ASPIRE

NSF Engineering Research Center

ELECTRIC POWER SYSTEMS

Utah State University

# Final TAC Review

## Electrification Plan for State of Utah Airport Infrastructure

June 2, 2022

# Project Team

- Utah State University
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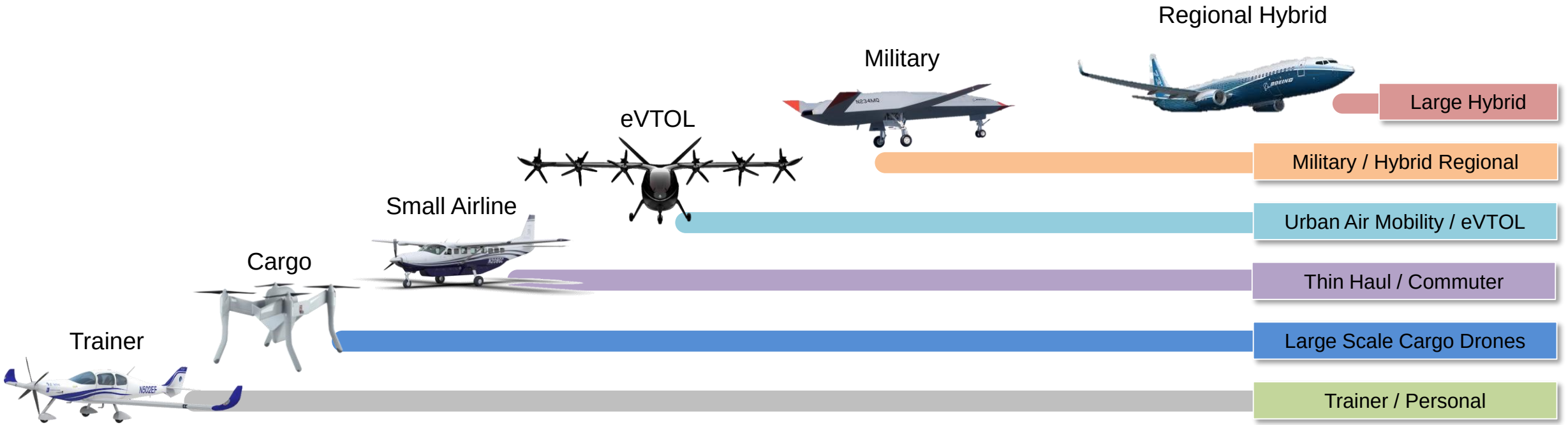
  - David Koch, Senior Director of Product Infrastructure
  - David Christensen, Director of Government Relations
  - Dallin Dahl, Program Manager I

# Problem Statement

- Electric aviation is here, and the sector's growth can be optimized.
- Charging infrastructure and grid integration is growth critical.
- Strategic preparation is key to realizing risk mitigation, intelligent growth trajectory, leadership, and economic benefits.



# Objectives

- Design the Utah Statewide Electrification Plan (U-SWEAP) framework
  - A **framework to plan for electrifying airports** and electric aviation corridors throughout the State of Utah that will support aviation uses such as pilot training operations, thin haul/commercial routes, and future advanced air mobility (AAM) operations.

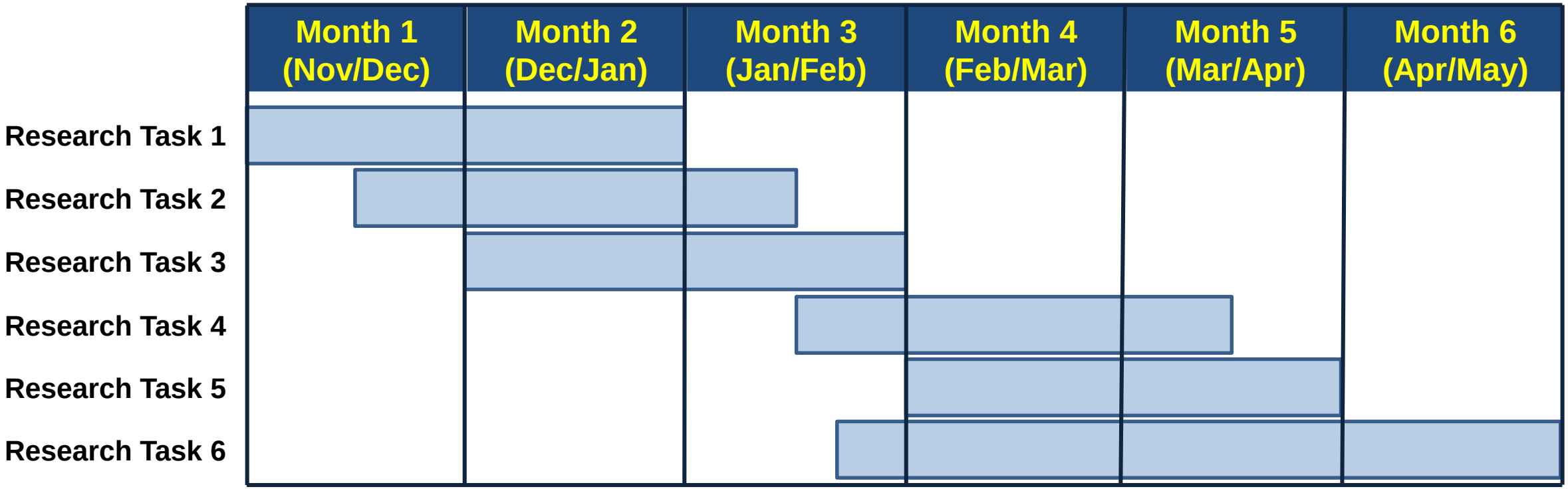
- **Anticipate future energy demands** on Utah's airports as electric aircraft technologies proliferate.

- **Evaluate business models** and implications for state-owned charging infrastructure compared with industry-owned infrastructure assets or a hybrid model.

# Project Research Tasks

| | Research Stage |
|---|---|
| **Research Task 1: Development of an electrification forecast for flight school operations in Utah** | Stage 1: Data Gathering |
| **Research Task 2: Development of an electrification forecast for thin haul/commercial operations in Utah** | |
| **Research Task 3: Development of an electrification forecast for AAM operations in Utah** | |
| Synthesis 1-3: Synthesis of the three forecasts from Tasks 1-3 into a statewide aviation electrification forecast | |
| **Research Task 4: Electrified aviation energy and power requirements—**derivation of new power and energy requirements at the Utah airports that are projected to support electrified aviation operations | Stage 2: Analysis |
| **Research Task 5: Proposed approach for deploying electric aviation support infrastructure—** exploration of the costs associated with different approach for deploying and operating electrified aviation supporting infrastructure | |
| **Research Task 6: U-SWEAP Framework—**an exploration of 1) the relationships between electrified aviation technology and the ecosystem in which it operates and 2) models that may be used to define and analyze those relationships and that ecosystem | Stage 3: Framework |

# Project Timeline



# Deliverables Summary

The project will deliver the **U-SWEAP framework** and **accompanying report**. The report will contain the following:

- Phase-specific data
  - Exploratory flight forecasts for pilot training, thin haul/commercial, and AAM operations
  - Preliminary airport power and energy requirements for charging infrastructure
- Preliminary Analyses
  - Infrastructure option operations and costs at airport analysis
  - Flight corridor impact assessment
- U-SWEAP Framework
  - Framework map addressing SOW sub-deliverables
  - Summary of framework outcomes

# Deliverables Schedule

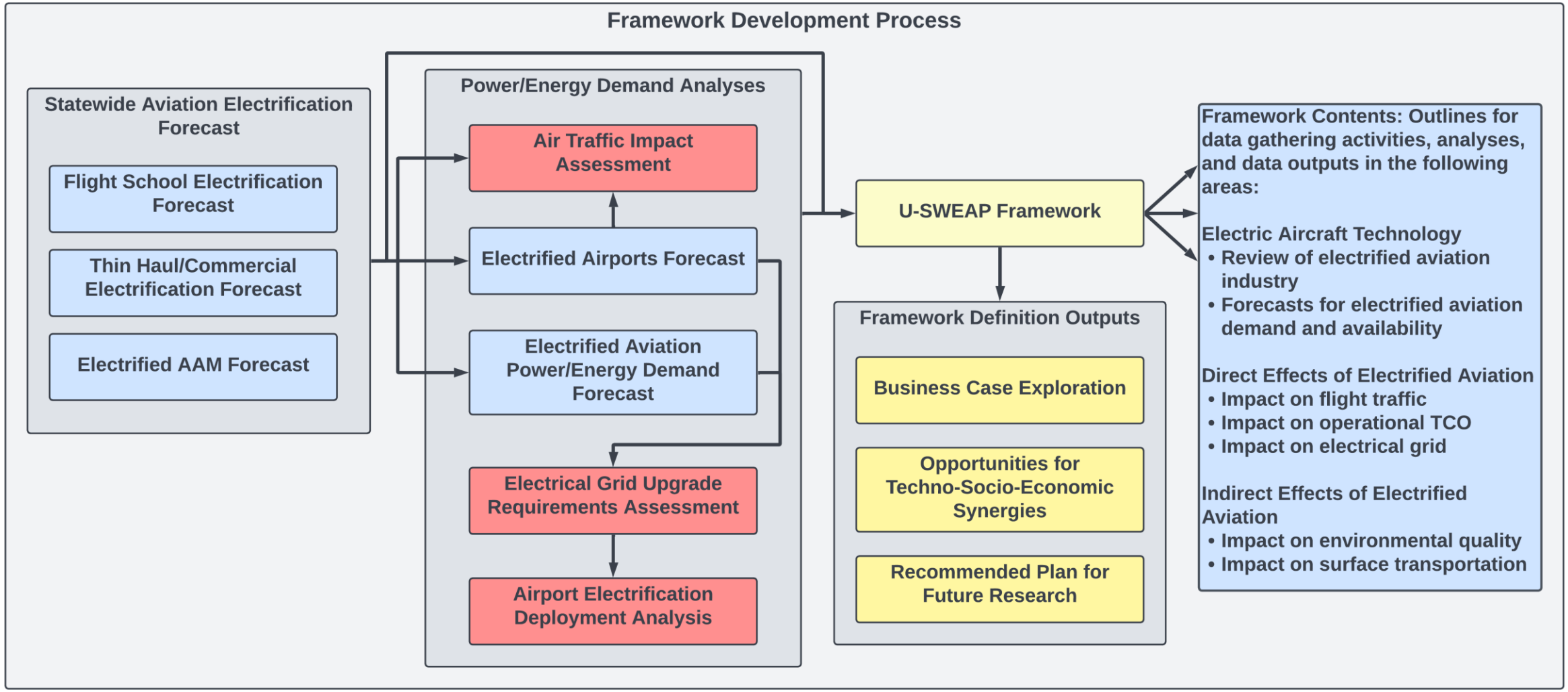
| Task Name | Duration | Start | Finish |
|---|---|---|---|
| **Milestones** | **141 days** | **Mon 11/15/21** | **Tue 5/31/22** |
| Kickoff | 0 days | Mon 11/15/21 | Mon 11/15/21 |
| Advisory board Review #1 | 0 days | Tue 3/1/22 | Tue 3/1/22 |
| Advisory Board Review #2 | 0 days | Mon 4/18/22 | Mon 4/18/22 |
| Advisory board Review #3 (Final) | 0 days | Thu 6/2/22 | Thu 6/2/22 |

| CDRL # | Description | Artifact | Delivery Date | Responsible Party |
|---|---|---|---|---|
| 1 | Interim Report #1 | Presentation | 3/07/2022 | ASPIRE/EPS |
| 2 | Interim Report #2 | Presentation | 4/18/2022 | ASPIRE/EPS |
| 3 | Final Report | Presentation & Report | 6/2/2022 | ASPIRE/EPS |

# Project Methodology and Findings

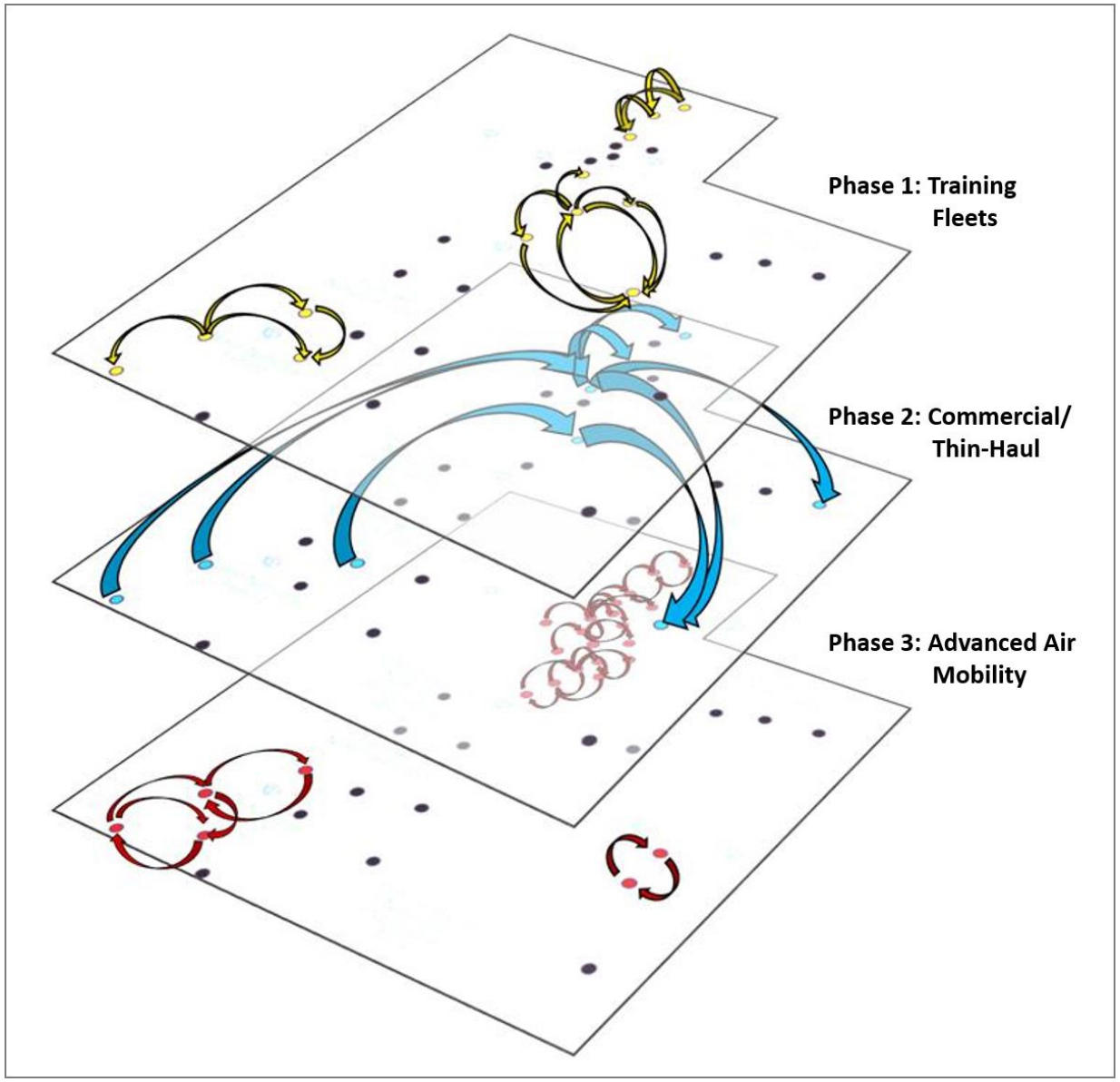
https://evtol.com/news/embraer-eve-beacon-evtol-maintenance-partnership/

# Methods Overview



# Statewide Electrified Aviation Forecast

- Fleet electrification and operations across three segments
  - University-sponsored flight school operations at USU, UVU, SUU
  - Thin haul/commercial (TH/C) operations—small-scale cargo and passenger operations between local airports
  - Advanced air mobility (AAM) operations—electric air taxi operations between points of interest
- Electric aircraft specs based a variety of aircraft, including but not limited to
  - Diamond eDA40 (flight schools)
  - Tecnam P2012 Traveler P-Volt (TH/C)
  - Hybridized Cessna Caravan (TH/C)
  - Hybridized Beechcraft King Air (TH/C)
  - Aggregated EVTOL aircraft data from Joby, Archer, Vertical Aerospace, Embraer Eve, Lilium, and Airbus (AAM)

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# Statewide Electrified Aviation Forecast Visualization

**Flight Schools**

**Thin Haul/ Commercial**

**North-South**

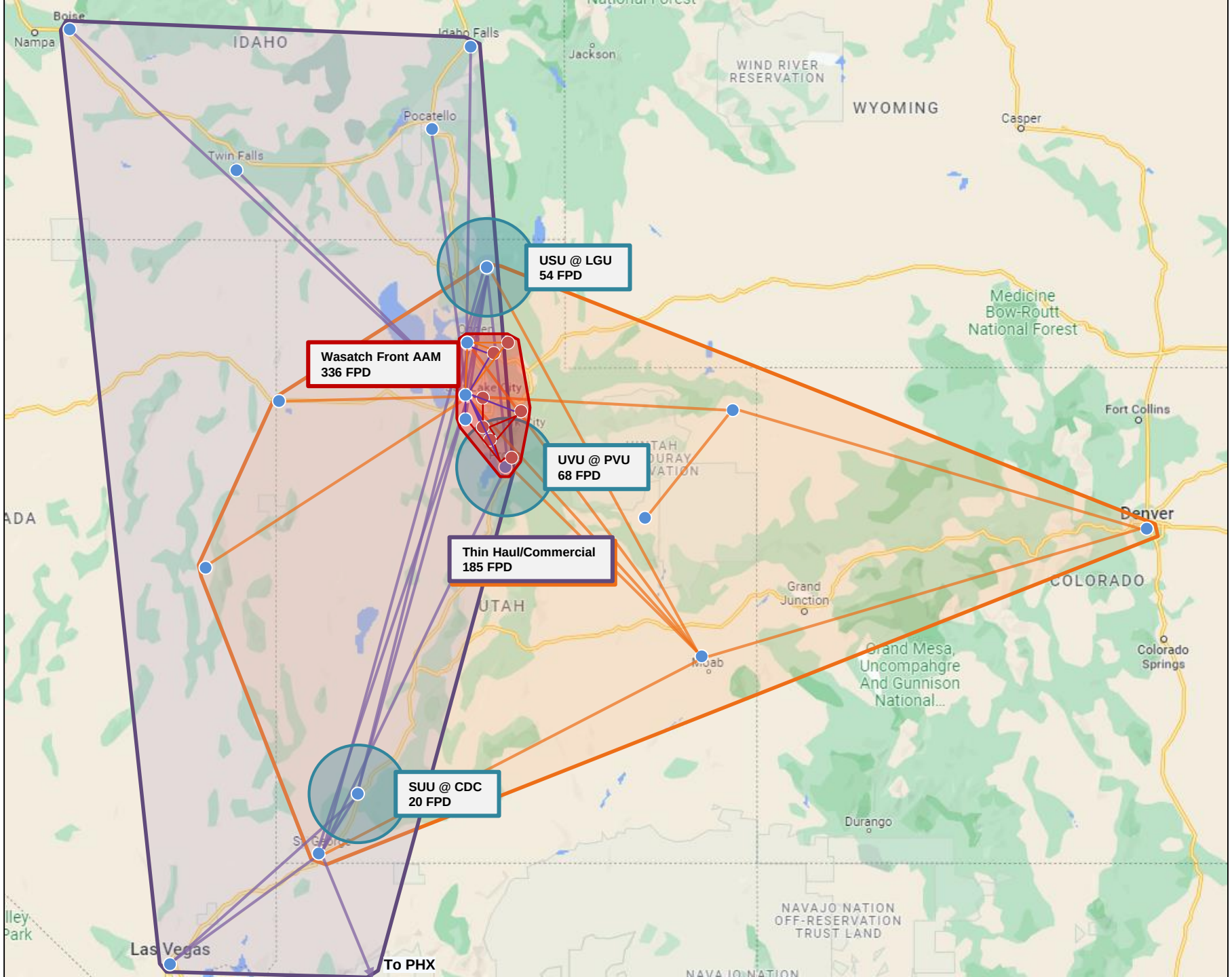
**West-East**

**AAM**

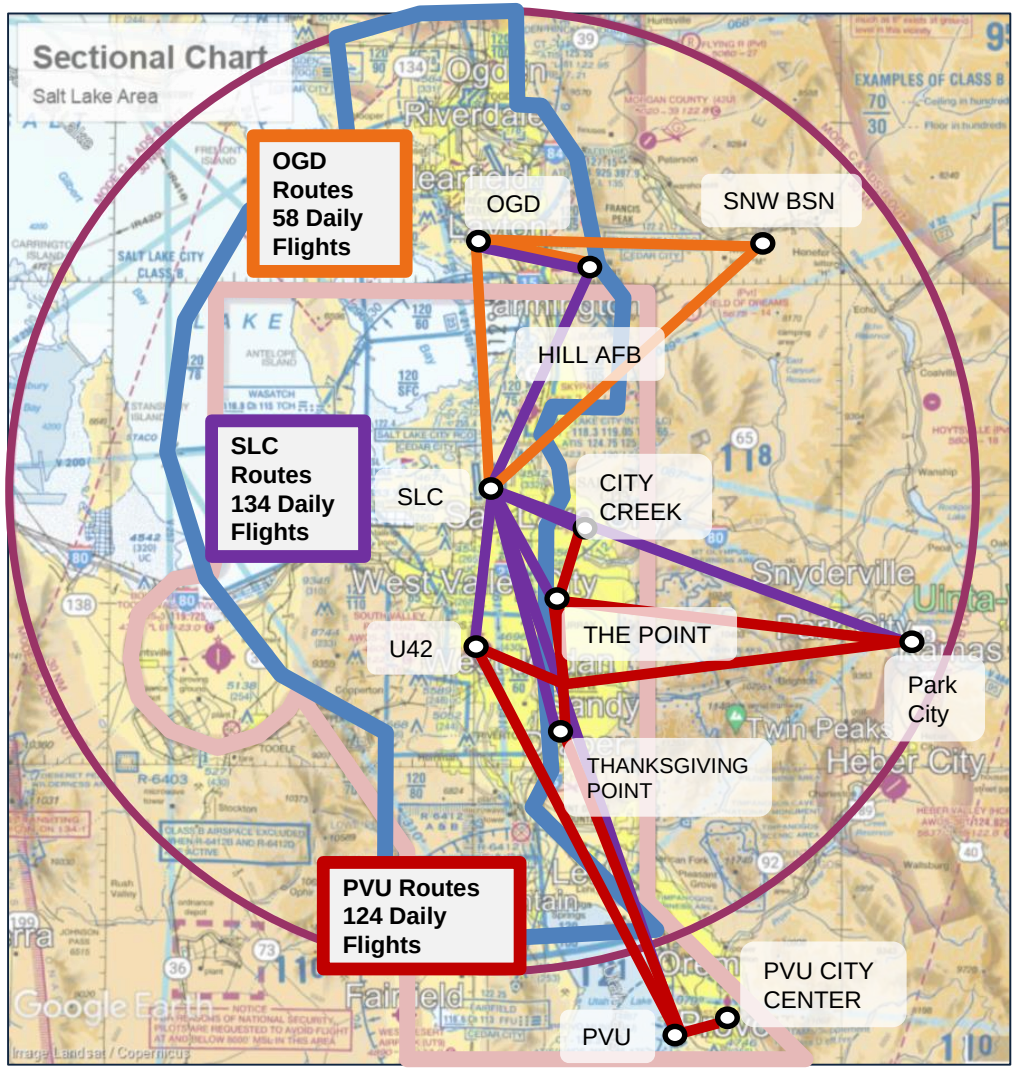
Existing Airport

Projected Vertiport

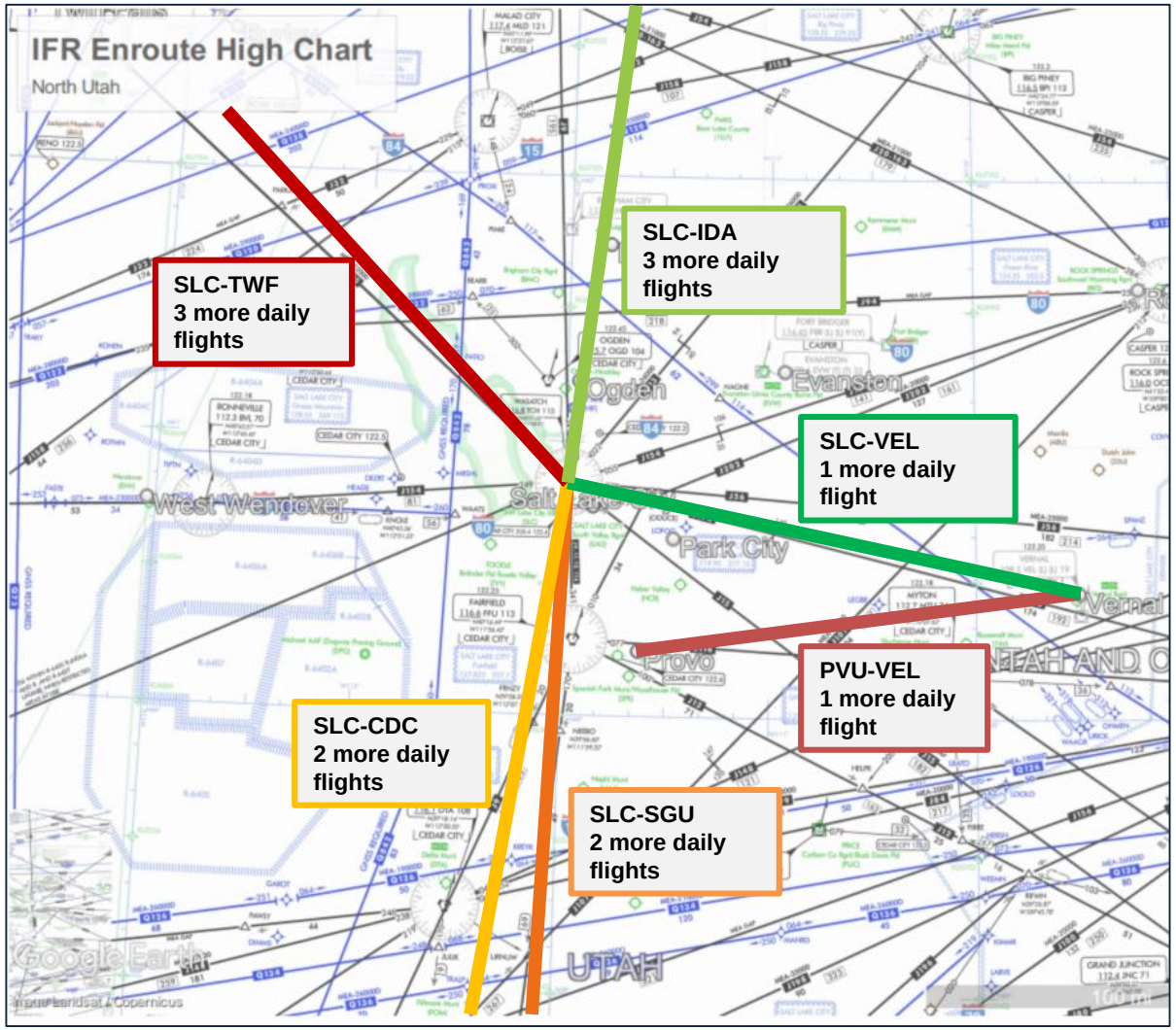
2030 Estimated Flights Per Day (FPD) Statewide: **663**



# Air Traffic Impact Assessment




New AAM routes along Wasatch Front

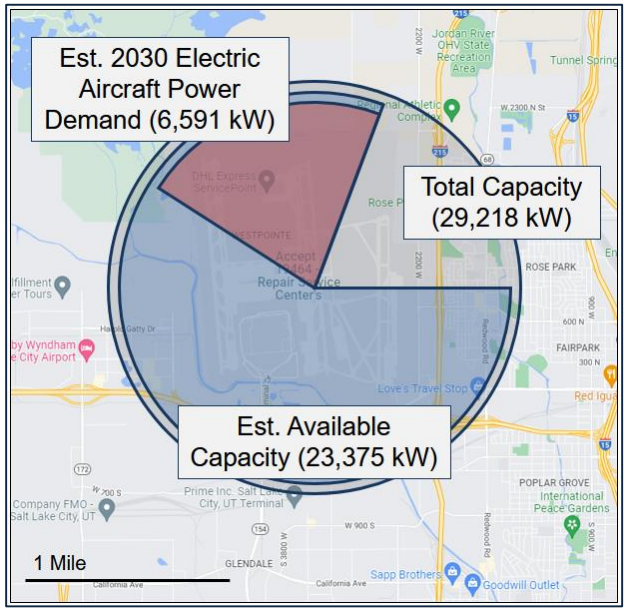



New thin haul/commercial routes centered on SLC airport

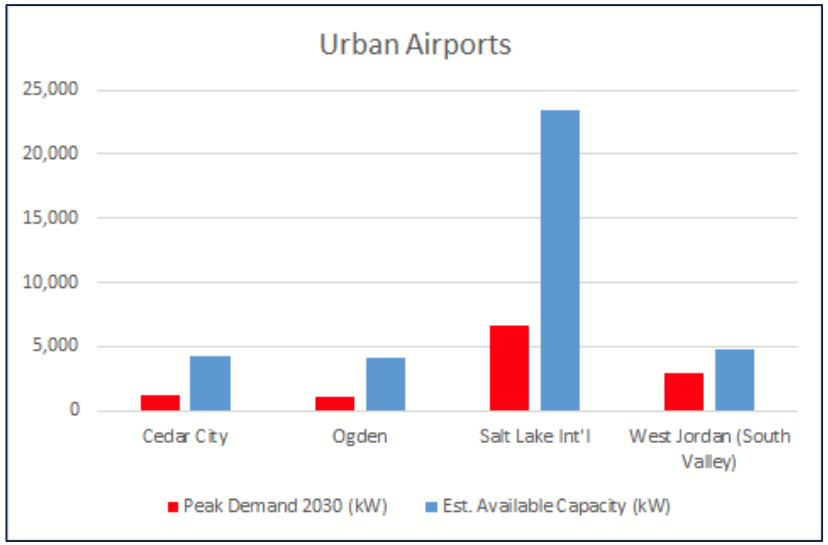
# Electrical Grid Power Requirements Assessment

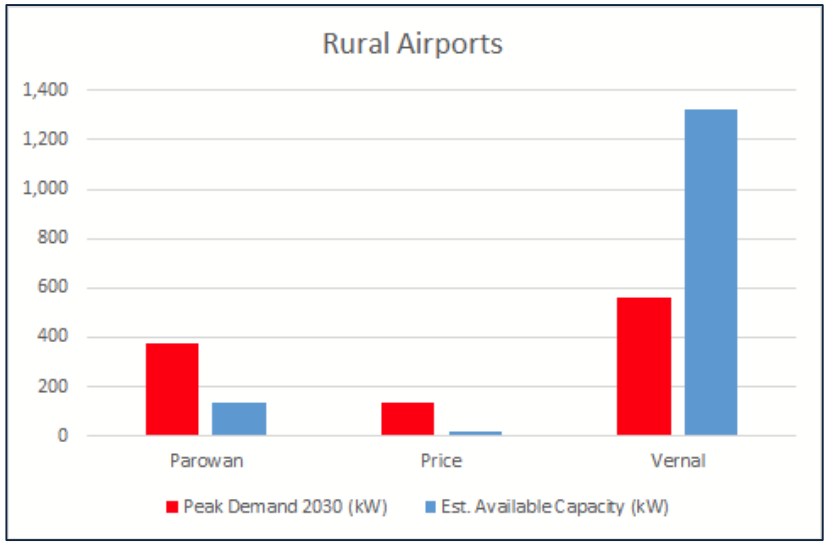
- **Urban airports** should be able to support initial electrification with little grid augmentation
- **Rural airports** may face a much more significant challenge

| Location | Peak Demand 2030 (kW) | Est. Total Grid Capacity | Est. Available Capacity (kW) | Capacity Surplus (2030) | Airport Fraction of Capacity |
|---|---|---|---|---|---|
| Parowan | 376.18 | 171.27 | 137.01 | -239.16 | 275% |
| Cedar City | 1232.16 | 5300.08 | 4240.06 | 3007.90 | 29% |
| Ogden | 1096.58 | 5103.87 | 4083.10 | 2986.51 | 27% |
| Price | 134.07 | 24.94 | 19.95 | -114.12 | 672% |
| Salt Lake Int'l | 6590.58 | 29218.17 | 23374.54 | 16783.95 | 28% |
| West Jordan (South Valley) | 2916.53 | 5946.06 | 4756.85 | 1840.32 | 61% |
| Vernal | 557.03 | 1654.45 | 1323.56 | 766.54 | 42% |




Power demand and capacity around SLC

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# Airport Electrification Deployment Analysis: SLC Study

Three scenarios analyzed

- Permanent infrastructure only, grid upgrade to accommodate full demand
- Some permanent infrastructure augmented by a mobile charging platform that can charge during off-peak hours and discharged during peak hours
- Some permanent infrastructure augmented by a mobile charging platform and a 1 MW solar panel array

Infrastructure cost breakdown with only fixed, permanent infrastructure

| | Price | Cost |
|---|---|---|
| Customer Charge | $53.00 | $53.00 |
| Facilities | $3.99 | $26,298.09 |
| Power | $13.27 | $87,462.57 |
| Total Peak | $17.26 | $113,760.66 |
| Energy | $0.03888 | $10,032.86 |
| Grand Total | | $123,846.52 |
| Avg ($/kWh) | | $**0.4799** |

Infrastructure cost breakdown with microgrid option

| | Price | Cost |
|---|---|---|
| Customer Charge | $53.00 | $53.00 |
| Facilities | $3.99 | $22,308.09 |
| Power | $13.27 | $74,192.57 |
| Total Peak | $17.26 | $96,500.66 |
| Energy | $0.03888 | $10,032.86 |
| Microgrid | Amortized | $8,333.33 |
| Grand Total | | $114,919.85 |
| Avg ($/kWh) | | $**0.4453** |
| Savings (%) | | **7.2%** |

Infrastructure cost breakdown with microgrid and solar options

| | Price | Cost |
|---|---|---|
| Customer Charge | $53.00 | $53.00 |
| Facilities | $3.99 | $22,308.09 |
| Power | $13.27 | $74,192.57 |
| Total Peak | $17.26 | $96,500.66 |
| Energy | $0.03888 | $1,635.21 |
| Microgrid | Amortized | $8,333.33 |
| Grand Total | | $106,522.20 |
| Avg ($/kWh) | | $**0.4128** |
| Savings (%) | | **14.0%** |

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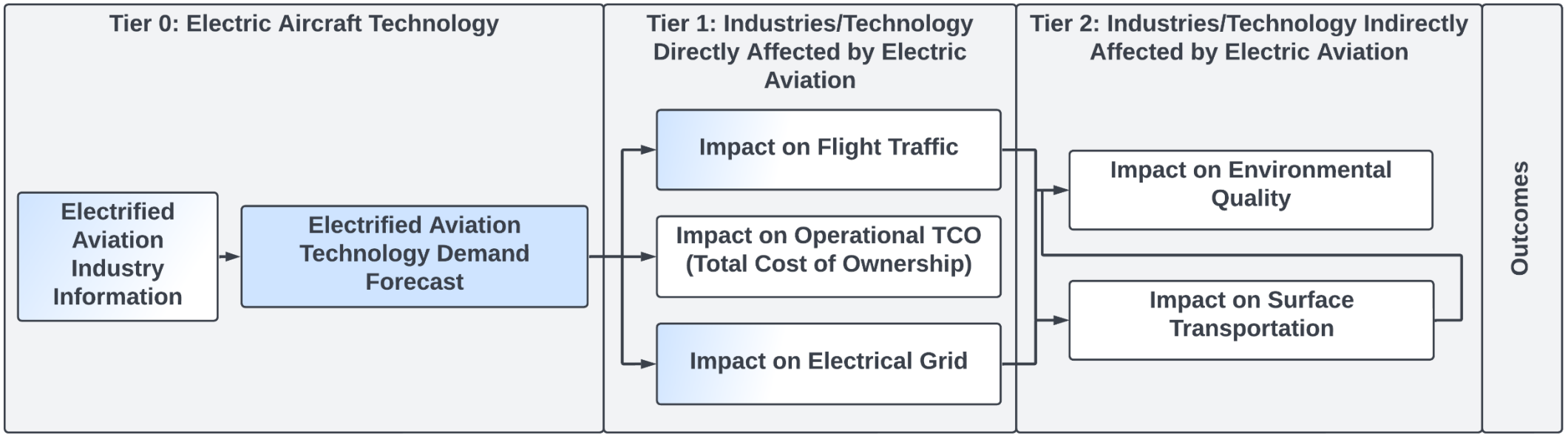
# U-SWEAP Framework Structure

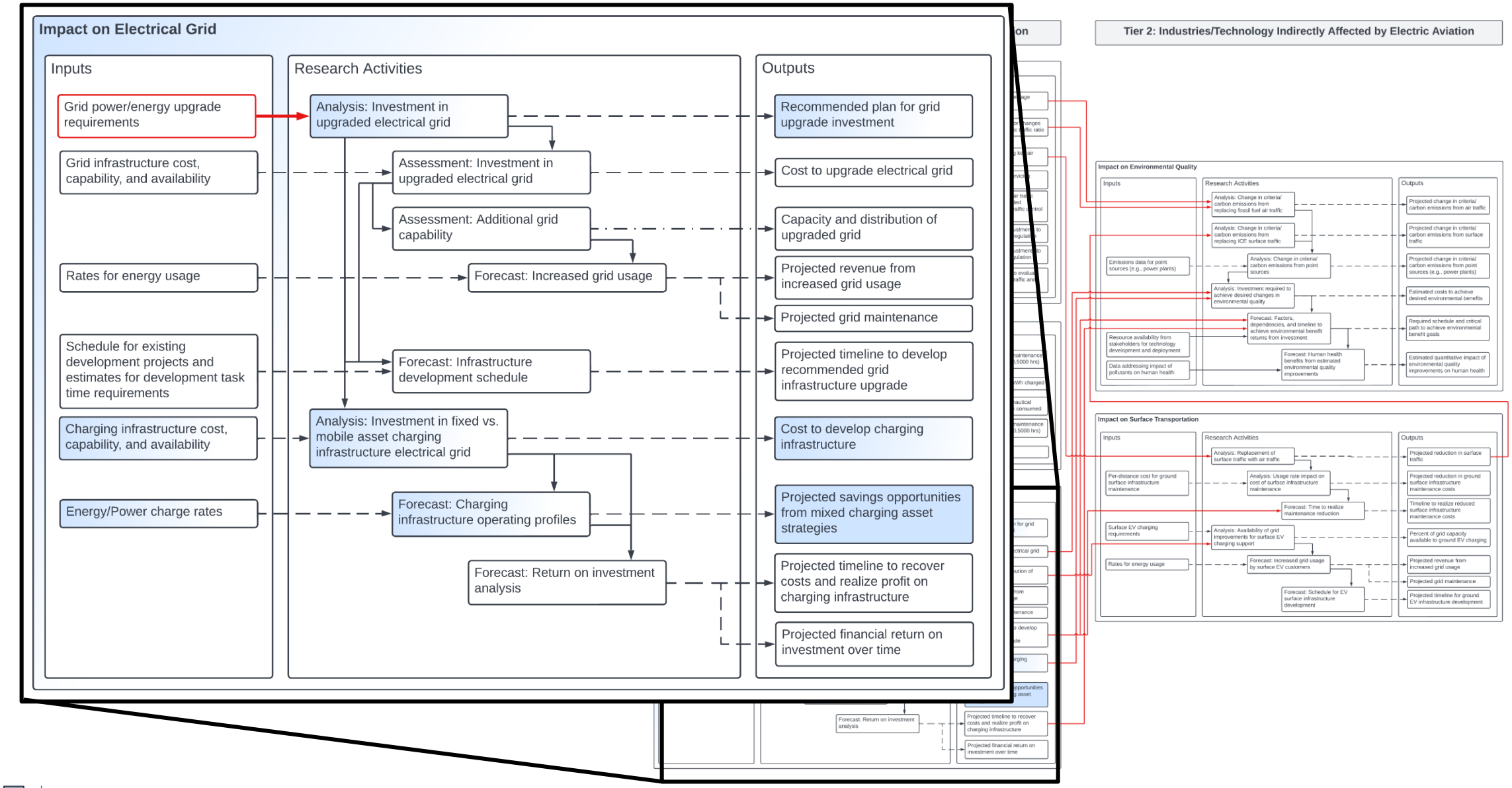



What information can we gather and analyze to tell us about the future of electrified aviation?

What are the immediate impacts and requirements on the existing ecosystem?

What are the non-obvious or long-term on the developing ecosystem?

# U-SWEAP Framework

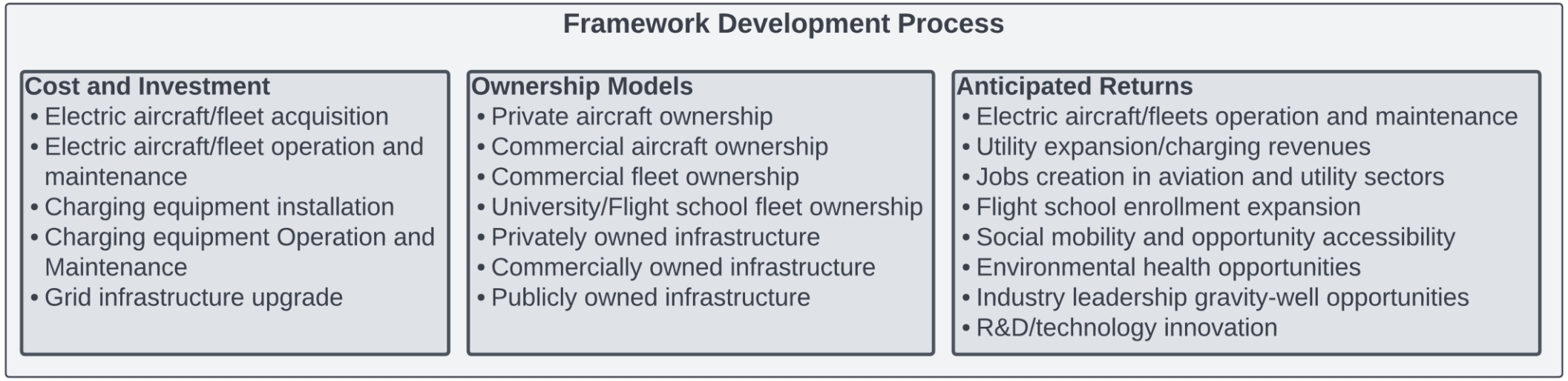


# Framework Outputs

## Opportunities for Techno-Socio-Economic Synergy

- Commercial and business development around new AAM hubs
- Grid infrastructure upgrades can be coordinated to support electrified aviation and electrified surface transportation
- Aviation adds a third dimension of flexibility to public transportation and mobility strategies
- Relocation of traffic density and emissions away from high-population-density areas
- Vitalize rural/at-risk communities with new mobility options

## Business Case Considerations

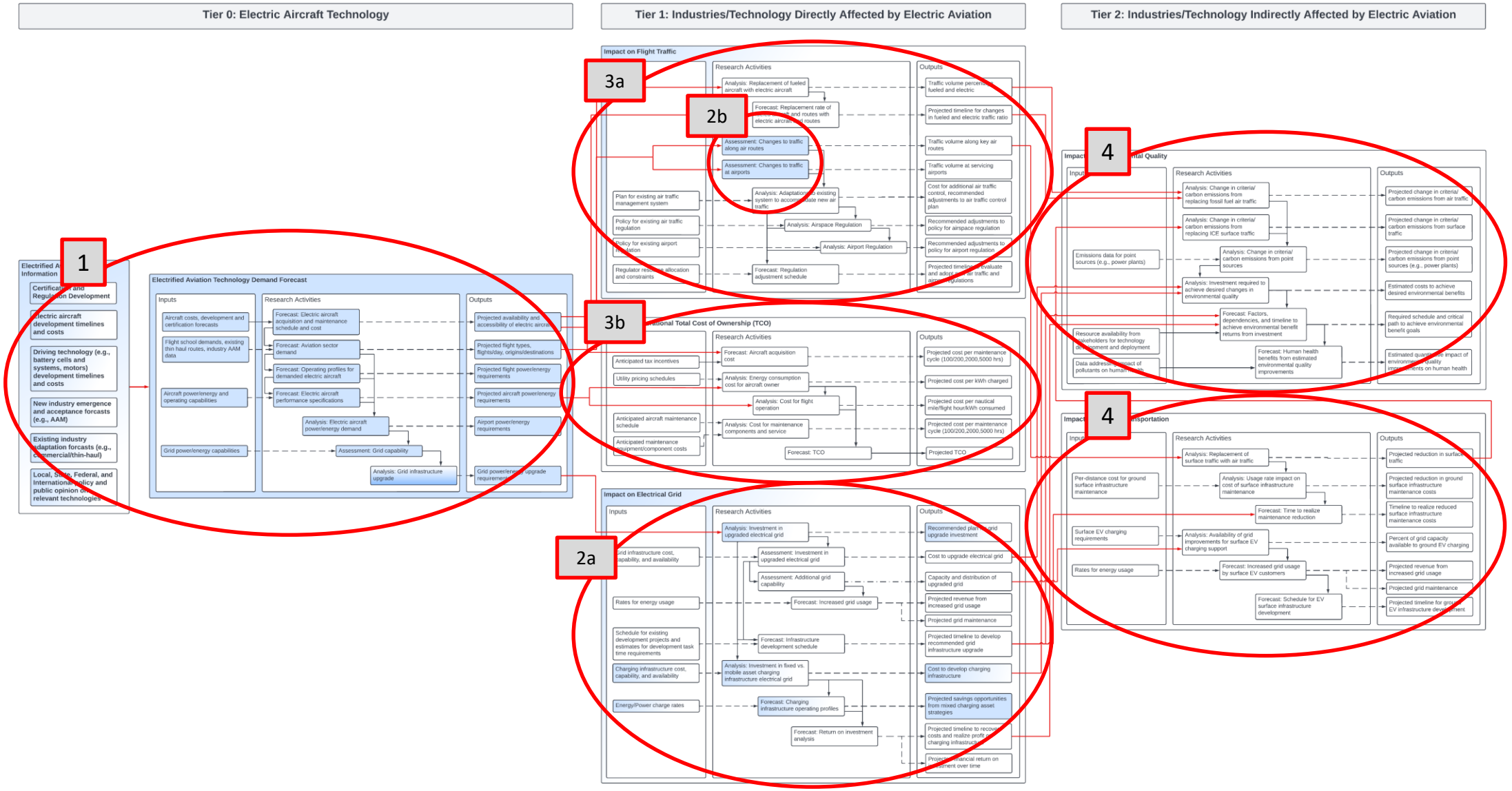



*See report for full discussion on these points

# Proposed Implementation Plans

https://evtol.com/news/embraer-eve-beacon-evtol-maintenance-partnership/

# Recommendations for Implementation and Future Work






# Q&A / Discussion