



Urban Air Mobility – NASA Perspectives

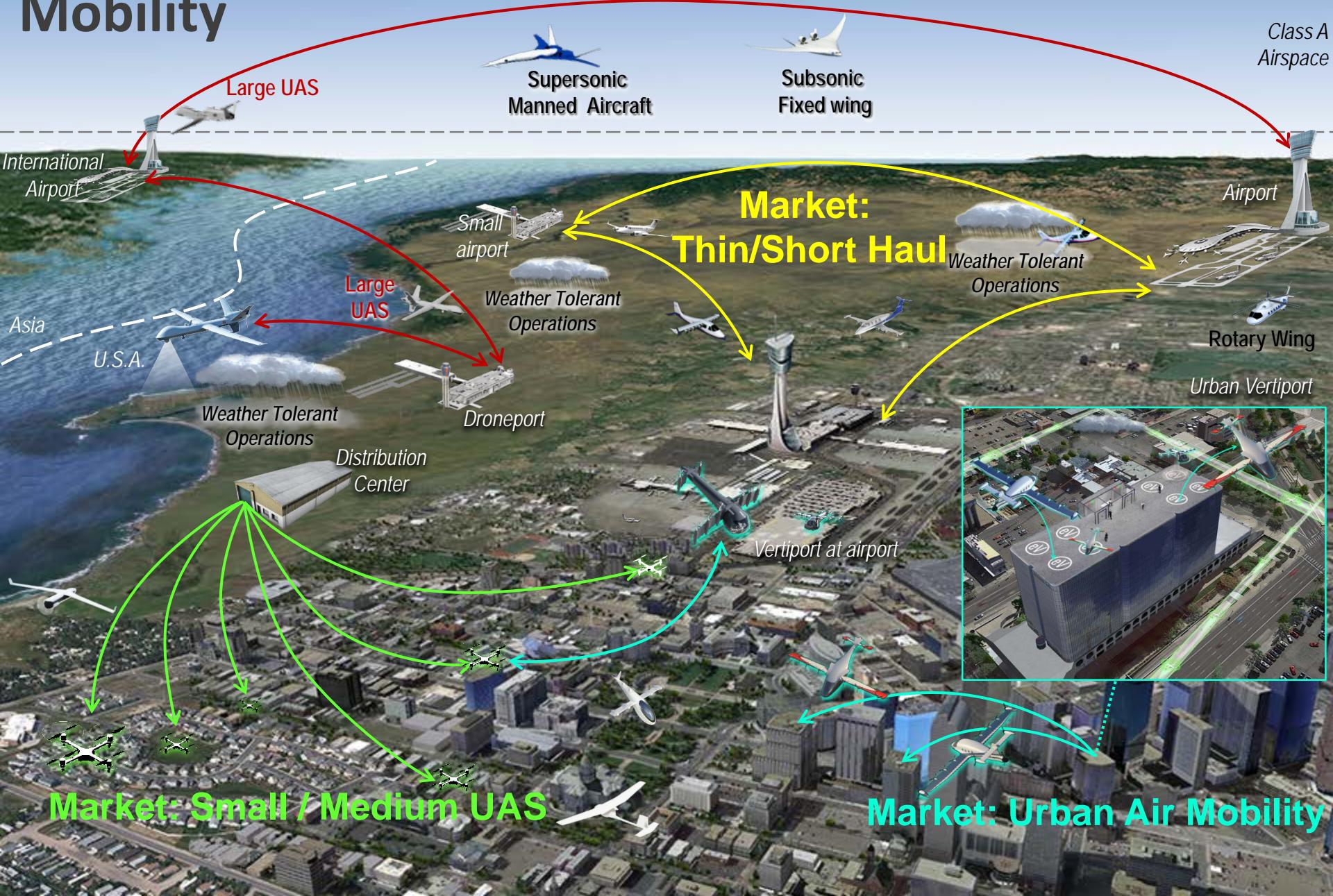
June 18, 2018

Future Mobility

HALE UAS

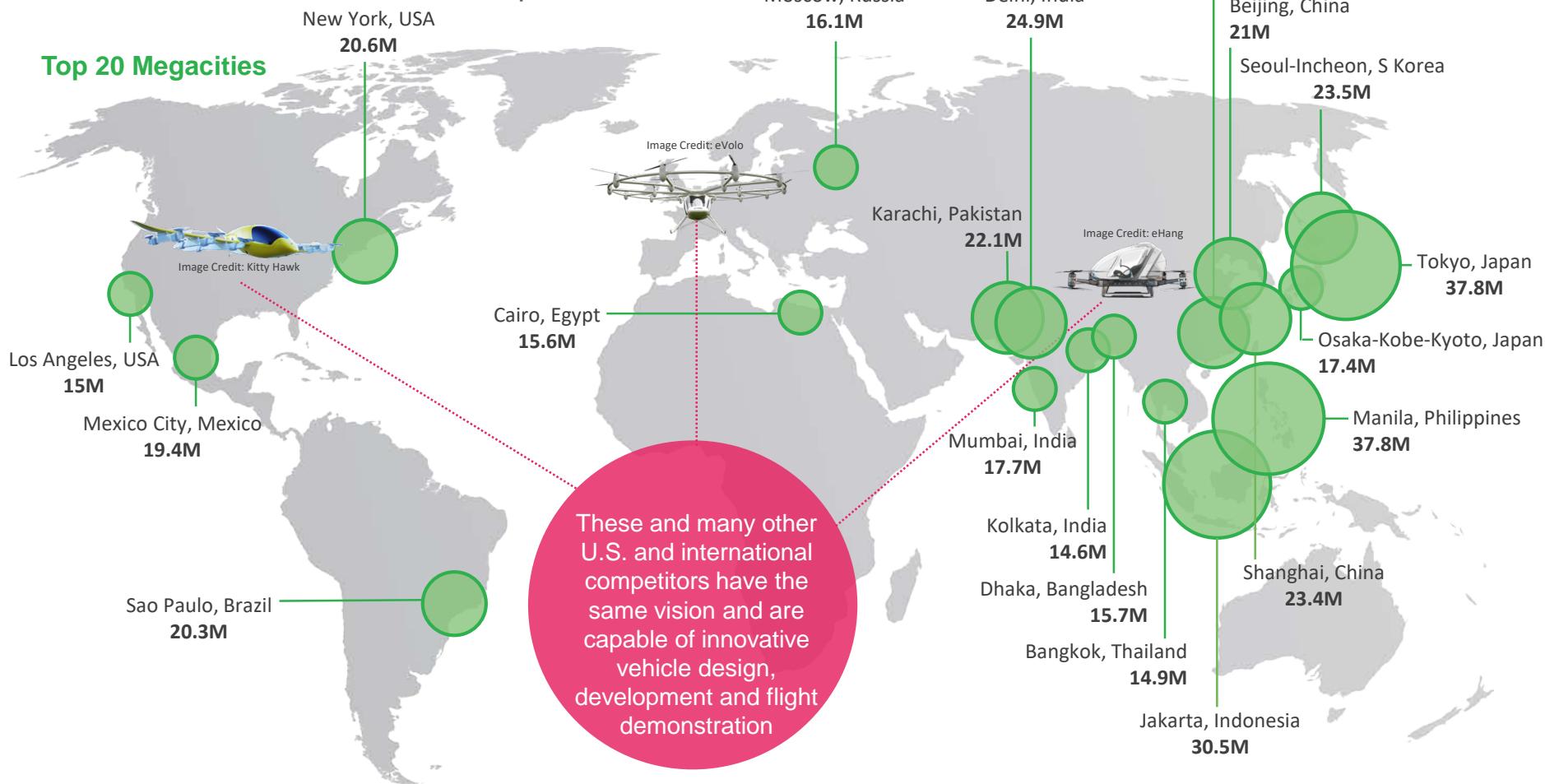
Market: Large UAS & HALE

Upper E
Airspace



Urban Air Mobility

Global Race to Achieve Leadership



Large projected market—McKinsey analysis of demand by 2030 in 15 major U.S. cities:

- 500 Million annual UAS package deliveries
- 750 Million annual passenger trips

Extrapolation to the global market would likely increase demand by 5 to 10x

Urban Air Mobility

Market Potential



- McKinsey & Company Market Analysis
- Assessed market potential across 15 U.S. cities
 - Last-mile parcel delivery – projecting a profitable market with ~500M deliveries by UAS. Commercial break-even point by 2030 with significant ramp-up by 2025
 - Air transportation – projecting a profitable market with ~750M passenger trips by 2028 with a ramp-up by 2025
- Assumes major issues can be solved
 - Safety, Privacy, Environment, and Noise / Visual Disruption

Emerging Aviation Markets

Global Race to Achieve Leadership



Urban Air Mobility



Ehang - China



E-Volo - Germany



Kitty Hawk Cora - US

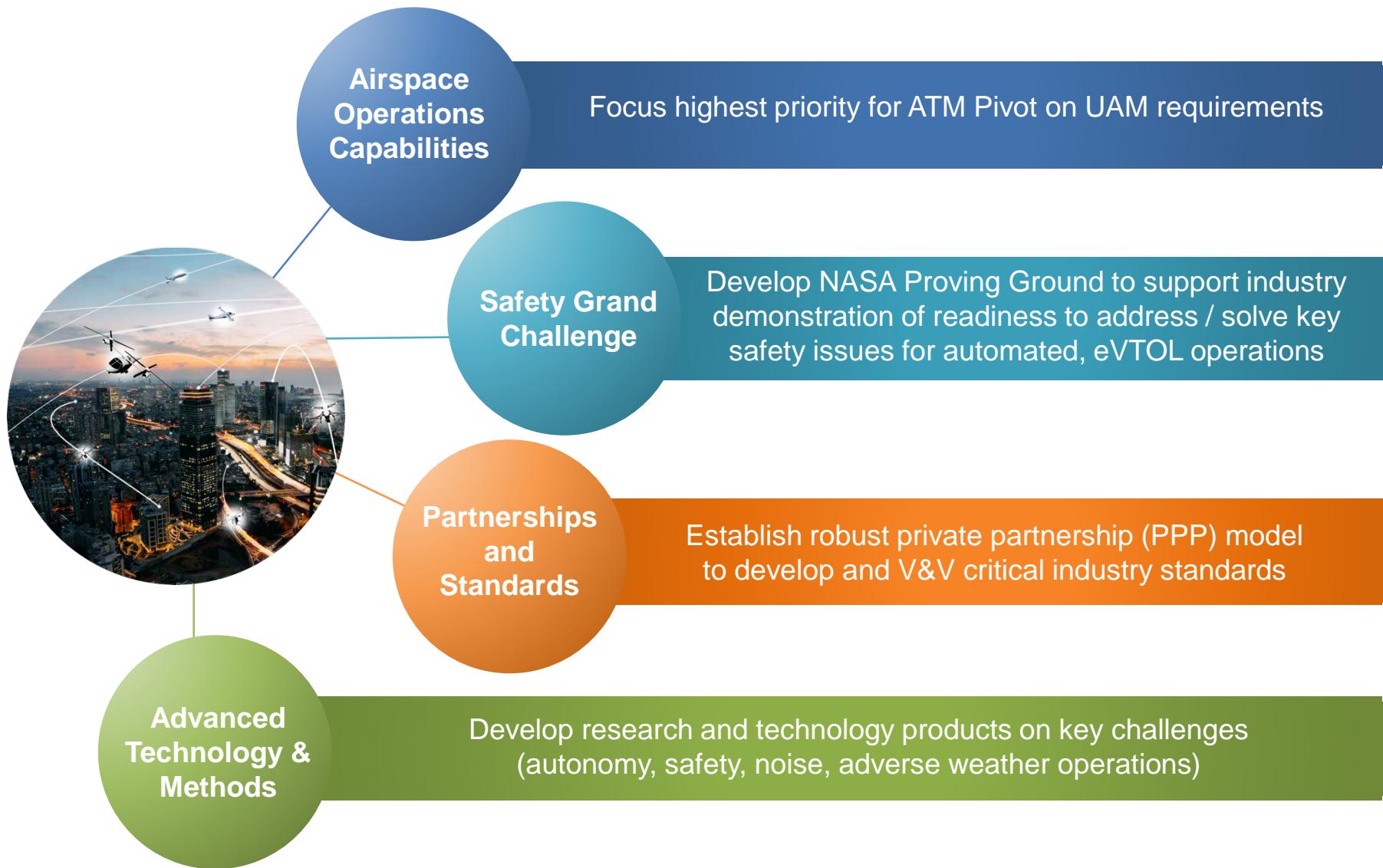
And many other U.S. and international competitors have the same vision and are capable of innovative vehicle design, development and flight demonstration

The race to capture the market will be won based on...

- Ability to certify innovative aviation technologies and configurations
- Achieving equitable community noise standards
- Enabling safe airspace access at high densities
- Achieving safe vertiport infrastructure standards

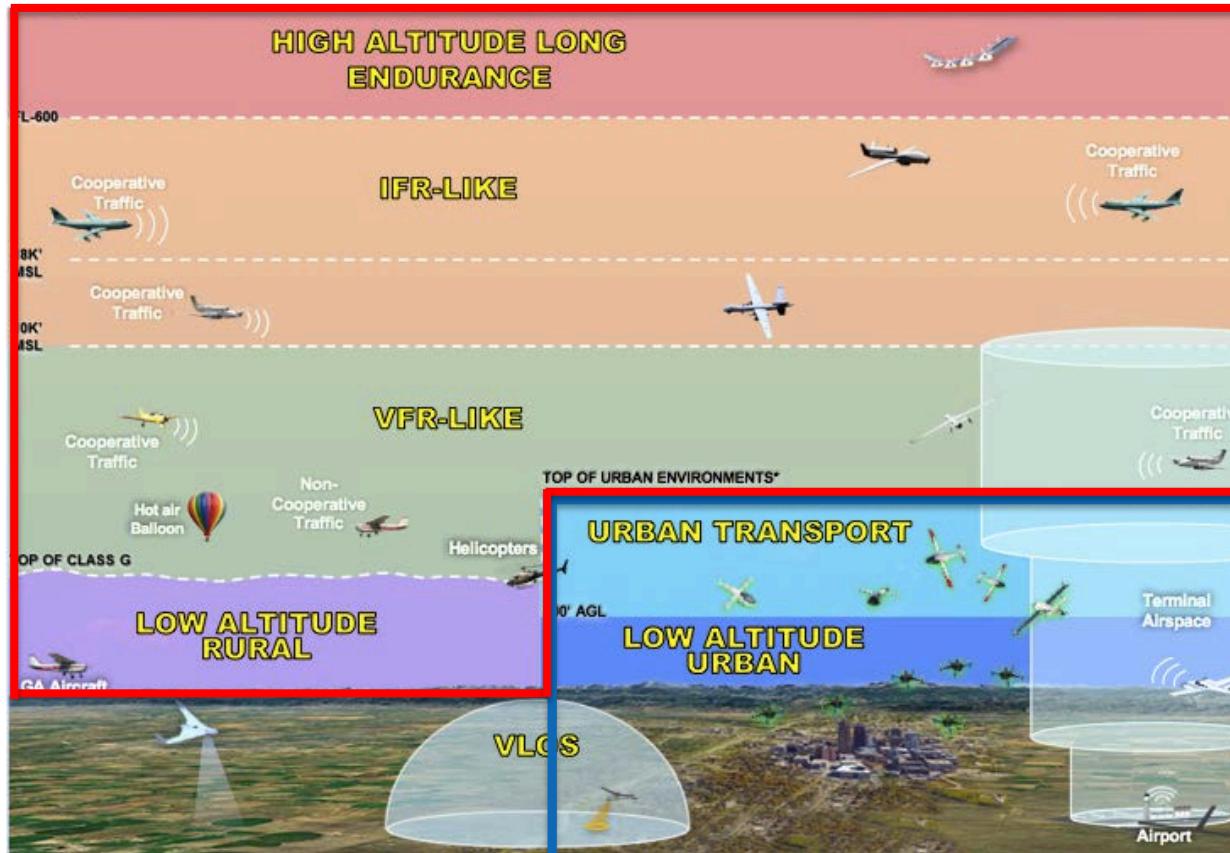
But most demonstrations and early market growth are overseas – all four key issues easier to manage in many other countries. The U.S. must lead or fall behind.

NASA is adjusting its portfolio to address the issues, support FAA and industry to accelerate U.S. competitive posture, and do it through a technically sound, sustainable and scalable approach



Enabling Safe UAS Operations in the U.S.

Firm Foundation for Airspace Operations Capabilities Development



UAS in the NAS –
Primary Focus is IFR-Like
and VFR-Like Operations
with Current NAS System

UAS Traffic Management
(UTM) Primary Focus in
Low Altitude Urban within
a New Operational Model

Emerging, Long-Term Urban Air
Mobility Focus builds off of
UAS in the NAS and UTM to enable Air
Taxi type operations in urban areas

UAM Reference Missions



Non-Passenger Carrying Reference Missions

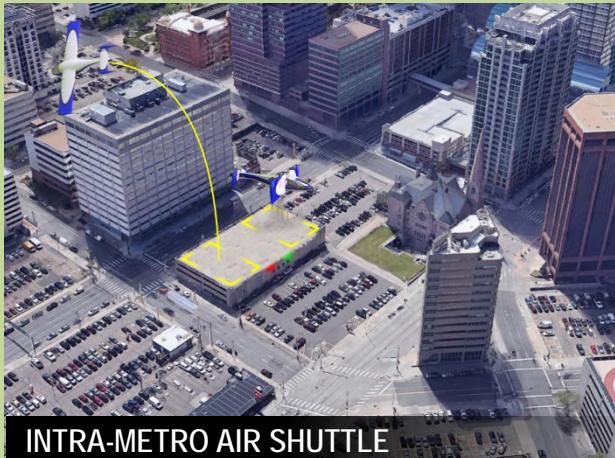


INITIAL STATE

INTERMEDIATE STATE

MATURE STATE

Passenger Carrying Reference Missions



UAM Technical Framework



Design, manufacture, and system readiness of UAM aircraft

Societal integration and acceptance of UAM operations

Design and implementation of systems to enable vehicles to share airspace and other resources

Community Integration

Vehicle Development & Production

Airspace System Design & Implementation

Individual Vehicle Management & Operations

Air Traffic & Fleet Operations Management

Operations and maintenance of a single UAM vehicle, independent of the sharing of airspace or other system resources

Urban Air Mobility (UAM) Vision
Revolutionize mobility within metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo

Operations and management of multiple vehicles within a UAM system that enable safe sharing of airspace and other system resources

Laying the Ground Work for Aviation in 2040



- The **global aviation system of 2040** is emerging today – new companies and new systems built on advanced technologies pioneered by NASA based on steady U.S. investment
- Based on what is emerging today, what can we see for 2040:
 - An **Urban Air Mobility** system that is all electric, autonomous and environmentally friendly moving billions of commuters and packages across the world's megacities. As a result, ground-based traffic congestion will be reduced, local air quality will be improved, and urban areas will be transformed
 - **Transformative subsonic airliners** developed by U.S. industry will approach near-optimal levels of efficiency, reducing cost and environmental impact, and will continue to enable more people to travel around the world supporting a vibrant and growing U.S. and global economy
 - A growing segment of increasingly affordable and **environmentally friendly supersonic air travel**. This will once again shrink our world and project U.S. technological leadership.
 - All of this will ride upon a **transformed airspace system** that provides the access and efficiency to enable this broad range of business models and provides proactive and prognostic "in-time" safety assurance, providing all citizens confidence that every flight is safe and secure.