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Appalachian GA Airports AAM Readiness

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Advanced Air Mobility (AAM)

The past decade has seen the development of a new generation of versatile electric aircraft with many potential uses.

Most are familiar.

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Advanced Air Mobility (AAM)

A new generation of versatile, economical electric aircraft with many potential uses that could benefit Appalachia

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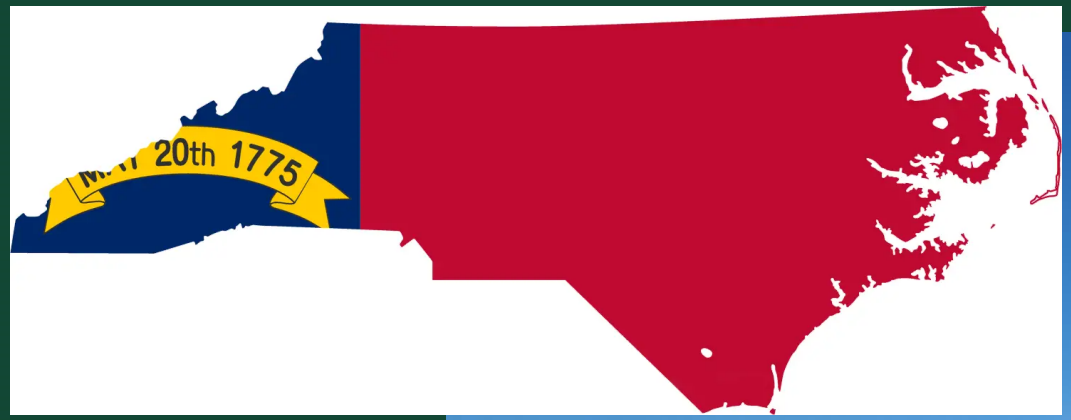
The "Electric Aviation Future" has begun

AAM Early Adopters

- Emergency response
- Commercial delivery
- Flight instruction
- Tourism
- Air cargo
- Military

Electric aviation is real, and airports everywhere aren't ready


20th 1775

BETA
THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

Appalachian General Aviation

230 +/- General Aviation (GA) public airports owned by local governments in 13 states

NC = 13

No commercial service, but base to 7,238 aircraft with 4.2 million flights annually

65% of GA flights are for business, military, medical, and emergency response

AAM Readiness Can Magnify Aviation Benefits

AAM will increase aviation benefits to Appalachia, but only if the region's airports are updated to provide the required utility capacity, charging capability, and supportive infrastructure for **uses deemed important to their communities.**

GA airports are public assets owned, financed, and managed by local government

Planning Study Partnership

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ITRE
Institute for Transportation Research and Education
NC STATE UNIVERSITY

ARC
Appalachian Regional Commission

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF AVIATION

Ohio Department of Transportation
Office of Aviation

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Planning Stage Airports

37 Appalachian GA Airports in **economically challenged counties** of Kentucky (19), North Carolina (4), and Ohio (14)

Implementation models for Appalachia's 230+ general aviation airports

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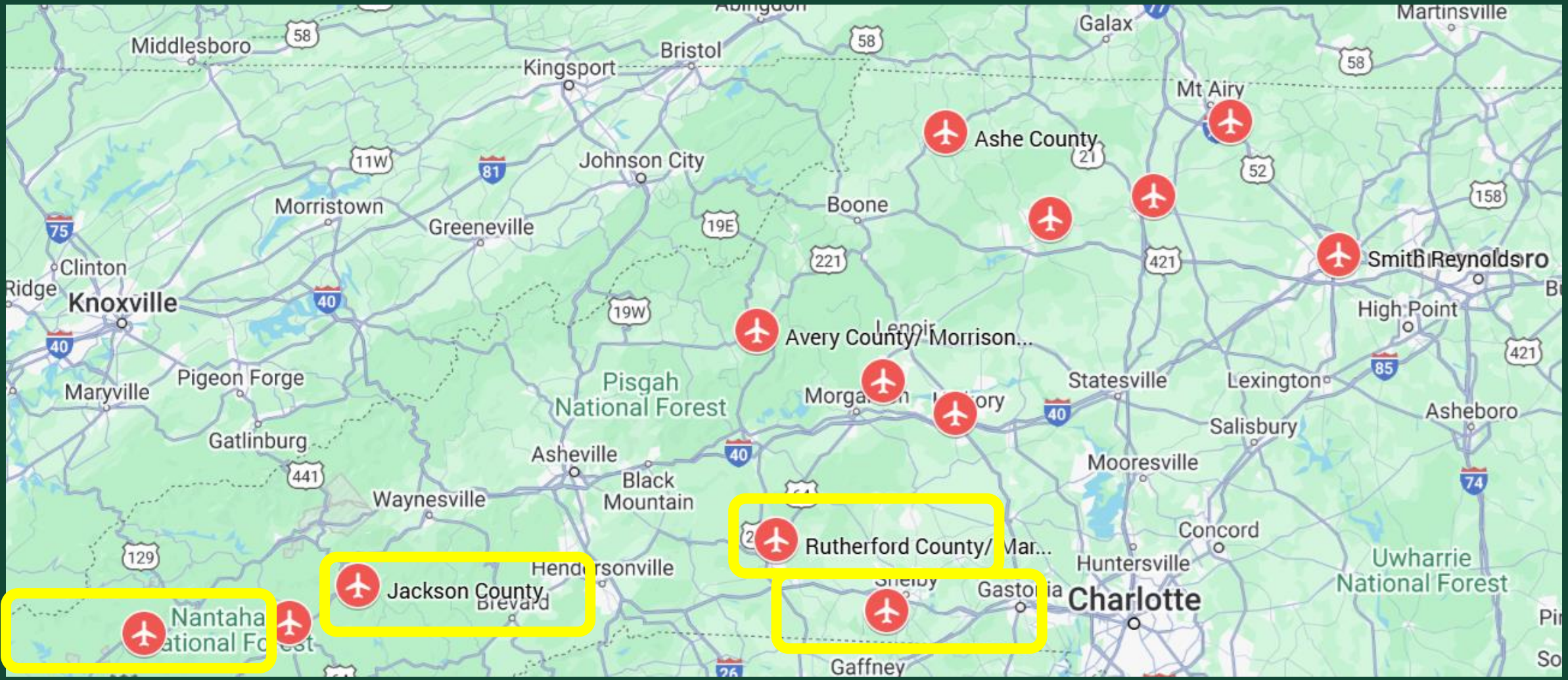
4 of 13 GA Airports in Appalachian NC



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Foothills Commission Study Airports

Rutherford County/ Marchman Field

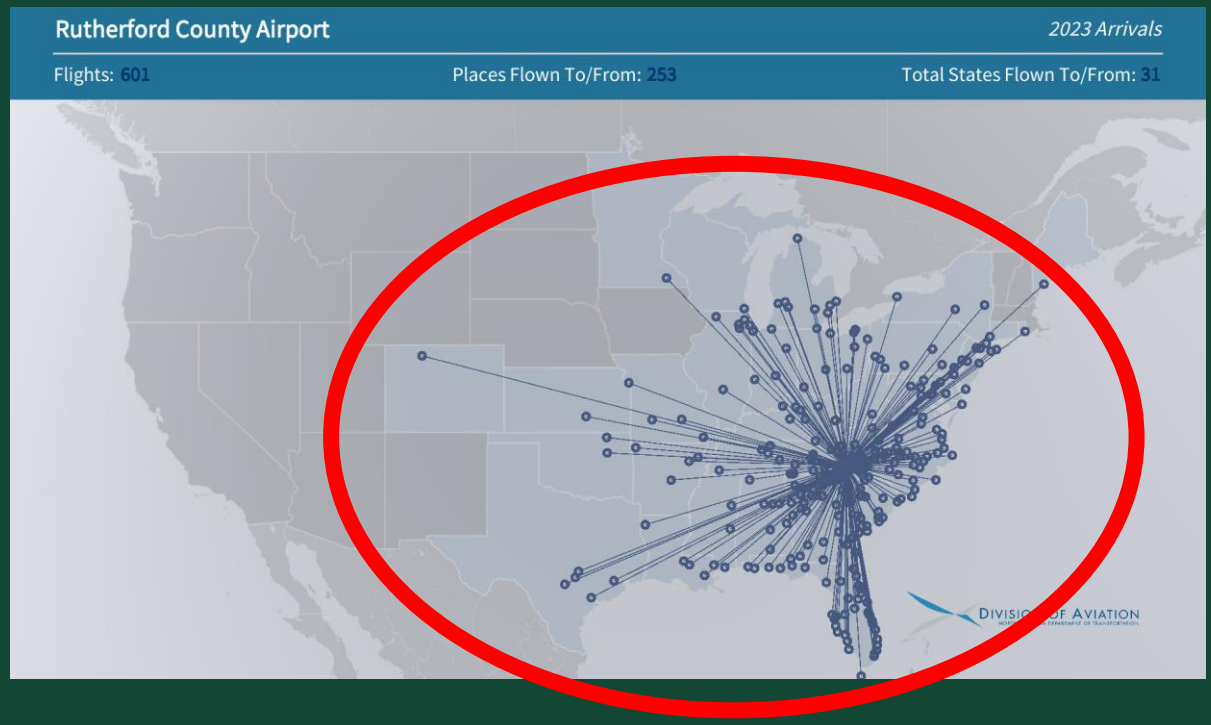
- 1975: owned and operated by Rutherford County airport Authority
- 280 acres; 5,000’ runway
- 12,150 annual aircraft operations; 46 based aircraft

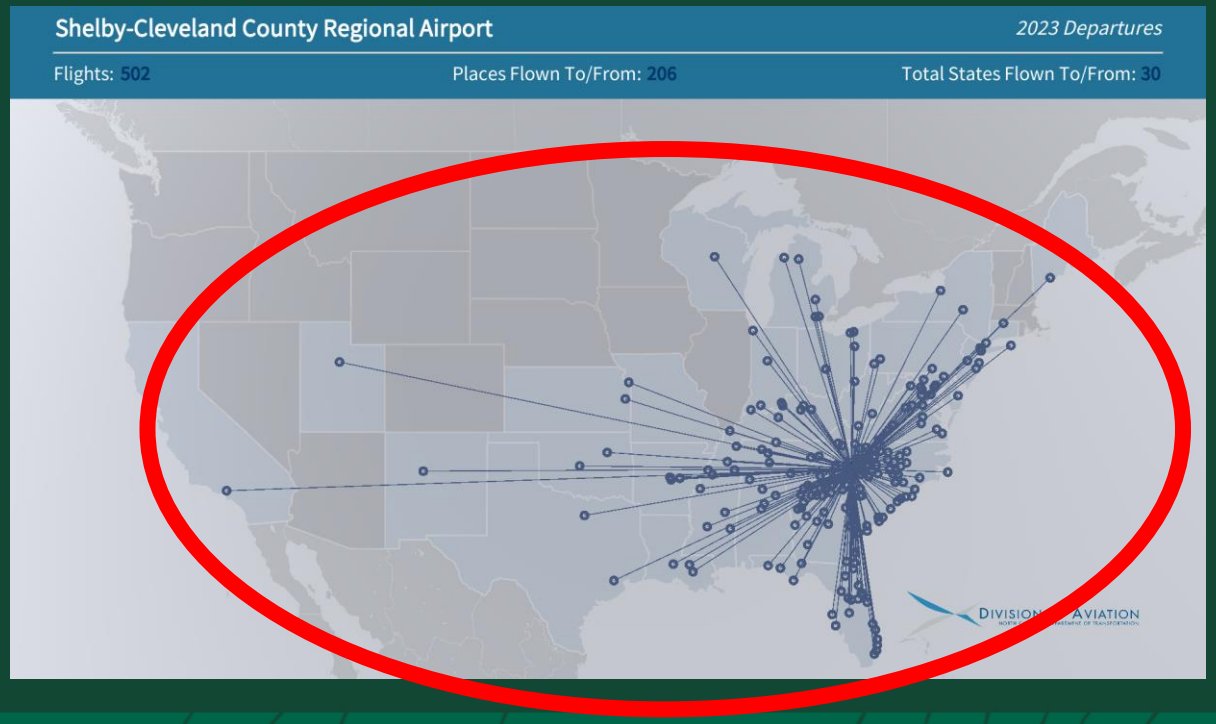
Shelby-Cleveland County Regional

- 1958: owned and operated by City of Shelby
- 225 acres; 5,001’ runway
- 18,200 annual aircraft operations; 66 based aircraft


"A mile of highway
Will take you just one mile...but
A mile of runway will take you everywhere!"

Rutherford County/Marchman Field

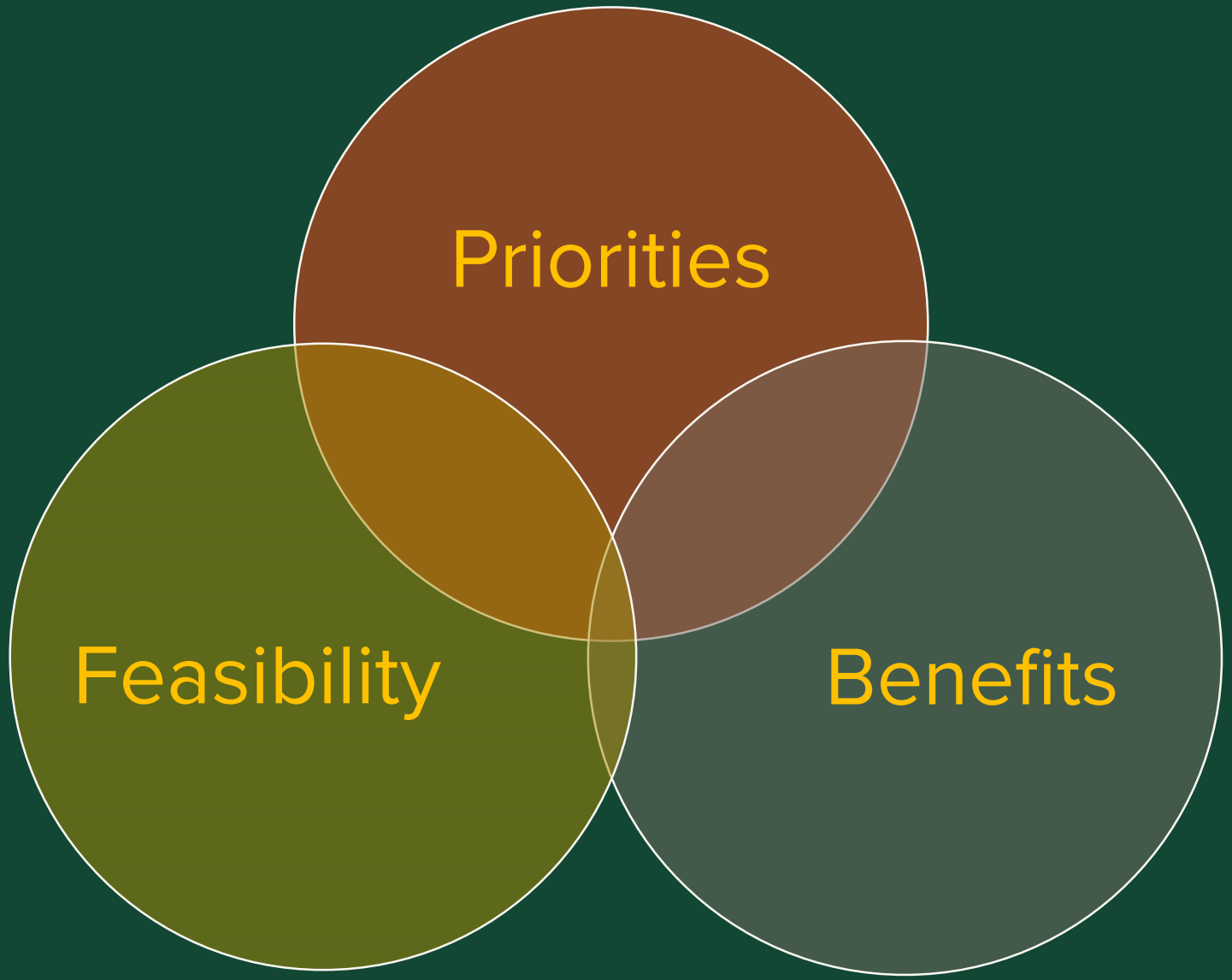




Shelby-Cleveland County Regional

Appalachian AAM Uses Examined

1. **On-Demand Air Taxi**
2. Regional Air Mobility
3. Airport Shuttle
4. Emergency Services
5. Business Aviation
6. Cargo Delivery
7. Flight Instruction
8. Tourism
9. Leisure


Priorities
Feasibility
Benefits

AAM Use Case Feasibility

- State of technical, regulatory, and commercial development
- Consistency with cohort airports' existing conventional aircraft use cases
- Airport managements' market insights
- Geographic and economic context (ITRE)

AAM Use Cases mirror existing GA airport activity

AAM Use Case Benefits

Assess potential AAM use case benefits to their host communities

- GA economic analysis literature
- Community, regional, and state economic development officials
- Aviation and AAM industry representatives

Community AAM Priorities

Engagements with regional development organizations' (LDDs) leadership, staff, and local officials to prioritize AAM use cases

- 15 LDDs host the 37 project airports
- Economic strategies (CEDS) examined for aviation role
- Engagement with all LDDs to identify priorities

On-Demand Air Taxi

Non-scheduled local point-to-point transportation (Uber)

(Competes with conventional helicopters)

Regional Air Mobility

Scheduled or on-demand transportation between cities over 50 to 150+ miles

Drive vs flight time/mileage differential

Airport Shuttle

Scheduled or on-demand transportation between major and regional airports and Appalachian towns and cities

Emergency Services

- Search-and-rescue operations
- Disaster response
- Emergency medical
- Patient/equipment/organ delivery

Business Aviation

Air Commerce uses for larger market access, customer service, product/service delivery, and interfacility travel

Cargo Delivery

Rapid logistics operations by Appalachian businesses:

- Pharmaceutical packages
- Food from local restaurants
- Local business products/packages
- Amazon and Walmart packages

Flight Instruction

Flight instruction makes up about 24% of all GA activity, doubling over past decade

Workforce training for pilots and aviation employees has high near- and long-term impacts

Tourism

Transportation of visitors and air tours that are quieter and less intrusive

Leisure

Recreational flying by owners or renters of private aircraft, rather than for business purposes

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LDD Engagement Top 3 Results

Ohio-4 LDDs

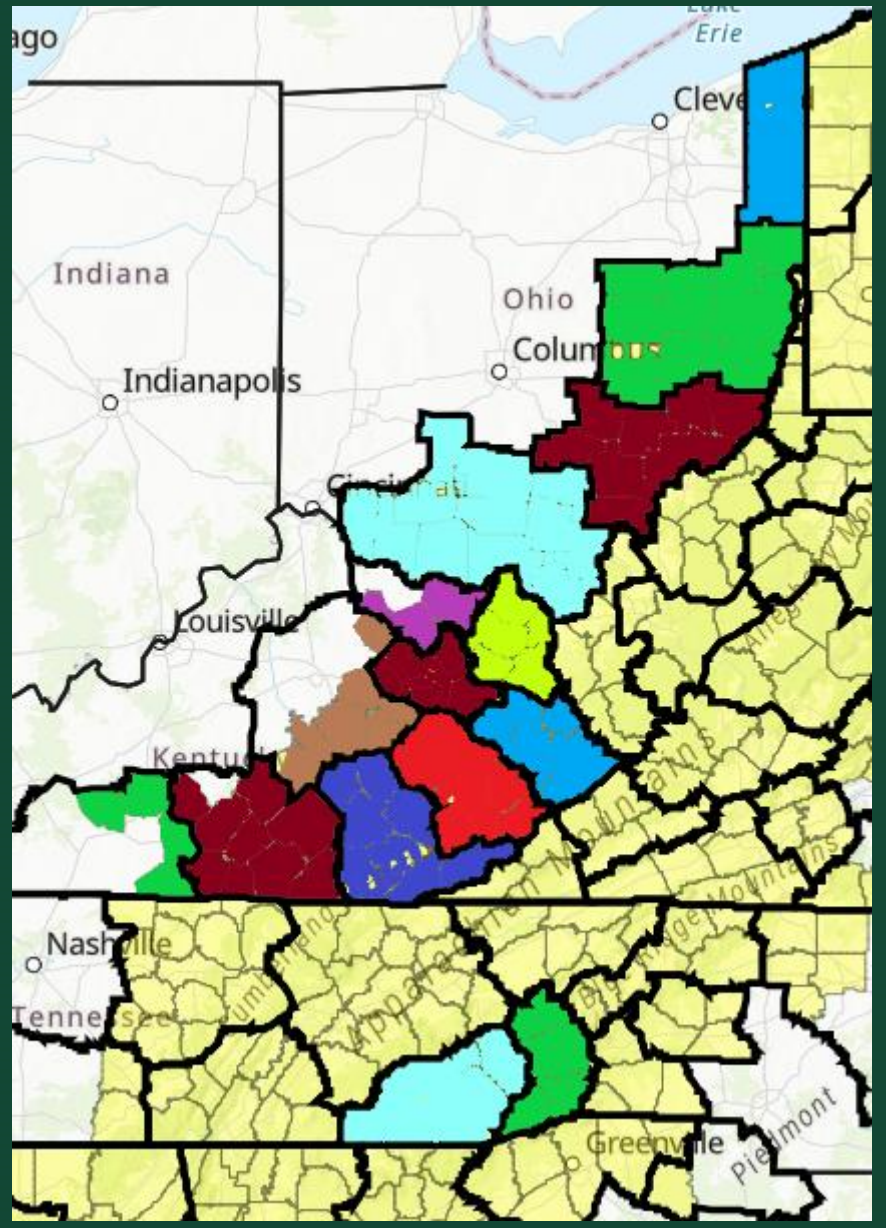
- Airport Shuttle
- Emergency Services
- Cargo Delivery

Kentucky-9 LDDs

- Emergency Services
- Business Aviation
- Tourism

North Carolina-4 LDDs

- Regional Air Mobility
- Emergency Services
- Cargo Delivery



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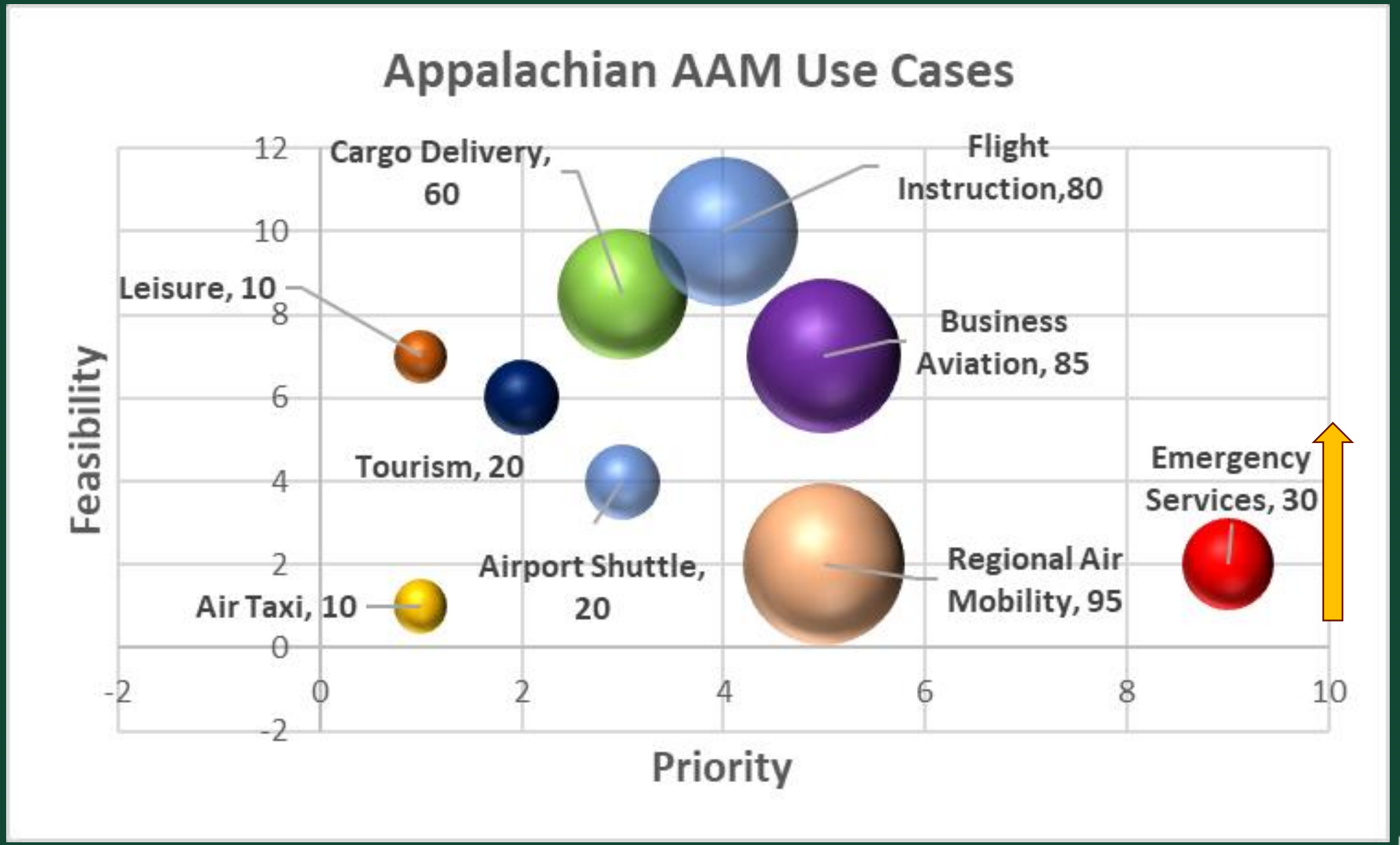
Appalachian AAM Use Cases
Feasibility
Priority
12
10
8
6
4
2
0
-2
-2
0
2
4
6
8
10
Cargo Delivery, 60
Flight Instruction,80
Leisure, 10
Business Aviation, 85
Tourism, 20
Emergency Services, 30
Airport Shuttle, 20
Regional Air Mobility, 95
Air Taxi, 10

Appalachia's AAM Scenarios

- **Emergency response**: AAM deployment in search and rescue, critical logistics, and medical supply
- **Aviation education**: increase GA flight instruction, maintenance, and other aerospace training through AAM
- **Air Commerce**: Expedite current and future high value business aviation activity by Appalachian firms
- **Regional Air Mobility**: Intra- and inter-regional multimodal aviation access hubs to expand commercial service

Rutherford County/Marchman Field Airport (FQD)

Rutherfordton, North Carolina

Airport Overview

12,150
Total Operations

55
Based Aircraft

5,000
Max Runway Length

500
Military Operations

0
Annual Air Taxi Operations

160
Flights within Ideal Electric Vehicle Range (80 miles)

Electric Infrastructure Readiness

5
Substations within 5 Miles

N/A
3 Phase, 240v On-site

206
Aerodromes within 80 miles[1]

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Duke Energy

Feasibility Analysis

GIS Variable / Use Case	On-Demand Air Taxi	Regional Air Mobility	Airport Shuttle	Emergency Medical Services	Corporate and Business Aviation	Cargo and Freight Delivery	Flight Training	Tourism	Leisure
Airspace Penalty	■	■	■	■	■	■	■	■	■
Jobs within 80 miles of Airport	■	■	■		■				
Population within 80 miles	■	■	■		■	■			
Average Time to Work	■	■	■		■				
Per Capita Income within 80 miles	■								
No. of Trauma Centers within 80 miles				■					
Absence of Major Roads within 80 miles						■			
Hotels within 30 miles								■	
Airport Operations									■
Airports within 80 miles			■						
Total Population Closest to this Airport		■	■						
Number of Substations within 5 miles	■	■	■	■	■	■	■	■	■
Mean Precipitation	■	■	■	■	■	■	■	■	■
Has 3-Phase Power	■	■	■	■	■	■	■	■	■

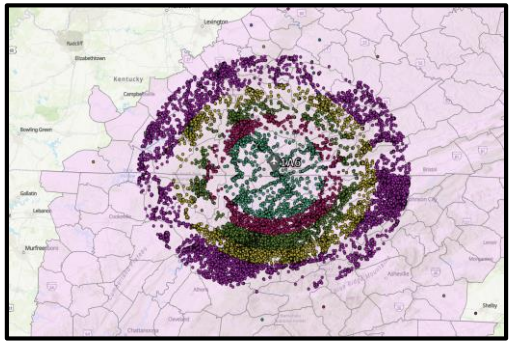

Figure 1. Visual Depiction of Proximate Jobs Analysis

Figure 2. Visual Depiction of Substations Analysis

For the site suitability analysis a max roundtrip distance of 160 miles (80 miles there and back) is applied

Top 20 - Feasibility Analysis Results

Not Including Three-Phase Power As a Variable

Rank	Airport	Code	County	City	State	Total Points
1	Geary A Bates/ Jefferson County	2G2	Jefferson	Wintersville	OH	770.6
2	Shelby-Cleveland County Regional	EHO	Cleveland	Shelby	NC	678.2
3	Highland County	HOC	Highland	Hillsboro	OH	597.8
4	Richard Downing	I40	Coshocton	Coshocton	OH	581.0
5	Madison	RGA	Madison	Richmond	KY	569.8
6	Northeast Ohio Regional	HZY	Ashtabula	Jefferson	OH	509.7
7	Ohio University	UNI	Athens	Albany	OH	480.4
8	Rutherford County/ Marchman Field	FQD	Rutherford	Rutherfordton	NC	477.5
9	Mount Sterling/ Montgomery County	IOB	Montgomery	Mt. Sterling	KY	459.7
10	Cambridge Municipal	CDI	Guernsey	Cambridge	OH	450.5
11	Vinton County Airpark	22I	Vinton	New Plymouth	OH	436.1
12	Pike County	EOP	Pike	Waverly	OH	423.2
13	Alexander Salamon	AMT	Adams	Winchester	OH	419.8
14	Ashland Regional	DWU	Boyd	Worthington	KY	407.4
15	Lawrence County Airpark	HTW	Lawrence	South Point	OH	394.4
16	Monroe County	4G5	Monroe	Woodsfield	OH	383.6
17	Greater Portsmouth Regional	PMH	Scioto	Portsmouth	OH	379.9
18	Lake Cumberland Regional	SME	Pulaski	Somerset	KY	379.3
19	Fleming-Mason	FGX	Fleming	Maysville	KY	378.4
20	London/Corbin/Magee	LOZ	Laurel	London	KY	360.3

AAM Readiness Varies…

- AAM Use Case scenario mix
- Aircraft types
- Flight activity levels
- Area utility grid adequacy

Identify and address airport-specific needs

...but Baseline Need = 480V, 3-Phase

Electric aircraft charging expected to require 480V, 3-Phase at charging levels 50kW to 3 MW

480V, 3-Phase is the most common power system used in US industrial and commercial sites

GA airports typically receive service from a single-phase overhead distribution line and a single transformer.

3-phase power has many additional uses for airport-associated economic development

Key Findings Summary

1. The AAM future is already occurring
2. Likeliest AAM use cases mirror existing GA aviation activity
3. Aviation underemphasized in local development
4. Addressing community priorities necessary for AAM support
5. Readiness requirements will vary, but **baseline = 480V, 3-phase power…and eventually chargers**

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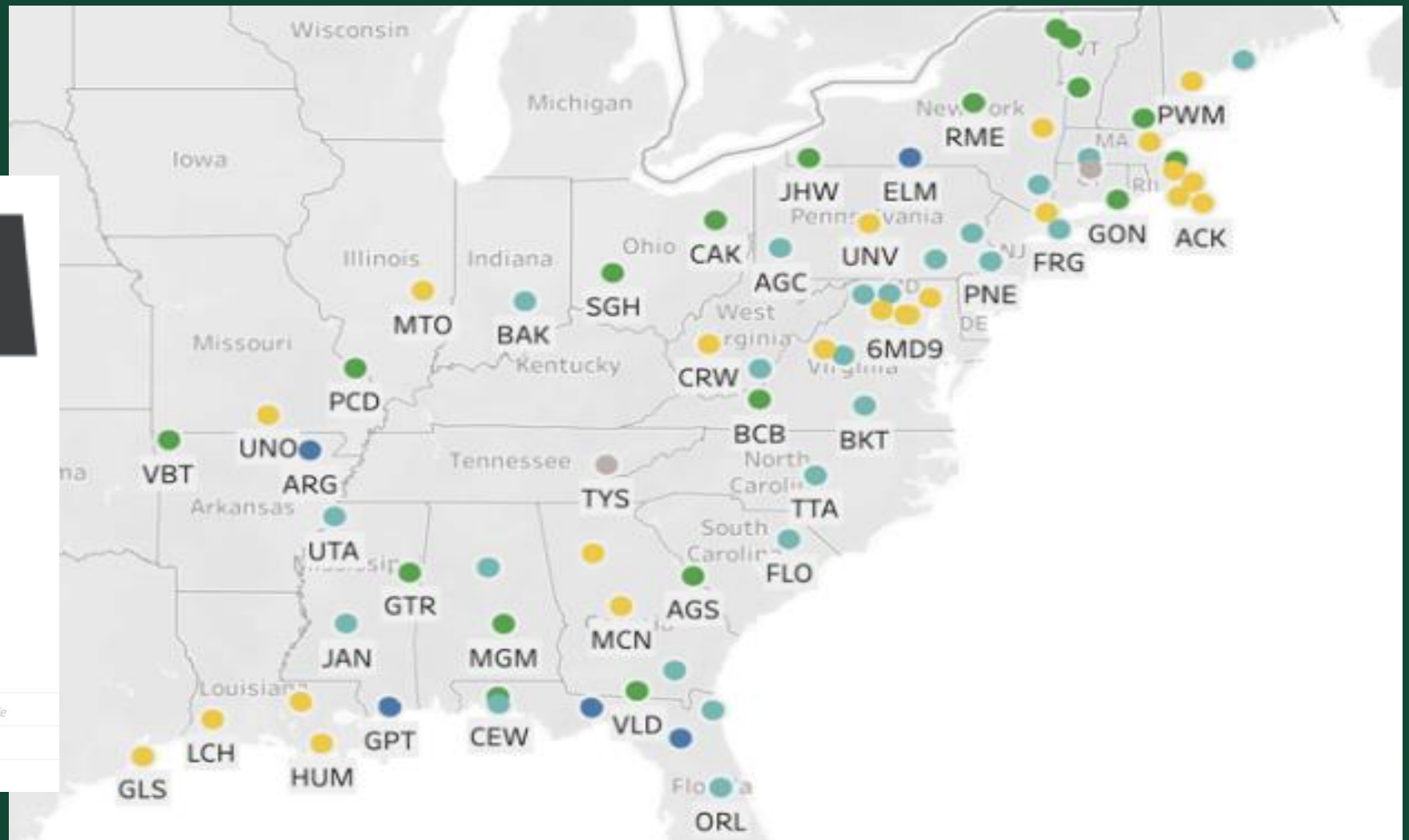
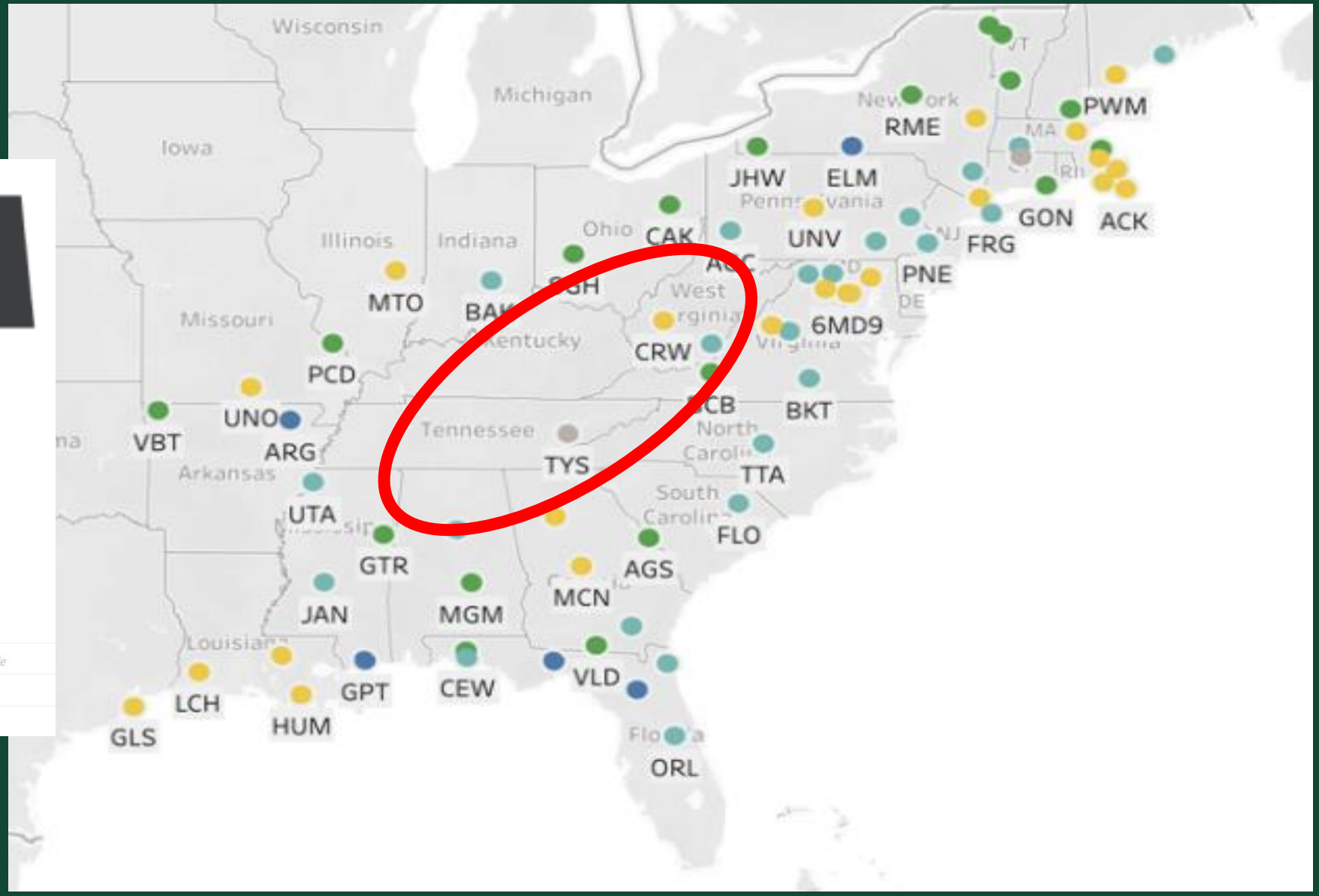
	Charge Cube Permanent Charge Solution	Mini Cube Mobile Charge Solution
		
	480 Vac, 3 Phase, 60 Hz	480Vac, 3 Phase, 60 Hz
	420 Amps	20–60 Amps, *Configurable*
	320 kW	40 kW
	Up to 1,000 Vdc	Up to 1,000 Vdc



AC VOLTAGE CONNECTION	480 Vac, 3 Phase, 60 Hz	480Vac, 3 Phase, 60 Hz
AC GRID CURRENT	420 Amps	20–60 Amps, *Configurable*

BETA

Charge Cube Permanent Charge Solution	Mini Cube Mobile Charge Solution
	
480 Vac, 3 Phase, 60 Hz	480Vac, 3 Phase, 60 Hz
420 Amps	20–60 Amps, *Configurable*
320 kW	40 kW
Up to 1,000 Vdc	Up to 1,000 Vdc



Charging System Cost?

BETA Technologies charging system installations are averaging **$765,000**

Cost variances driven by 3-phase power availability and siting issues