, and once the required competence was achieved, the Bristow pilots were authorized by BETA to fly as aircraft commanders.

Airport Integration
Integration into the airport operating environment was shown to be straightforward, with the aircraft being manoeuvred and handled as per an equivalent small aircraft.

Briefings with Rescue and Firefighting Services (RFFS) were carried out prior to operations commencing to ensure knowledge of electric aircraft risks.

3.1.2. Airspace Integration

Routing & Altitude Requirements
During the IFR phases of the Test Arena, it was noted that existing IFR routings (SIDs, STARs etc.) are optimized for turbine type aircraft which operate at higher speeds and benefit from operating at higher altitudes than electric aircraft (due to gains in turbine efficiency). Electric aircraft in particular do not notably benefit from efficiency savings of flying at higher altitudes, rather they use significantly more energy during elongated climb phases. This can disproportionally decrease the effective range of electric aircraft. Thus, from an energy management perspective, electric aircraft perform best under "lower altitudes" conditions, implicating that lower airspace sections are most advantageous for battery electric aircraft. Consequently, it is recommended that ANSPs consider the introduction of routes optimized for the operation of electric aircraft ("e-routes") that take into account shorter climb phases, cruising in lower airspaces and minimum safe altitude flight levels, and SIDs and STARs that take the reduced climb and descent requirements into account. Such designated e-routes will maintain performance and in conclusion safety.

Holding
Unexpected or unplanned delays and holding have an outsized reduction in plannable range for any aircraft with limited range. Therefore, familiarity of ANSPs and ATC controllers with aircraft capability is essential to facilitate such operations. During the project this was achieved with regular liaison with ATC units.

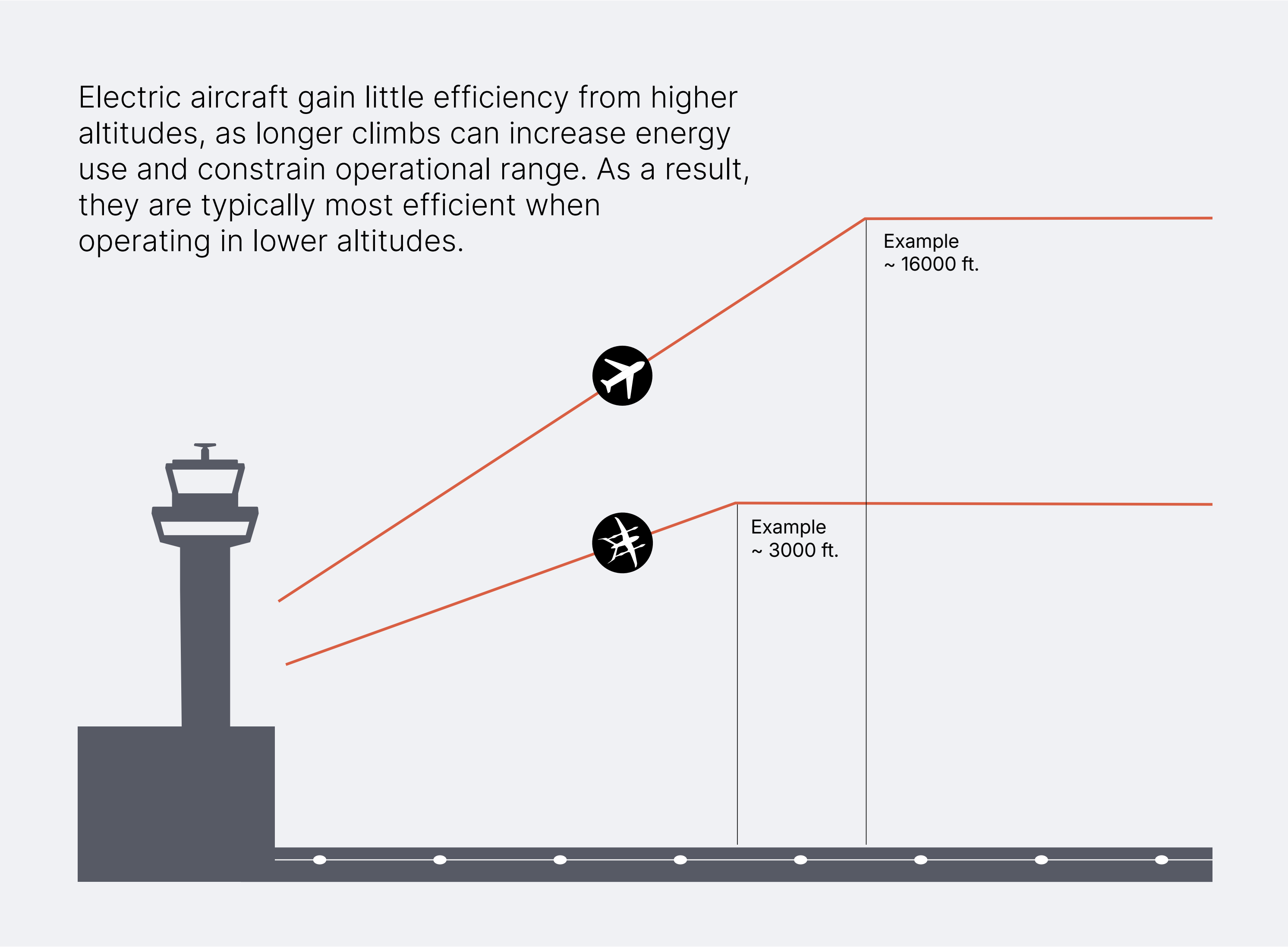

Electric aircraft gain little efficiency from higher altitudes, as longer climbs can increase energy use and constrain operational range. As a result, they are typically most efficient when operating in lower altitudes.

Figure 6: Illustration of differing efficiency profiles for electric and turbine aircraft

VFR and IFR Operations
A total of 126 flights were conducted over the 6 months demonstration programme. These flights are summarized in table 2, which provides an overview of both VFR and IFR flights.

The initial VFR phases were assessed as straightforward, with the aircraft operating successfully in the visual circuit and in local VFR training areas both by day and by night. It proved useful to have completed face-to-face briefings with local ATC to discuss performance requirements and enable sequencing with other traffic.

Once the required competencies were achieved during "local-area" flights, the phased introduction of A-B flights between SVG and BGO was carried out. In order to ensure that charging would be possible at each selected alternate airport, initial flights were carried out to both Haugesund (HAU) and Stord (SRP) to test the compatibility of Beta's Minicube charger with local electricity supplies. This was carried out successfully and consequently VFR flights between SVG and BGO were commenced.

	NUMBER OF FLIGHTS	LOCAL AREA FLIGHTS	A-B FLIGHTS	IMC FLIGHTS
VFR	112	65	47	
IFR	14	4	10	3

Table 2: Summary of VFR and IFR flights

In accordance with FAA Part-91 and EASA Part-NCO, during VFR flight it was necessary to maintain at least 30 minutes of energy reserves; this was achieved throughout all flights for both A-A and A-B operations. As part of the EASA Alternative Fuel and Energy Scheme, consideration could be given to enabling a reduced minimum energy level for VFR operations in certain weather conditions when landing at destination can be assured.

On completion of the VFR phases of the Test Arena, IFR operations were commenced. As expected, these flights were commenced in the autumn and winter periods, and therefore there were challenges in operating an aircraft without an icing capability in such conditions. This was consequently an excellent opportunity to assess the impact of such weather conditions on flight operations.

Practically, the IFR operations again were straightforward, with the aircraft operating well in the environment and able to integrate within the ATC environment.

Energy management and the requirement to hold at least 45 minutes of reserve energy and, in most weather conditions, to hold a suitable alternate aerodrome did prove a challenge in certain conditions and this was as expected. However, the potential to utilize or develop alternate routing, and to review minimum energy requirements is one of the main learnings of the Test Arena from an operational perspective and is also noted in chapter Routing and altitude requirements.

3.1.3. Charging and Energy Management

Aircraft Charging

Throughout the project, the aircraft was charged 177 times, using a mixture of BETA's Minicube and fast-charging devices installed at both SVG and BGO airports. Often the aircraft was charged overnight via the Minicube, and fast-charged in-between flights or used to top-up the battery in the morning. There was also a possibility with the charging equipment at SVG to programme the fast-charger with scheduling possibilities and enable the charger to reach 100% State of Charge (SOC) at a chosen departure time. This function could have been valuable to test during a longer test-phase. To support fast-charging a thermal management system by BETA was also utilized in SVG for certain rapid turnaround activities.

Integration with Third-Party Chargers
Close co-ordination was required with the providers of fast-charging devices to ensure that they integrated efficiently with the aircraft's management systems. The demonstrator aircraft utilized a CCS (Combined Charging System) connector which made the integration relatively simple. The CCS standard is common in electric vehicle charging and enables communication between the charger and the unit being charged, with CCS1 used in North America and CCS2 used in Europe. With other novel equipment, such as electric excavators, communication issues have been frequent during the first charging session. The project partners were therefore happy to notice that communication between the aircraft and the third-party charging equipment worked well from the first charge, which indicates a very good level of interoperability.

Technical review of the charger specifications was also done beforehand to verify compatibility. The team additionally tested and validated the usage of a CCS2 to CCS1 adapter and verified that interoperability was available. However, it should be noted that the adapter was rated for a lower charging power than the aircraft, so the charging power from the third-party fast-charger had to be decreased accordingly. After a short time, the charging cable at SVG was swapped from a CCS2 to a CCS1 cable, to eliminate the need for an adapter and to be able to charge at full power. This increased the charging stability significantly, and eliminated some minor connection-issues that had sometimes occurred while using the adapter.

It is recommended that a single standard is developed for charging systems to ensure effective integration with electric aircraft. BETA is working with other OEMs and industry partners to help encourage interoperability and a common charging standard. BETA is also engaged with associations like GAMA (General Aviation Manufactures Association) to promote these standards in aviation.

Thermal Management, Fast Charging, Rapid Turnaround operations
Fast turnarounds at airports will be one of the most important drivers of successful commercial introduction of electric aircraft, enabling the scale to drive efficiency and effectiveness.

Fast charging by its nature causes an increase in the temperature of battery packs, and this temperature rise can lead to the requirement for aircraft Battery Management Systems to restrict the speed of charging to control such a temperature rise. Consequently, thermal management can be used to control this rise by using liquid cooling during charging.

As part of the project, BETA provided a Thermal Management System, and this was tested over a period of rapid-turnaround flights. It successfully demonstrated a significant control of battery pack temperatures, and therefore validated the effectiveness of short-turnaround activities. An offboard thermal management system like this is not used today commonly for ground electric vehicles, but will enable electric aircraft to have increased performance and capabilities.

It is recommended that a single standard is developed for thermal management systems to ensure effective aircraft integration with ground infrastructure. BETA is developing this standardisation through partnerships with other OEM's, GAMA and SAE International to define these standards.

Temperature Considerations
One of the key pre-identified learning requirements was to understand the impact of outside air temperature (OAT) on the batteries and therefore in-flight energy management.

The collected data shows that there was minimal impact throughout the test flights, with battery performance being consistent across different temperature profiles. It should be noted that the aircraft was stored in a temperature-controlled hangar overnight (as per best practice) and was not "cold-soaked" for a significant period of time.

Overnight Stops
The aircraft was, when required, operated to aerodromes where it remained overnight. This proved to be another straightforward operation, with the key requirement being to ensure that the aerodrome was equipped with the correct power to enable charging to be carried out. One finding of the project is the need for information about available power outlets or charging infrastructure at airports easily available for all pilots, such as via NOTAMs and with a map placement or directions to the charging infrastructure.

Representative Flights
To ensure that data was collected and analysed that could be considered to be representative to actual potential A-B commercial flights, 13 flights were identified that flew between SVG and BGO or BGO and SVG. These flights were carried out between September 2025 and January 2026 in a range of temperatures and windspeeds. The data was consolidated as follows:

Table 3: Consolidation of data for representative flights

Number of Flights	13
Average Track (Nautical Miles)	96.5
Average Flight Time (mins)	53.2
Average Energy Used (kWh)	108.5
Average Groundspeed (knots)	109.8
Average Outside Air Temperature (^{0}C)	7.8

It should be noted that the direct distance between SVG and BGO is 86nm and the most direct IFR routing is 88 nm. The nearest alternative airport from BGO is SRP at 30nm range, and from SVG is HAU at 31nm range.

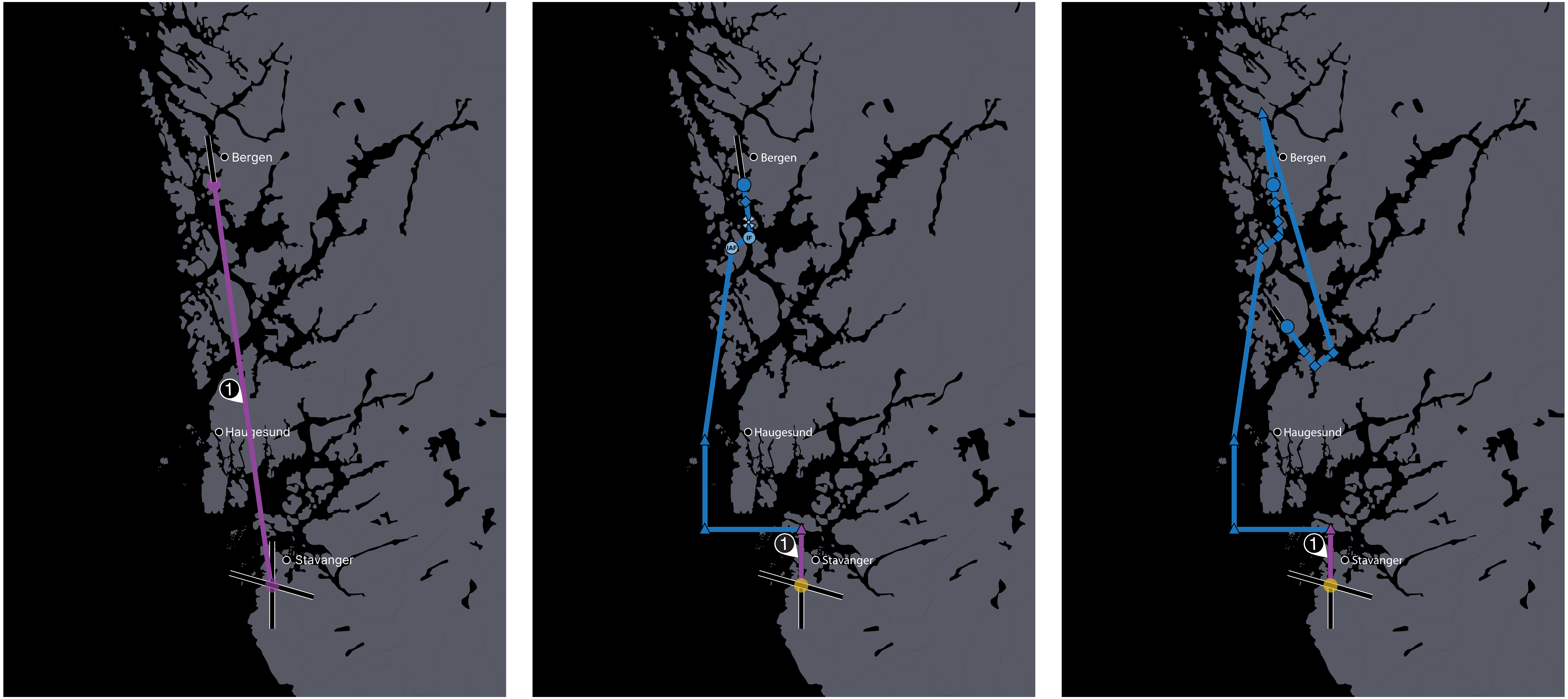
As an example, the following table shows an IFR flight plan between SVG and BGO, including the requirement to hold SRP as an alternate aerodrome. By using published procedures, and without utilizing a STAR procedure, the routing is 175 nm, if a STAR is included, then the track miles increase to >200 nm.

Table 4: Example of differences in flight plan routing and track mileage SVG - BGO

SVG to BGO	Route	Track Mileage
VFR Direct	SVG – BGO	86nm
IFR Departure then Direct	SVG – ALUVA1H – RIVIP RNP 35 - BGO	108nm
IFR w/Alternate	SVG – ALUVA1H – RIVIP RNP 35 – BGO – IRDAV – ARVOG RNP 32 – SRP	196nm

This highlights the challenges of operating an electric aircraft in IFR airspace and underlines the potential of 'e-routes' to be developed that enable more direct routings for new and novel aircraft.

Figure 7: Visual route comparison



VFR Direct SVG – BGO

IFR Departure then Direct SVG – ALUVA1H – RIVIP RNP 35 - BGO

IFR with Alternate SVG – ALUVA1H – RIVIP RNP 35 – BGO – IRDAV – ARVOG RNP 32 – SRP

3.1.4. Engineering Requirements

A further important assessment was to review the complexity of engineering new technology aircraft and develop a deeper understanding of maintenance personnel requirements for future commercial operations.

Reliability was excellent; it was clear that the simplicity of the aircraft systems, the use of distributed electric power, the fly-by-wire systems and the low complexity of maintenance tasks meant that day-to-day maintenance requirements were minimal and could be carried out by an individual engineer. As expected, more complex tasks such as battery pack replacement or depth maintenance activities would require at least two engineers, but could be effectively planned during expected downtimes.

3.1.5. Aircraft Delivery and Inspection

BETA was responsible for Aircraft delivery to Bristow’s Facility in SVG Norway to begin the Test Arena activities. Prior to the Test Arena BETA flew the aircraft throughout a large portion of Ireland, UK and Central Europe. Along the way BETA conducted multiple aircraft static and flight demonstration events for potential customers and familiarization sessions for multiple Civil Aviation Authorities. The largest event was flying the demonstrator aircraft in the 2025 Paris Air Show.

Upon arrival at SVG, BETA and Bristow maintenance conducted a joint “acceptance” inspection to document and verify the condition of the aircraft prior test arena flight operations. This inspection served as both a verification of airworthiness from an engineer technician perspective, as well as an opportunity to document the starting status of life limited parts such as approximate tire wear. BETA provided all required on site tools, spares and support equipment. All this equipment was delivered and stored at SVG Airport for the duration of the test arena project.

3.1.6. National CAA Traffic Permission & Operational Control

ALIA’s Special Airworthiness Certificate was issued by the FAA and required any operations outside of United States airspace to obtain permission from the governing authority of that airspace. This required BETA to apply for and obtain an appropriate Traffic Permission from the CAA for all flights in Norway. Upon submission of the required information package from BETA, and by recognising the FAA-issued Special Airworthiness Certificate, CAA found that the necessary requirements and conditions were fulfilled. The CAA therefore issued a Traffic Permission covering the entirety of the programme with the primary purpose to conduct market survey operations. A central condition in the Traffic Permission was that BETA would try to adhere to CAT regulations to the extent possible. Where not possible, BETA had to comply with the requirements listed in Part-NCO as a minimum.

The aircraft was N-registered from the FAA. The approval given by the CAA was in accordance with the provisions of the Aviation Act § 2-2 and § 4-4; Regulation (EU) 1178/2011 Part-FCL, Regulation (EU) 1321/2014, Regulation (EU) 923/2012 (SERA) and Regulation (EU) 965/2012 Part-NCO and Part-CAT.

This was a relatively straightforward process that required BETA to provide documentation of airworthiness, pilot training and certification, registration, insurance and the concepts of operation for the test arena project. The Traffic Permission was deliberately processed by a separate team within CAA, separate from the core CAA team involved in the Test Arena Programme, to ensure regulatory neutrality. The information provided by BETA allowed CAA to review and assess if the aircraft could operate safely in their airspace or if there were any additional limitations the CAA would require. The Traffic Permission was issued pursuant to the Norwegian Aviation Act Section 2-2 no. 4.

As the project progressed, the project partners simulated commercially equivalent operations by mirroring the relevant EASA Part-CAT regulations enabling the assessment of the suitability of the type of aircraft for future Part-CAT operations, while remaining in compliance with the FAA Special Airworthiness Certificate and CAA Traffic Permission.

3.1.7. Operator Safety Risk Management

The project partners drew on Bristow’s operational experience, safety measures, emergency response system and credibility operating in the Norway local area, and the safety risk management and procedures as referred to in Chapter 2.6 Safety and Risk Management. This provided a great foundation for the rest of the project activities to start from.

Table 5: Overview of ATC controller responses and observations at SVG and BGO

Responses from ATC	52
SVG responses	27
BGO responses	25
Operational observations reported - NO	43
Operational observations reported - YES	10

3.1.8. Air Traffic Management

Direct familiarisation between pilots and ATC proved essential for achieving this, ensuring controllers understood the aircraft's performance characteristics and operational needs. In addition, Avinor set up a voluntary quick survey for the ATC personnel to fill out after each interaction with the aircraft to capture any feedback they may have. Throughout 126 flights, the survey got 52 responses. Out of the 52 responses, ten made various operational observations, with no major consequences. Among other things, ATC commented that ALIA was characteristic to other single-engine airplanes of similar size.

No explicit observations on the ground related to taxiing were reported. Worth noticing was that a significant number of responses explicitly underscored a positive experience: "It was fun to work with an electric aircraft", or that the operation went well and there were no issues to report. Filling out the survey was for some perceived as additional work.

In sum, these ATC responses did not report any major challenges in integrating the ALIA into the existing airspace.

3.1.9. Small-Scale Operations and Low-Power Charging Economics

The demonstration programme provided valuable insight into the low operating cost potential of electric aircraft, particularly for small-scale operations with limited daily utilisation. While detailed cost modelling was outside the scope of the project, several clear cost drivers and implications emerged.

For operators with the ability to charge slowly over extended periods, such as overnight charging, reliance on high-power charging infrastructure can be avoided. Slow charging enables the possibility to shift electricity consumption away from peak hours, reduce maximum power demand, and, where relevant, combine charging with peak-shaving measures. This significantly lowers exposure to power-based grid tariffs, which are a key cost driver for charging prices in Norway.

In such operating concepts, charging costs are primarily driven by energy consumption (kWh), rather than peak power (kW). For a typical flight energy demand of approximately 108 kWh, and assuming an average electricity cost of around 0.13 EUR/kWh[2], the estimated energy cost per flight can be approximated as:

108 kWh × 0.13 EUR/kWh = 14.04 EUR

[Average kWh per flight × average electricity price = estimated energy cost per flight]

This level of operating cost represents a very favourable cost profile for electric aviation, particularly for smaller operations with predictable schedules and limited turnaround pressure. Importantly, this charging approach will in many cases not require investments in high-power grid connections or fast-charging systems, reducing both capital expenditure and operational risk in early market phases.

3.1.10. Fast Charging and Cost Implications for Airport-Scale Operations

In contrast, operators with a need for rapid turnaround times, or airports aiming to support high-utilisation commercial operations, will require access to fast-charging infrastructure. The cost structure for such operations differs significantly from that of slow-charging concepts.

Fast charging not only increases electricity costs due to increased investment in infrastructure, but also triggers substantially higher power-based grid tariffs, as grid charges in Norway are largely determined by the single highest power peak registered during a billing period. Even a limited number of high-power charging events can therefore result in elevated grid tariffs for an entire month, particularly during early operational phases with low overall energy consumption.

Using Norwegian fast-charging price levels within the automotive sector as an illustrative reference, with typical prices of approximately 0.64 EUR/kWh, the estimated energy cost per flight can be expressed as:

108.5 kWh × 0.64 EUR/kWh = 69.44 EUR

[Average kWh per flight × fast-charging price = estimated energy cost per flight]

In addition to higher energy costs, fast-charging operations require significant upfront investments in charging equipment and grid infrastructure. Low utilisation combined with high peak demand represents the most unfavourable cost scenario.

To prevent high investment and operational costs from becoming a barrier to electrification, public incentives and grant schemes are assessed as critical. While support for infrastructure deployment is important, subsidies addressing power-based grid tariffs are considered particularly effective. By fully or partially compensating peak power costs, the average charging cost per kWh can be significantly reduced, directly lowering the operational cost for electric aircraft.

The use of on-site battery systems offers an additional mitigation measure. By charging batteries gradually at lower power levels and supplying high charging power to aircraft from the battery, maximum grid demand can be reduced. This lowers power-based tariffs but introduces higher capital expenditure related to battery procurement, installation, space, maintenance, and replacement. Given current battery costs, public funding is therefore well suited to support pilot deployments and testing of such solutions at airports.

It should be noted that all cost figures presented are based on Norwegian electricity prices and grid tariff structures. Electricity markets, tariff systems, and incentive frameworks differ substantially between countries, and charging costs will therefore vary accordingly.

[2] NOK 0,1412 per kWh. Average cost per kWh incl. Grid for Norwegian households in 2025. Source: Statistics Norway SSB 09007: Kraftpris, nettleie og avgifter for husholdninger 2012-2025

Key Learnings From Impact Goal 1

- **Electric aircraft can be integrated into existing airport and airspace operations with limited disruption**, provided early coordination with ATC, ANSPs, and RFFS. Both VFR and IFR operations were assessed as operationally straightforward, and ATC feedback indicated no major integration challenges.
- **Training and licensing frameworks are largely transferable**, but access to suitably experienced personnel is a constraint. Single-pilot IFR experience—critical for future commercial operations—proved difficult to source in Norway, highlighting a need to adapt training pipelines and licensing strategies for electric aircraft operations.
- **Current IFR procedures are sub-optimal for electric aircraft**, as standard SIDs, STARs, and altitude profiles are designed for turbine aircraft. Long climb phases and indirect routings significantly reduce usable range, underlining the need for dedicated "e-routes" and adapted IFR procedures.
- **Energy reserves, holding, and alternate requirements** may cause a disproportionate operational impact on limited-range electric aircraft. Close familiarity by ATC with aircraft performance is essential, and there may be scope to review minimum energy requirements under defined conditions as part of future regulatory development.
- **Charging infrastructure and interoperability are critical enablers of operations**, particularly for overnight stays and A–B flights. The project demonstrated that standardized charging interfaces (CCS) work well in practice, but also highlighted the need for clear, accessible information on available power and charging locations at airports.
- **Fast charging and thermal management are key to commercial viability**, enabling rapid turnaround operations. Active thermal management was shown to significantly reduce battery temperature rise during fast charging, validating the feasibility of short-turnaround concepts—but also pointing to the need for standardized thermal management solutions.
- **Maintenance and engineering requirements are comparatively low and predictable**, driven by system simplicity and distributed electric propulsion. Day-to-day maintenance could be handled by a single engineer, with more complex tasks planned during downtime—supporting scalability for future Part-CAT operations.

> *"The need for development of "e-routes" is a key finding from the demonstrations in the Test Arena, and a key enabler to advanced air mobility. As an ANSP, Avinor recognizes the need to explore ways to optimize the routing to cater for the special needs of electric aircraft"*
>
> - Jon Fredrik Løvberg,
> VP Airside Operations, Avinor

Image 5: Demonstration aircraft at Florø airport.
Photo: Ø. Løwer / Avinor

3.2. Impact Goal 2: Safe and efficient testing of new technology that contributes to necessary regulatory development

Executing a demonstration programme where an aircraft or an operation is not fully certified or approved could inherently represent a higher risk. Several mitigations were established to maintain an acceptable level of safety. By using a phased approach in the programme, establishing a dedicated Safety Steering Committee, having no commercial pressure in executing flights and having continuous dialogue on operational and safety-related topics, the operation was conceived as controlled and uneventful.

Nevertheless, the aim of the demonstration project extended beyond aligning with the current regulatory framework. As reflected in the learning objectives, the aim of the project exceeded simply achieving compliance with existing regulations, the ambition was also to evaluate the suitability of the current regulatory framework for this type of operation, uncover potential regulatory barriers and needs for regulatory development. The relevant regulations and environments for Part-CAT operations (over and above the basic approval to operate in the sandbox) were considered.

3.2.1. Safe and Efficient Testing through Operational Phases

The three operational phases – familiarization, maturation and growth – were followed as planned and was important to ensure safe and efficient testing. No further adjustments to the original Traffic Permission were required during the project period, indicating that the regulatory sandbox established for the demonstration programme was appropriately designed. The absence of changes reflected that no operational need arose at the time. However, in retrospect, had such needs emerged, it would have been advantageous if the approval had been structured to align more explicitly with the different phases of the project. A phased approval framework could have offered greater flexibility and strengthened the programme's overall robustness, allowing regulatory adaptations to be made more efficiently as the project progressed.

3.2.2. Safe and Efficient Testing through Just Culture

Throughout the project all four Project Partners agreed to a collaborative culture whereby reporting of any observations, mistakes or incidents would be positively encouraged, and that the principles of Just Culture would be followed. In a Just Culture environment "front-line operators or other persons are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but in which gross negligence, wilful violations and destructive acts are not tolerated" (International Civil Aviation Organization (ICAO). It was also essential to ensure that anything that was unsafe, or could appear to be unsafe, could be highlighted and if necessary, work could be stopped to enable such an issue to be reviewed without time pressure.

3.2.3. Reporting of Potential Hazards

A hazard register is necessary to be able to identify risks and to further mitigate these risks. The reporting was also important for CAA in developing a register for hazards (Hazard ID) for new technologies or concepts being introduced. As requirement of the Traffic Permission, all reports made in the BeSafe system were shared with the CAA. Even minor events and issues that might ordinarily be perceived as insignificant were consistently reported throughout the project. Hence, the threshold for reporting was intentionally low, clearly reflected by the number and diversity of reports submitted. The CAA confirmed that all the occurrence reports were received in the ECCAIRS 2 database, demonstrating that the reporting mechanisms functioned as intended. 22 reports were reported, of which all of the 22 reports were closed. This indicates that a genuine just culture was established during the demonstration project, which is seen as key for safe testing of new technology. The types and classifications of the reports are shown in tables 6 and 7.

Table 6: Types of safety reports

Hazard reports	3
Ground Safety report	1
Air Safety	18
Sum of safety reports	**22**

Table 7: Classificaton of safety reports

Ground Handling / Maintenance	7
Flight Handling	2
Environment	3 (2 bird activity)
Radios	6
ATC	3
Planning	1
Sum of safety reports	**22**

Image 6: Left: Minister of Transport, Jon-Ivar Nygård. Right: Minister of Climate and Environment, Andreas Bjelland Eriksen. Photo: Ø. Løwer / Avinor

3.2.4. Classification of the Aircraft

New technologies come with properties that do not fit the existing regulatory framework. One example from this operation is the classification of the aircraft. The EASA OPS Regulation[3], Part-CAT, classifies aircraft based on engine technology either being reciprocating engines or turbine engines. It is therefore necessary to consider the introduction of classifications suitable for aircraft with hybrid and electric engine technology.

3.2.5. Energy Reserves

The flights clearly demonstrate that current regulatory energy-reserve requirements in Part-CAT impose significant operational constraints on such operations. As indicated in Impact goal 1, maintaining regularity was highly dependent on favourable weather conditions, limiting regularity needed for extensive commercial use. These limitations became particularly evident during IFR flights and operations in IMC, where narrow energy management margins were further reduced. Although these issues are most visible for electric aircraft, they may also become relevant for other energy carriers and emerging aviation technologies. The introduction of electric aircraft highlights a need for regulatory bodies to re-evaluate certain aspects of airspace management.

3.2.6. Climb and Lower Airspace Sections

The Norwegian AIC-N 09/19 on weather minima for the approval of Part-CAT SET-IMC[4] operations is an example of a national requirement developed in response to the Norway's mountainous topography and associated risk factors. While the rationale behind the AIC remains fully justified, its practical implications may limit commercial use of battery electric aircraft, particularly because unpredictable weather conditions make planning and operational regularity difficult under the prescribed minima. Holding the principle that safety should never be compromised as overriding priority, it may nevertheless be appropriate to reexamine whether the operational characteristics of new technologies could help mitigate some of the underlying risks that the AIC seeks to address, while still maintaining an equivalent level of safety. The demonstration flights provide initial evidence base for assessing whether specific performance features of this aircraft category, such as reduced system complexity, enhanced automation, or other inherent capabilities, could support a more tailored regulatory approach without diminishing established safety objectives.

3.2.7. Airspace Management and Uniform Airport Approach

Overall, the ATC reports indicate that the ALIA can be integrated into the existing airspace structure. However, the demonstrations highlighted clear opportunities to optimise lower-altitude airspace. Current approach profiles are typically uniform, designed for aircraft with higher climb performance and decreasing weight during flight. The mass of this type of aircraft remains constant from take-off to landing, influencing both climb capability and approach planning. Thus, given battery-electric capabilities, this uniform approach designs remain suboptimal for aircraft such as the ALIA.

These differences show that battery-electric aircraft have operational and regulatory requirements that diverge from those of conventional energy carriers. Exploring low-climb corridors or alternative arrival concepts could help accommodate their performance characteristics and reduce constraints on their operation. Allowing operators to propose such procedures would provide regulators with practical evidence to support the development of appropriate airspace frameworks for this new aircraft technology.

3.2.8. Training of personnel

EASA Part-66 and Part-147[5] for maintenance personnel, together with Part-FCL[6] for flight crew, illustrate how the current licensing and training framework provides a solid basis for competence management in aviation. Although the aircraft's maintenance and operational complexity is notably lower than that of conventional aircraft, the same licensing structure applies. Even with a simplified aircraft design, the current training regulations can result in higher formal training and licensing requirements than those applied to more complex conventional platforms. The demonstration project highlighted that the emergence of battery electric aircraft may therefore warrant reflection on whether existing requirements remain proportionate and optimally aligned with operational realities of battery electric aircraft.

The introduction of new technology (e.g. automation) often requires careful consideration of how to balance giving up control in favour of reliable technology with appropriate competence requirements, without compromising safety. This is a broader challenge across technologies.

A shift to new aircraft technologies affects the entire operational ecosystem, including aerodrome personnel, ATC, training organisations and the CAA. Identifying the specific competence requirements across these functions will be important for ensuring a coherent and safety oriented regulatory approach as such technologies mature.

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3) Regulation (EU) 965/2012

4) Single Engine Turbine-Instrumental Meteorological Conditions: 09/19 Værminima ved godkjenning av ervervsmessige SET-IMC operasjoner i Norge

5) Regulation (EU) 1321/2014

6) Regulation (EU) 1178/2011

Key Learnings From
Impact Goal 2

- **Safe and efficient testing was ensured through a phased programme**, which collectively maintained a safe and controlled operational environment within the frames of the issued Traffic Permission.
- **A low threshold for safety reporting fostered a genuine Just Culture**, ensuring that all relevant events were reported and enabling CAA to develop a hazard register.
- **The definition and classification of the aircraft highlighted limitations in current Part-CAT regulations**, demonstrating that hybrid and electric propulsion require new regulatory classifications to ensure appropriate oversight.
- **Energy-reserve requirements in Part-CAT** reveal significant constraints on battery-electric operations, especially under IFR and IMC, indicating the need to re-evaluate reserve frameworks for aircraft with limited energy margins.
- **The performance characteristics of battery-electric aircraft** are better adapted to lower-airspace operations. As a result, national requirements such as AIC-N 09/19 are not well aligned with these characteristics and create unpredictable operational regularity in practice.
- **Uniform approach profiles in current ATM** are not optimised for constant-mass and low-climb aircraft characteristics, suggesting that regulators should consider alternative approach profiles and low-altitude corridors to better align with their performance.
- **Training of personnel** revealed that existing licensing frameworks may be disproportionate for technologically advanced, mechanically simple electric aircraft, signalling the need to reassess competence requirements across pilots, maintenance staff, ATC, aerodrome personnel and CAA inspectors.

> *"Understanding how the present regulatory framework works for new technologies is critical for us. What parts are working as they are and what parts may be subject to improvements? We are also further developing our safety management thinking based on these novel concepts – and have seen how important a strong and joint safety culture is for professional preparation and execution of innovative operations"*
>
> - Jan Petter Steinland, Director Strategic Analysis and Transformation, CAA

Image 7: Demonstration aircraft charging at Florø airport.
Photo: Ø. Løwer / Avinor

3.3. Impact Goal 3: Knowledge on establishment and scaling of value chains for new energy carriers in aviation

The International Test Arena aims not only to accelerate Norway's transition toward low- and zero-emission aviation, but to also generate positive spillover effects for the Norwegian industry. Norway has a long experience as an early mover in the transition from fossil fuels to zero-emission electric mobility. In car sales, around 95% of new cars sold in 2025 are fully electric, compared to 10 years ago when the market share was around 15%, and 15 years ago around 1%. The transformation of the Norwegian transport sector, through large-scale deployment of charging infrastructure, new mobility solutions, evolving user patterns, improved user experiences, and growing societal acceptance of innovative technologies, provides valuable insights. This background offers valuable knowledge for establishing and scaling new value chains in aviation.

By leveraging this national experience, the Test Arena seeks to stimulate innovative market participation and support the rapid development of operationally feasible charging solutions for electric aircraft.

3.3.1. Experience from Public Procurement

Open procurement processes are an effective way to gather practical knowledge and stimulate innovation, and as a public company Avinor is required to make public procurement on all purchases. For the purchasing process of charging infrastructure, suppliers were invited to propose solutions that met airport-specific requirements, including height limitations and safety distances related to aircraft movements and ground obstacles.

This approach resulted in hands-on testing of a mobile battery container that provided on-demand fast charging without requiring a high-capacity grid connection. It also provided experience with installing underground charging infrastructure and assessing different types of user interaction with equipment.

The demonstrations showed that current fast-charging technologies are functional and reliable. However, scaling these technologies to support larger aircraft with significantly higher power requirements will require targeted adaptations. Importantly, the suppliers involved in the initial demonstrations see opportunities to further develop and commercialize the solutions they designed, including applications in heavy transport, electric construction machinery and other sectors undergoing electrification. This indicates that the Test Arena contributes positively to supplier-driven innovation.

Looking ahead, the industry will depend on standardised charging interfaces and harmonised charging port placement on aircraft. Airports will also require substantial investment in high-capacity grid connections. In our project, investments in increased grid capacity, including a new high-voltage connection and grid station, accounted for approximately 80% of total costs, while the fast charger itself represented less than 20%. As charging power levels increase, challenges may arise related to cable weight, equipment size, risk of damage and HSE considerations during aircraft connection. These factors will be crucial to address in order to enable large-scale electric aviation.

3.3.2. Aerodrome and Apron

During the demonstration programme, the aircraft visited seven airports. As part of standard practice when arriving at a new location, the crew undertook familiarisation activities, typically through direct contact with ATC or other airport personnel in advance of the visit. The information exchanged concerned, among other things, available facilities. The project made it clear that such information was essential for planning purposes, yet it also revealed that no centralised or standardised source for this type of data currently exists.

Low- and zero-emission aircraft like the ALIA may require charging facilities that are not compatible with conventional stands or apron layouts. This can lead to aircraft being parked in non-standard or remote positions, often separated from normal ground-handling routines.

Given the operational needs of electric aviation, airports should ideally provide relevant facility information through established and standardised communication channels such as the AIP or ADR charts. This could include details on charging infrastructure, such as charging facilities, available charging power, plug types, number of chargers, their location, adapter compatibility, and access to charging hatches. Making this information routinely available would improve predictability for operators and support safe and efficient integration of electric aircraft as they enter the commercial domain.

3.3.3. Experiences from Stavanger Airport Sola – SVG

At SVG, Avinor initiated a public procurement for a permanent charging solution and received five offers. The selected solution was delivered by DriiV AS, with hardware from Kempower. The demonstration provided concrete insights into how Nordic climate conditions affect equipment performance.

The solution was a 300kW fast charger located off the apron, with an underground conduit to a hatch on the apron. Inside the hatch was a charging control unit, and a 5-meter charging cable with a Combined Charging System 2 (CCS 2) cable, with an adapter from CCS2 to Combined Charging System 1 (CCS1) as the charge port on the aircraft was CCS1. Due to use of the adapter, which was rated for slightly lower effects than the aircraft, the maximum charging effect from the charger had to be decreased. The use of CCS2 to CCS1 adapter worked, but it is suspected that the adapter led to minor charging or connection issues and is not recommended as a permanent solution. In late September a new CCS1 cable was installed, and the connection issues were eliminated. The charger could then be upgraded to deliver maximum charging effect. It is also worth noticing that the CCS standard enable the charging of other vehicles at the airport, so depending on the placement it can represent

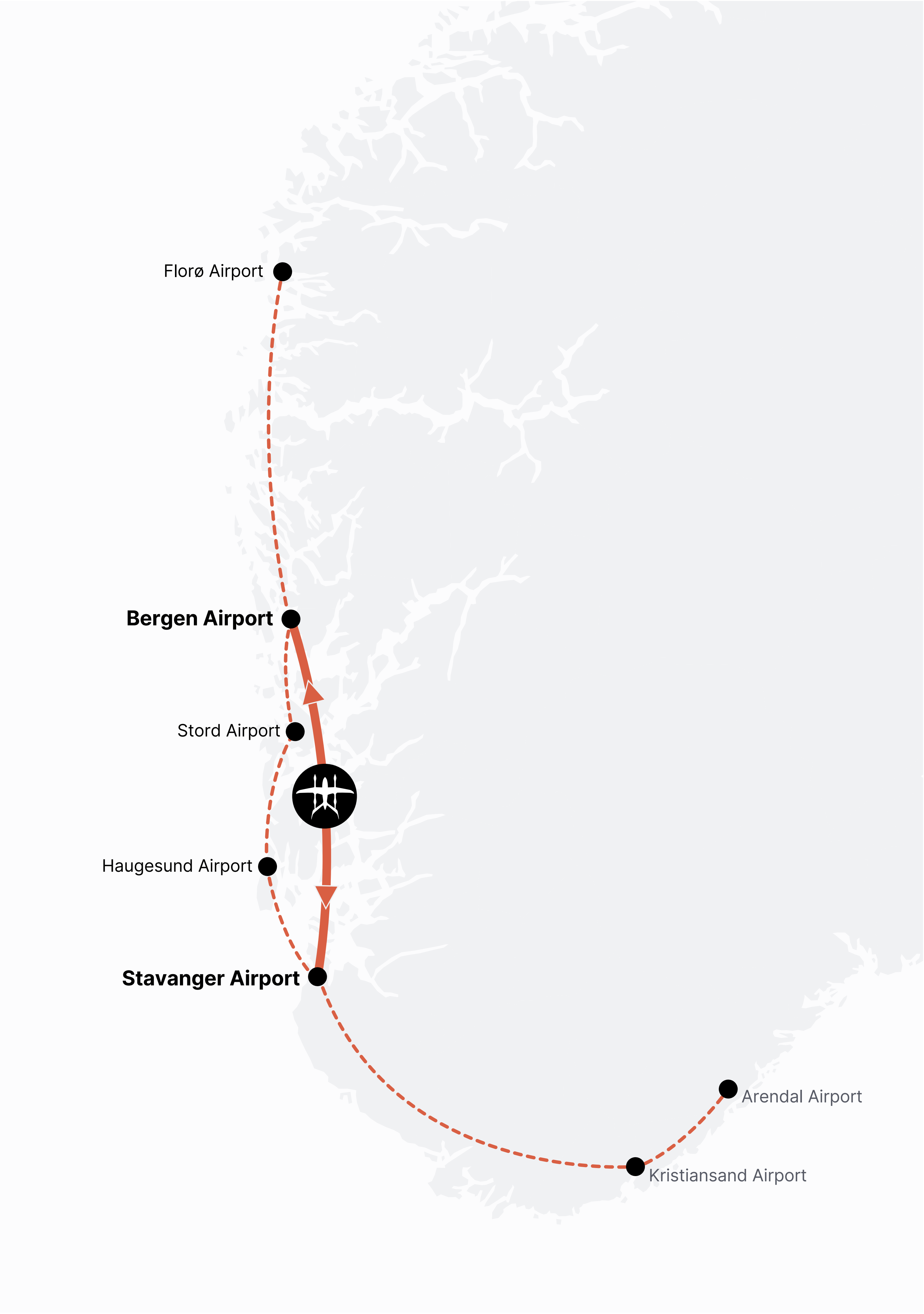

Figure 8: Illustration of visited airports

multiple charging possibilities. In order to utilize this most effectively, it will be an advantage if both the aircraft and the other vehicles in the airport can use the same charging plug without an adapter.

The underground charging hatch required design adaptations to handle Norwegian winter conditions. During the planning phase, Avinor and the Irish hatch manufacturer developed a sloped bottom and drainage design to minimise water ingress. This solution performed well in practice. Frost, ice and snow created challenges with access to the lock, and opening of the hatch. These were addressed by installing heating pads to keep the hatch clear of snow and ice. Another important consideration was temperature management inside the hatch. The team evaluated whether the hatch needed to stay open during charging to prevent overheating, or whether it could remain closed to reduce the risk of trip or fall hazards. These operational insights will be used to optimize future infrastructure design.

3.3.4. Experiences from Bergen Airport Flesland – BGO

At BGO, the local energy grid had limited capacity, and the grid operator estimated a lead time of approximately one year for an upgraded connection. Since the demonstrations needed to take place within six months, Avinor requested a charging solution that did not rely on a strong grid connection. After dialogue with the market it was decided to procure a solution with a leased battery bank combined with a CCS fast charger, to avoid a large investment cost on the batteries.

Seven offers were received, and the winning supplier was Skagerak Mobil Energi with hardware provided by Ayond. The solution consisted of a battery container with approximately 208 kWh of usable energy. It operated on a 400V 125A grid connection and could deliver up to 300 kW of charging power.

Battery containers proved to be a viable way to deliver fast charging at airports with limited grid capacity. They may also serve as backup power sources for other airport needs.

Several early-stage challenges were identified, particularly relating to winter temperatures and heat distribution inside the container. Adjustments to internal fans were needed to ensure stable temperature levels and optimal output. These issues were resolved quickly by the supplier.

Flesland also tested a movable charging arm, allowing the charging unit and cable to be rolled to the aircraft. The concept worked well but required careful snow removal and surface maintenance to avoid small obstacles such as ice ridges. The battery container included a visual display that enhanced user friendliness. Future versions could further improve usability by showing charging speed, system errors and whether power limitations stem from the charger, the grid or the aircraft.

The demonstrations were supported by a consistently positive and proactive team of pilots, mechanic, suppliers and local staff. Minor issues did occur, but they were resolved quickly thanks to a patient and solution-oriented mindset. This cooperative attitude eliminated friction and kept the project running smoothly, creating a constructive atmosphere throughout the testing period.

Image 8: Demonstration aircraft and temporary mobile charging infrastructure at Bergen airport. Photo: M.S. Mølmen / Avinor

Key Learnings From Impact Goal 3

- **Long lead times for upgraded grid connections can be a major barrier.**
- **Aerodrome and apron operations demonstrated the need for airports to provide standardised, centralised information on charging infrastructure,** as electric aircraft often require non-standard parking positions and advance coordination to ensure safe and predictable operations.
- **Battery containers are a practical solution for airports with limited power availability.**
- **Charging solutions in Norway must be designed for Nordic climate conditions**, including snow, ice and large temperature variations.
- **Existing fast-charging technology works** but requires adaptation for larger aircraft and higher power needs.
- **Standardisation of aircraft charging ports and charging interfaces is essential** for scalable and future-proof solutions.
- **Open procurement stimulates innovation** and yields diverse technical solutions.
- **Early collaboration between airports and suppliers is essential** for solving practical challenges.
- **Real-world demonstrations reveal operational details** that cannot be identified through planning alone.
- **User-interaction design is critical for safe and efficient ground operations.**
- **Climate adaptations must be built into equipment design from the start** rather than added later.
- **Flexibility in infrastructure approaches increases resilience** during early technology adoption.
- **The value of a positive and collaborative attitude should not be underestimated.**

> *"The demonstrations confirm that establishing and scaling new energy value chains in aviation is not only a technical task. It is an operational challenge that requires flexibility, coordination and learning in live airport environments as technologies and standards continue to evolve."*
>
> - Karianne Helland Strand, Executive Vice President for Sustainability and Infrastructure, Avinor

Image 9: BETA Pilot Nate Dubie (left) and Bristow Pilot Jeremy Degagne (right) at Arendal airport. Photo: Ø. Løwer / Avinor

3.4. Impact Goal 4: Knowledge about market potential for new air mobility

An important element of the Test Arena is understanding where new air mobility solutions can create value in Norway and internationally. To assess market potential, the project combined real-world demonstrations with market dialogue, including engagement with stakeholders and observations of emerging industry and public interest. This chapter summarises the main learnings on public acceptance, potential use cases, and conditions that may influence market introduction. It also highlights how policy and regulatory framework can enable or constrain early deployment, and where new market segments may emerge as certification and operational models mature.

3.4.1. Public and Stakeholder Engagement

The demonstrations generated significant engagement across Norway, offering strong indications of public interest in new air mobility. The aircraft was showcased at seven airports, including high-visibility events such as Arendalsuka, the First Flight celebration at SVG, and the inaugural charging event at BGO. These gatherings attracted industry leaders, politicians, educational institutions, and the general public. National and international media coverage, including NRK and The New York Times, helped elevate Norway, BETA and Bristow's profiles as early movers in sustainable aviation. Overall, the consistently positive tone across media and public interactions demonstrated widespread curiosity and openness toward low-emission air mobility.

While no public surveys were conducted, early reactions from interviews suggest that societal acceptance may evolve similarly to electric cars and trucks, where scepticism diminished once users experienced benefits such as reduced noise and improved comfort. These developments point to early market opportunities as familiarity with the technology increases. According to the Societal Readiness Level (SRL) framework (Francis et al., 2026; Innovation Fund Denmark, n.d.), this demonstration programme has advanced the SRL for electric cargo operations in Norway from SRL 5 ("Proposed solution(s) validated by relevant stakeholders") to SRL 6 ("Solution(s) demonstrated in a relevant environment with stakeholders"). Given the programme's duration, learning outcomes and improvements made throughout the demonstration period, the maturity level can reasonably be considered to have progressed further towards SRL 7 ("Refinement of the solution and possible retesting").

In this respect, the demonstration programme has been successful in significantly advancing the societal readiness for electric cargo operations in Norway.

3.4.2. Industry Interest and Emerging Market Opportunities

The demonstration generated strong engagement from operators, public authorities, and industry partners exploring how electric aviation could enable new connectivity solutions. Several use cases emerged as particularly promising within this region, including medical transport, improved connections for island and remote communities, regional tourism, logistics and time-critical cargo, and government or military support missions. These applications share a common need for reliable short-distance connectivity, often in areas where geography, cost, or environmental considerations have historically limited the viability of conventional aviation. In particular, logistics and cargo operators highlighted the opportunity to improve delivery speed and network flexibility on short-haul routes, while medical stakeholders pointed to increased responsiveness and access in remote areas. Passenger and regional mobility use cases also showed potential to increase frequency and accessibility on underserved routes.

A key insight from industry discussions is that electric aviation has the potential not only to replace existing services but also to unlock entirely new markets. The combination of lower operating costs, reduced noise, and zero-emission operations could make short regional routes economically viable for the first time, particularly in areas with dispersed populations and challenging terrain. Throughout the project, there was clear interest at both the political and operator level in moving toward early adoption, with several stakeholders indicating that they would be prepared to move toward procurement or operational planning as soon as regulatory approvals and aircraft certification are achieved.

The project also stimulated considerable interest from sectors connected to the future aviation value chain. The charging and energy industries showed strong enthusiasm, linking aviation electrification to Norway's broader transition to electrification in road transport, heavy vehicles, and construction machinery.

3.4.3. Policy Levers, Barriers and Conditions for Market Introduction

The project highlighted several structural factors that will influence the pace and scale of new air mobility adoption in Norway. Government procurement power, including through future PSO route tenders, represents a powerful lever for stimulating early demand. If environmental requirements or new route configurations are introduced, the state could directly accelerate the transition toward low- and zero-emission aviation. At the same time, key barriers must be addressed, including grid capacity constraints, the need for robust charging standardization, integration with airport turnaround operations, and the weight and cost of current battery technologies. Addressing these challenges, combined with targeted incentives and continued technology development, will be essential to enabling large-scale deployment.

Key Learnings From Impact Goal 4

- **Public and stakeholder engagement showed strong nationwide interest in new air mobility**, with large audiences at seven airports and high-profile events, positive media coverage, and indications that societal acceptance is following a trajectory similar to electric road transport, raising the Societal Readiness Level from SRL 5 toward SRL 7.
- **Industry interest signals emerging market opportunities across the aviation value chain**, especially from charging and energy companies that see aviation electrification as a natural extension of Norway's broader electrification transition, highlighting commercial potential for suppliers adapting solutions to aviation needs.
- **Several promising use cases were identified, such as medical transport, island connectivity, tourism, logistics, and time-critical cargo. This indicates that electric aviation can both replace and expand services**, making short regional routes economically viable due to lower costs, reduced noise, and zero-emission operations.
- **Policy levers and structural conditions will strongly influence market uptake**, with government procurement (e.g., PSO tenders) offering powerful demand-pull potential, while barriers such as grid capacity, charging standardization, airport operational integration, and battery weight/cost must be addressed to enable large-scale deployment.

> *"The excitement around the advancement of electric aviation was contagious everywhere we took the aircraft. Everyone was surprised how large and capable the aircraft is. Clearly, it's designed to fly all around the beautiful, but challenging terrain of Norway, and it's doing it quiet, clean and efficient!"*
>
> - Nate Dubie, BETA ALIA Instructor
> Pilot and Operational Test

Image 10: Demonstration aircraft at Arendal airport. Photo: Ø. Løwer / Avinor

3.5. Additional findings and learning

In addition to the findings structured under impact goals 1–4, the demonstration project generated several observations related to collaboration, operational planning and execution in a multi stakeholder test environment. This chapter summarises supplementary findings and learnings that do not naturally fit within the preceding impact goal chapters, but which were nevertheless important enablers for safe and efficient demonstrations. The section therefore focuses on practical experience from local engagement, coordination with stakeholders, health and safety considerations, communication and alignment across project partners, and how these insights can inform future Test Arena activities.

3.5.1. Local Engagement and Operational Preparedness

Early involvement of local airports proved essential for building ownership, strengthening collaboration, and ensuring smooth project execution. When local personnel were included from the outset, they developed a stronger sense of responsibility and were more willing to contribute ideas. Thorough preparation of RFFS teams was equally critical by introducing them to the aircraft beforehand, presenting the crash card, and ensuring they felt confident in handling the technology, and showing the aircraft when it arrived This reduced uncertainty and enabled them to treat the aircraft like any other familiar platform. The same level of preparedness was necessary for emergency crews at alternate airports and increased the acceptance level and level of trust.

3.5.2. Coordination With ATC and Flight Operations

Proactive communication with Air Traffic Control contributed significantly to efficient demonstrations. Early meetings with ATC helped set expectations, prevent conflicts with peak traffic periods, and establish shared understanding of the operational plan. Pilots communicated early and openly with local towers, clarifying aircraft behaviour ("it behaves like a conventional small aircraft") and receiving timely updates on local conditions, such as optimal arrival times. This consistent two-way communication ensured safe, predictable, and well-coordinated operations.

3.5.3. Health, Safety, and a Learning Culture

Electric aircraft introduce new health and safety considerations—not inherently negative, but different. Electric motors create a "silent" hazard compared to the audible cues of a running conventional aircraft, and this distinction should be incorporated into future safety training. At the same time, lower noise and reduced exposure to grease, oil, fumes, and smell can improve workplace comfort and technician well-being. Maintaining a "Just Culture" remains vital, ensuring that observations and lessons are reported and openly shared to enhance safety for all stakeholders.

3.5.4. Building a Just Culture

In a global operation, establishing and maintaining a Just Culture cannot be taken for granted. Different organisational and national cultures shape how personnel perceive accountability, reporting obligations and openness around errors or deviations. The project demonstrated that promoting Just Culture requires deliberate attention, particularly when teams with varied backgrounds and work practices collaborate. Ensuring that all participants understand the principles of Just Culture—and feel confident that reports will be treated fairly—is essential for achieving reliable and transparent safety reporting across borders and operational environments.

Physical meetings were essential throughout the project, particularly during critical phases such as contract negotiations. In-person workshops enabled faster clarification than digital channels alone, which is especially valuable in innovation processes where not everything is suited for Teams or email. These physical sessions also helped participants get to know one another better, creating an open and constructive tone that strengthened collaboration. Meeting face-to-face fostered trust and built strong working relationships across the project partners, and contributed to a positive and supportive project climate. The value and impact of physical meetings should therefore not be underestimated.

3.5.5. Communication, Visibility, and Cross-Functional Alignment

Communication played a major role in the project, attracting wide interest from internal stakeholders and national and international media. The production of communication materials and the visibility created through physical events reinforced the importance of having a cross-functional communication group with the authority to make rapid decisions. Given that communication and news value are time-sensitive, this mandate ensured consistent and timely messaging across all Project Partners.

3.5.6. Continuous Learning and Future Demonstrations

For both Avinor and the CAA, it is important to emphasise that this project represents only the first in a series of demonstrations. It is neither possible nor expected to learn everything from a single initiative. The intention is to take a step-by-step approach, enabling further demonstrations and gradually integrating lessons learned. These insights will support the development of airports, regulatory evolution, and continued testing of low- and zero-emission aircraft, contributing meaningfully to the broader goal of a more sustainable aviation ecosystem.

Key Learnings

- **Early local engagement strengthens operational readiness**, as involving airport staff and emergency teams from the outset builds ownership, increases confidence in handling new technology, and ensures smooth execution at both primary and alternate airports.
- **Proactive coordination with ATC and flight operations enables safe and predictable demonstrations**, with early briefings, expectation-setting and continuous communication ensuring alignment on traffic peaks, aircraft behaviour and local conditions.
- **Electric aircraft introduce new health and safety considerations that must be integrated into training**, including awareness of “silent” electric motor hazards, while also offering workplace benefits such as reduced noise and fewer emissions.
- **Building and maintaining a Just Culture across organisations and national contexts requires deliberate effort**, ensuring all personnel feel safe to report issues and trust that observations will be handled fairly and transparently.
- **Physical meetings remain crucial for complex, innovative projects**, enabling faster problem-solving, clearer alignment, and stronger interpersonal trust than digital communication alone can provide.
- **Effective communication and visibility depend on a cross-functional team with decision-making authority**, ensuring timely, coordinated messaging for internal stakeholders and media during a fast-moving, high-profile project.
- **Continuous learning is essential, as this demonstration represents only the first step**, with future trials expected to refine understanding, guide regulatory evolution, and support the progressive integration of low- and zero-emission aircraft into the aviation ecosystem.

4. Implications and Recommendations

4.1. Implications for Infrastructure, Aerodrome and ATM

From an ATM perspective, the introduction of electric conventional take-off and landing (eCTOL) aircraft is expected to be relatively straightforward, as their operational profiles are largely comparable to those of conventional aircraft. Greater challenges are anticipated with vertical take-off and landing (VTOL) aircraft, which may require new procedures, airspace concepts, and traffic management solutions.

In addition, electric aircraft may have different physical dimensions and configurations compared to the aircraft currently in operation, with implications for both airside operations and infrastructure planning. In that perspective, standardization of for example charge port placement or thermal management connections on aircrafts will be important to ensure easy operational integration airside. For aerodrome operators, a key consideration is the long lead time associated with establishing charging infrastructure and securing sufficient grid capacity. This underscores the importance of early and continuous dialogue with operators planning to transition to electric aircraft, in order to ensure timely infrastructure development aligned with future operational needs.

4.2. Implication for Market Actors

The project has drawn attention from suppliers who had not previously considered aviation as a relevant market. One example are charger providers, who reported that the project opened new opportunities for further development of their products. Thus, electric aviation represents an emerging business domain with potential for entirely new commercial models. From a strategic perspective, the early stages of electric aviation can be viewed as a “Blue Ocean” opportunity, where limited competition and high innovation potential create favourable conditions for new market entrants (Kim & Mauborgne, 2005).

4.3. Implication for Policy

Given its dependency on high energy density, stringent safety requirements and long certification cycles, the aviation sector is recognised as difficult to decarbonise. Due to this complexity, no single solution will deliver the necessary emissions reductions. Instead, progress in decarbonisation will depend on integrated operational, technological and regulatory measures.

This programme has demonstrated that electrification offers a practical and effective pathway towards low emission regional aviation. However, electricity is an increasingly scarce resource, and electric aviation will require prioritisation within national energy planning. Secure grid connection is a fundamental prerequisite, and we call for policymakers to ensure adequate grid capacity and infrastructure availability at airports.

Policymakers also hold substantial influence through environmental regulation and targeted incentives. Public tools such as PSO routes and strategic public procurement may play a pivotal role in accelerating early adoption, particularly if implementation begins at a limited scale and within a clearly defined operational scope. Moreover, well-designed policy instruments, e.g. environmental requirements, financial incentives, or supportive frameworks can accelerate adoption.

4.4. Regulatory Implications

The regulatory implications identified in this demonstration programme concern several levels of the aviation system, including the CAA, EASA and ICAO. The programme has demonstrated that electric aircraft have operational and regulatory characteristics that do not fully align with those of conventionally powered aviation. Based on the findings, we have identified a set of key areas where regulatory development or clarification may be necessary. The main areas for regulatory consideration are as follows:

First, based on the findings we recommend to further look into the aircraft classifications and associated energy-management requirements for Part-CAT operations under Regulation (EU) 965/2012 for possible revision (as outlined in Sections 3.2.1 and 3.2.2). In addition, the national requirements for approving

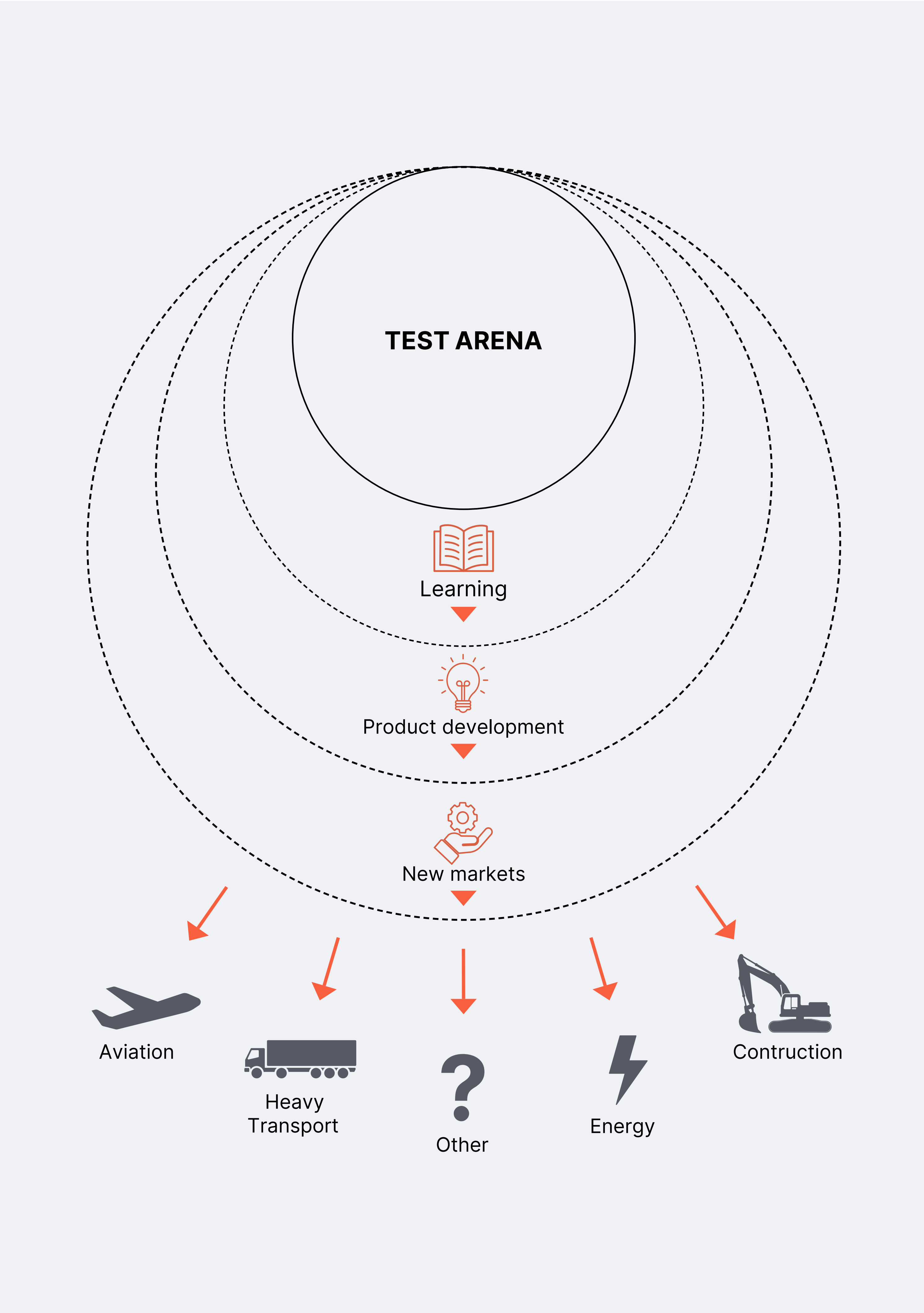

Figure 9: From test to value creation

SET-IMC operations in Norwegian AIC-N 09/19 may need reconsideration to better accommodate electric single-engine Part-CAT operations, as described in Section 3.2.3.

Second, relating to airspace routing and procedure design, the findings suggest future regulatory development regarding low-climb corridors or alternative arrival procedures to mitigate performance liabilities. Allowing operators to propose such procedures would provide regulators with practical insight into how rules and frameworks might evolve to accommodate this type of aircraft.

Third, implications regarding airport design requirements, apron layout and the communication of facilities could be considered from a regulatory standpoint. As electric aviation introduces new infrastructure needs, particularly related to charging, there may be a need to clarify or update standards for airport planning and the publication of essential facility information.

Fourth, the identification of future competence requirements. New technologies may necessitate updated regulatory frameworks covering training and qualifications not only for flight crew, but also for aerodrome personnel, ATC, training organisations and the CAA representatives.

Fifth, recognising that novel technologies challenge established safety and risk models. Electric aviation introduces forms of uncertainty that may not be fully addressed by existing frameworks, creating a need for new methods to identify, assess and mitigate emerging risks and uncertainty.

4.5. Societal Implications

The project has advanced the SRL for this technology area from SRL 5 towards SRL 7, by moving BETA's own validated solutions to be validated in a relevant operational environment. Progressing further towards SRL 8, however will require the technology to be tested under real commercial cargo operations and embedded more fully into the day-to-day processes and logistical value chain at airports. This includes routine handling, coordination with airport services, and integration with established operational procedures.

Moreover, to further enhance SRL to other geographic regions or operational domains, similar demonstration activities would be needed elsewhere in the country to account for regional differences in infrastructure, geography, and operational practices. Additionally, broader outreach, communication efforts, and social integration activities would support public awareness and stakeholder acceptance, which are critical components of higher SRL stages.

Finally, this report and the dissemination of its insights represent an important contribution to further SRL progression. By sharing experiences, challenges and lessons learned, the report can help accelerate understanding, reduce barriers for future adopters, and support informed decision making as electric aviation evolves from demonstration to wider implementation.

4.6. Further Exploration and Research

The demonstration project has revealed implications for the aviation ecosystem that have long-term and complex implications. These findings show that continued progress will require a systematic effort that looks beyond the aircraft itself and considers the broader operational environment in which electric aviation must function for the sustainable transition.

First, the project has highlighted areas for further examination, including scalability, technology maturity, and the transition from a prototype platform to a fully certified aircraft capable of commercial operations in Norway. It should be noted however, that ALIA CX300 is not 100% representative of a future type certified ALIA. The aircraft operated exclusively from the General Aviation area; for good operational reasons, the project therefore did not simulate a full commercial Part-CAT operation. As a result, important aspects were not tested under realistic commercial conditions. Aspects such as cargo and passenger logistics, turnaround processes, charging workflows, including solutions for battery cooling, and apron integration remain important areas for future exploration.

Second, the project did not incorporate extensive market analysis. Initial indications suggest potential value across several areas such as environmental benefits, regional connectivity, detailed operational economics, reduced noise, supply chain development and training needs. However, the size, distribution and beneficiaries of these value streams require further examination. A clearer understanding of the market potential will be essential for airports, operators, training institutions, local communities and policymakers.

Third, this demonstration project suggests revisiting the typology of aircraft based on emerging performance characteristics. New capabilities at lower altitudes point to the possible emergence of a "low-altitude economy," which may create new opportunities and impose new regulatory and infrastructural requirements. Mapping this potential in a national context could guide both infrastructure planning and industrial development.

Fourth, the project highlighted the need for deeper exploration of energy management in an innovative context. Battery capacity remains a known limitation, but future technological developments may reshape operational possibilities. Energy management considerations also extend beyond batteries and may become relevant for other emerging propulsion concepts. Understanding how to operate safely and efficiently under evolving energy constraints is therefore an important research area.

Taken together, these topics form a coherent research agenda that can support the continued development of sustainable aviation. They also underline that while the demonstration project has advanced our knowledge significantly, further exploration is essential to ensure that new technologies can be integrated safely, effectively and with clear societal benefit.

Conclusion

Linking back to the original purpose of the International Test Arena, the primary aim was to identify introductory barriers, and secondary to identify scalability issues.

What could be the enablers for this kind of technology? The demonstration project confirmed that electric aviation is ready for real-world operations. The results show that a gradual introduction of electric aircraft is feasible and can be scaled over time, with the technology already demonstrating strong potential for commercially viable operations. The overall limitation is the certification of the aircraft, which is expected within the near future.

Following this demonstration project, operators are given a clearer understanding of the expected costs associated with early-stage operations, including the reduction in operating and maintenance costs due to the relative simplicity of electric propulsion systems. Avinor has gained insight into the required facilities, the likely operational challenges, and potential technical and infrastructural solutions. The regulatory sandbox has enabled safe and efficient testing of the existing regulatory framework in relation to new technologies and emerging aircraft types. The aircraft demonstrated that it can be integrated into controlled airspace without undue complexity.

In summary, the project has strengthened our understanding of how innovation processes could be organised, and how collaboration models can be structured to support safe and efficient adoption of new aviation technologies. The experiences also indicate that electric aviation can expand regional connectivity by enabling aviation to serve routes and communities where conventional aviation has historically been economically difficult to sustain. The Norwegian climate and topography added another complexity to the project, strengthening the evidence that zero-emission aviation can operate reliably even in demanding environments and can contribute as part of the broader effort to reduce aviation emissions. "When you can make it here, you can make it everywhere".

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> *"As a nation that is heavily reliant on aviation, both today and in the future, the transition to a more sustainable aviation industry is a key priority for the government. This first flight represents a significant step on a long and complex journey. The test arena demonstrates how collaboration between authorities, airports, manufacturers, and operators – and not least strong political support – is essential. The systematic approach enabled by the test arena is unique, and I am proud that Norway is taking the lead."*
>
> Norwegian Minister of Transport, Jon-Ivar Nygård,
> on the day of the first flight Aug 8, 2025.