Texas Department of Transportation

REPORT AND RECOMMENDATIONS OF THE

Urban Air Mobility Advisory Committee

OCTOBER 2022

PREFACE

Advanced Air Mobility (AAM) is a next-generation transportation modality transforming America's regional and interregional connectivity for the movement of people and goods. AAM includes a broad range of innovative aeronautics technologies, including a large class of unmanned aerial systems, vertical take-off and landing (VTOL) aircraft, electric aircraft, and transformative air traffic management systems. Urban Air Mobility (UAM) is a subset of a complex AAM ecosystem that focuses on high-density automated aircraft operations over densely populated areas, especially aircraft operations below 4,000 feet.

The Texas Transportation Commission Urban Air Mobility Committee, constituted through the directive of SB 763, was tasked with assessing current state law regarding UAM and providing suggestions for potential changes, as well as providing guidance on the development of UAM operations and infrastructure for the State of Texas. The Committee embraced a broader interpretation of the directive to set a goal to identify and define the State's path to adopting this new transportation modality. The guiding vision of the Committee was to "Maximize Opportunity and Safety" and included four principles:

1. Texas will be the destination for the early adaptation and development of UAM Technologies.
2. UAM will provide extensive business and economic opportunities for our residents.
3. The adaptation of the UAM paradigm will create equitable upward social mobility for our residents.
4. Texas will be the national role model for the safe deployment of UAM.

Through four working groups (Technology, Airspace and Infrastructure, Safety and Security, and Commerce and Community Integration), the Committee explored the intersection of policy and technology doctrine to develop a set of recommendations to support the UAM ecosystem development for the State of Texas. The Committee collects and synthesizes information on (i) state, national, and global contexts, (ii) technology and maturation level, (iii) state and federal laws, and (iv) strategic advantage of our State in developing the recommendations. The recommendations are summarized in this report.

The Committee worked diligently to develop a robust set of recommendations that can be used as a foundation for developing new regulations (or potentially changing existing ones) that can facilitate the development of the State's UAM deployment and adaptation capabilities. However, due to the very short duration of the Committee, an extensive assessment of some of the important areas could not be done. Rapidly emerging AAM technologies and elasticity needed in the regulatory framework to address these evolving technology paradigms require much more in-depth analysis than those the Committee was able to provide. Regulatory impacts, challenges, and opportunities for high-density UAM, interoperability, cybersecurity, industry-regional government partnership, and workforce development issues must be fully considered before comprehensive UAM implementation guidelines can be developed. A comprehensive legal and regulatory review was not presented to this committee due to the statutory timeframe, including but not limited to relevant U.S. Supreme Court cases *United States v. Causby* and *Griggs v. Allegheny Cty.*; further legal analysis by appropriate independent experts is required. The Committee likely needs an additional 24 months of effort to provide more comprehensive assessments.

It was my privilege to serve as Chair of the Texas Transportation Commission Urban Air Mobility Committee and work with a group of very distinguished UAM stakeholders. Very special appreciation to the Texas Department of Transportation leadership and the Texas A&M Transportation Institute team for their extensive support to the Committee.

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and
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URBAN AIR MOBILITY ADVISORY COMMITTEE

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Chad Sparks, Bell, Vice Chair
Amanda Nelson, Bristow Group Inc.
Ben Ivers, The Boeing Company
Bill Goodwin, Joby Aviation
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EXECUTIVE SUMMARY

BACKGROUND & PURPOSE

In spring 2021, the Texas Legislature passed Senate Bill 763 in the 87th Regular Session requiring the Texas Transportation Commission to establish the Urban Air Mobility Advisory Committee "to assess current state law and any potential changes to state law that are needed to facilitate the development of urban air mobility operations and infrastructure in this state."

Urban Air Mobility (UAM) envisions a safe and efficient aviation transportation system that will use highly automated aircraft that will operate and transport passengers or cargo at lower altitudes within urban and suburban areas.

Advanced Air Mobility (AAM) builds upon the UAM concept by incorporating use cases not specific to operations in urban environments, such as:

- Commercial intercity.
- Cargo delivery.
- Public services.
- Private/recreational vehicles.

DEFINITIONS

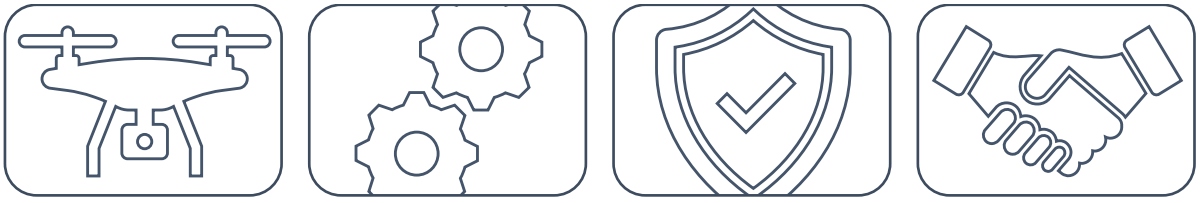
URBAN AIR MOBILITY (UAM) ADVISORY COMMITTEE *GUIDING VISION*

The UAM Advisory Committee established a vision that focused on maximizing opportunity and safety for the State of Texas. The core principles of this guiding vision are:

- Texas will be the destination for early adaptation and development of UAM Technologies.
- UAM will provide extensive business and economic opportunities for our residents.
- The adaptation of a UAM paradigm will create upward social mobility for our residents.
- Texas will be the national role model for the safe deployment of UAM.

UAM ADVISORY COMMITTEE MEETINGS

The Urban Air Mobility Advisory Committee held four public meetings which included opportunities for input from stakeholders and the general public. During the initial meetings, the committee identified four key areas for the success of UAM:



Technology | Airspace and Infrastructure | Safety and Security | Commerce and Community Integration

The working groups each held four meetings for a total of 16. All 20 of these meetings were posted in advance on the Texas Department of Transportation's (TxDOT's) website and were open to the public. Public comment was welcomed and received at all meetings. During the working group meetings, critical topics were established for each area based on the charge of the committee.

The discussions on these critical topics concluded with the development of recommendations that were reviewed and approved by the full committee. The first recommendation was put forth by multiple working groups.

URBAN AIR MOBILITY ADVISORY COMMITTEE RECOMMENDATIONS

- Extend the work of the Urban Air Mobility Advisory Committee beyond the sunset date of January 1, 2023, to continue working in key areas of this emerging and quickly evolving industry in order to remain responsive to the needs of Texas and ensure Texas' role as a leader in this industry.

Technology

- Encourage the development of an urban air mobility/advanced air mobility sandbox by:
    a) Directing the preparation of a feasibility study to understand the market, differentiating factors from similar existing facilities, potential market/players, funding sources, revenue opportunities, locations, necessary digital and physical infrastructure, and potential use cases; and
    b) Pursuing the development of a facility that will provide opportunity for testing and commercialization that will attract business and move the industry and state forward.
    c) Having the State take the initiative to work with industry to determine additional standards in terms of communications, technology, and environmental awareness systems to encourage consistency and harmony at all levels of government and stakeholders.

> The committee's discussion regarding a sandbox focused on the concept of a designated place, either geographical or digital, where new technologies can be tested under liberal rules for a predetermined duration before a commercial rollout to the public.

- Consider the initial funding for a UAM/AAM Sandbox Feasibility Study and ultimately its development along with an incentive program to attract industry with the ultimate

objective of using user fees to fund the ongoing operations and maintenance of the sandbox

- Encourage state agencies to adopt a technology-neutral/open architecture approach to the urban air mobility/advanced air mobility industry to allow easier adoption of new technologies and deployment into new regions.

- Identify areas where technology will drive standardizations.

Airspace and Infrastructure

- Provide consistency across Texas law by creating statutory uniformity and standard definitions pertaining to unmanned aircraft operations and urban air mobility/advanced air mobility.

- Develop an urban air mobility/advanced air mobility–centric research facility to test and evaluate technology, provide data collection opportunities, and coordinate with federal entities to share information and help guide data-driven public policy. The Texas Legislature is encouraged to consider the benefits of state funding for the successful development and operation of this facility.

- Develop a statewide plan, or integration within the Texas Airport System Plan, that addresses the potential locations for and classifications of vertiports and other associated infrastructure to help define the future operational environment of urban air mobility/advanced air mobility.

- Direct the State to work with municipalities to provide technical assistance to local governments in adapting and integrating urban air mobility/advanced air mobility in their communities.

Safety and Security

- In collaboration with the appropriate federal entities, the state will work to encourage the development of minimum standards/safety management systems for vertiport operations including passenger and goods movements and ground infrastructure.

- Recommend Texas law does not conflict with federal law.

- Encourage the Legislature remain an active participant in urban air mobility/advanced air mobility as the industry and technology will outpace current regulations and enable the appropriate state agency to lead and manage the regulatory concerns.

- Direct the Texas Department of Transportation to review existing state aviation standards and guidelines, airport facility planning, and compatibility guidance to ensure they apply to urban air mobility/advanced air mobility.

- Support the development of standardizations at the federal level and within industry as technology develops/changes so safety is prioritized as the technology matures.

- Encourage state-level cooperation with local governments to ensure appropriate preparation, training, and safety practices associated with vertiport operations including law enforcement, fire service, and emergency medical services associated with traditional aviation and advanced air mobility aircraft operations.

Commerce and Community Integration

- Direct all law enforcement and first responder agencies to adopt education and training recommendations as identified in *Unmanned Aircraft: Responding to and Recovering from Disasters* (State of Texas, November 2020), a report born out of House Bill 2340 (86R, 2019), establishing a small unmanned aircraft study group for a statewide response team.

- Create a statewide primary point of contact to direct urban air mobility/advanced air mobility workforce development efforts, lead public awareness and education efforts, and collaborate with local, regional, state, and federal entities to encourage more input and participation.

- Direct the State to provide resources and assistance on the use of urban air mobility/advanced air mobility technology infrastructure for cities, local and regional governments, transportation planning organizations, other entities, and industry to better identify what the different levels of government can do to integrate industry innovation and community vision and help promote urban air mobility/advanced air mobility technology.

- Direct the appropriate state agencies to jointly collaborate with local school districts, higher education institutions, and any interested private and/or public stakeholders on educational opportunities related to urban air mobility/advanced air mobility technologies.

IN CLOSING

The recommendations developed by this committee represent the culmination of many meetings and hours of discussion on how best to position our state to facilitate the emerging and quickly evolving advanced air mobility industry.

The committee recognizes that many of the recommendations may add additional workload to some agencies such as the TxDOT Aviation Division. The Aviation Division, which currently has responsibilities surrounding the planning, programming, and funding of airport projects across the state as well as some aviation education responsibilities, is likely to find itself as the focal point for several of these recommendations. The committee understands that many of the additional roles and responsibilities imbedded within its recommendations will be best addressed and carried out with appropriate accompanying resources.

The committee would like to thank the Texas Legislature and TxDOT for the opportunity to participate in this important work and their commitment to advanced air mobility.

INTRODUCTION

In spring 2021, the Texas Legislature passed Senate Bill 763 in the 87th regular session requiring the Texas Transportation Commission to establish the Urban Air Mobility Advisory Committee (*1*). The bill was passed in the Senate on April 20, 2021, and in the House on May 11, 2021. The governor signed the bill on June 14, 2021. The bill was authored by Sen. Beverly Powell and sponsored by Rep. David Cook.

TxDOT's Strategic Planning Division and Aviation Division began working with the Texas A&M Transportation Institute (TTI) in fall 2021 to provide support for the work of the Urban Air Mobility Advisory Committee upon its establishment. TTI assisted TxDOT by developing a literature review and background research for the committee as well as a review of activity in other states. TTI also provided supporting materials and assistance to the committee and TxDOT during the committee's work. Resource documents and meeting notes were maintained for the committee members' use in their work.

The primary charge and focus of the Urban Air Mobility Advisory Committee was to develop the recommendations found in the Key Areas in Urban Mobility section of this report, and the committee unanimously adopted the recommendations and accompanying report during a public meeting of the full committee on July 7, 2022. A draft report, as presented during the July 7th meeting, was posted to the committee's website for public comment; input provided during the public comment period is reflected as an appendix to the report.

COMMITTEE ESTABLISHMENT AND LEADERSHIP

The responsibility for establishing the Urban Air Mobility Advisory Committee fell to TxDOT and, more specifically, the Strategic Planning Division. TxDOT worked in late summer/early fall 2021 to identify and select members for the committee that met the representation requirements set forth in Senate Bill (SB) 763. Ultimately, 29 members were selected and approved by the Texas Transportation Commission at its November 2021 meeting. TxDOT was assisted by TTI in operating the committee, developing background resources, and facilitating the committee's work and public meetings.

At the committee's initial meeting in December 2021, a chair and vice chair were selected to lead the committee's activities. The committee elected Dr. Ahsan Choudhuri as the committee chair. Dr. Choudhuri currently serves as associate vice president and professor of aerospace engineering at The University of Texas at El Paso. He is the founding director of the university's Aerospace Center. The committee also elected Mr. Chad Sparks as the vice chair. Mr. Sparks is the director of strategy and enterprise growth alignment at Bell in Fort Worth, Texas.

During his first meeting as chair, Dr. Choudhuri shared his vision for how he saw the advisory committee working together going forward. Following discussion with the full committee, four working groups were established to allow the 29-member committee to begin addressing the multitude of issues and challenges that urban air mobility presents.

The four working groups, which are discussed in more detail later in this report, are:

1. Technology.
2. Airspace and Infrastructure.
3. Safety and Security.
4. Commerce and Community Integration.

Each working group was led by a lead facilitator who was selected by TxDOT following a request of the committee members to identify on which working group they would like to serve. The lead facilitators for the working groups were as follows:

1. Dr. Maruthi Akella, The University of Texas at Austin—Technology.
2. Mr. Nathan Trail, Supernal (Hyundai Motor Group)—Airspace and Infrastructure.
3. Mr. Ben Ivers, The Boeing Company—Safety and Security.
4. Mr. Michael Hill, Volatus Aerospace—Commerce and Community Integration.

The committee identified the topics and issues that fell under each of these areas, and the working groups used them as a starting point for their discussions. The working groups were charged with developing recommendations that fell within their group's purview.

Each of the working groups held four meetings and voted on the recommendations they developed on their fourth meeting. All working group recommendations were presented to the advisory committee as a whole at the June 14, 2022, meeting in Austin, Texas, where they were each discussed, amended if desired, and voted on. The committee adopted 20 recommendations that appear below under their respective working groups along with some additional context. This report of the Urban Air Mobility Advisory Committee was discussed and approved by the committee at its July 7, 2022, meeting in Austin, Texas.

COMMITTEE MEETINGS

The Urban Air Mobility Advisory Committee held four meetings between December 2021 and July 2022. The four working groups each held four meetings for a total of 16. Collectively, there were 20 meetings of the Urban Air Mobility Advisory Committee and its working groups. All meetings were posted in advance on TxDOT's website and were open to the public. Public comment was welcomed and received at all meetings, and the input was documented by TxDOT and TTI staff. There was a one-week public comment period following the committee's approval of the recommendations and report on June 14, 2022, and July 7, 2022, respectively. Figure 1 shows the timeline of the committee meetings.

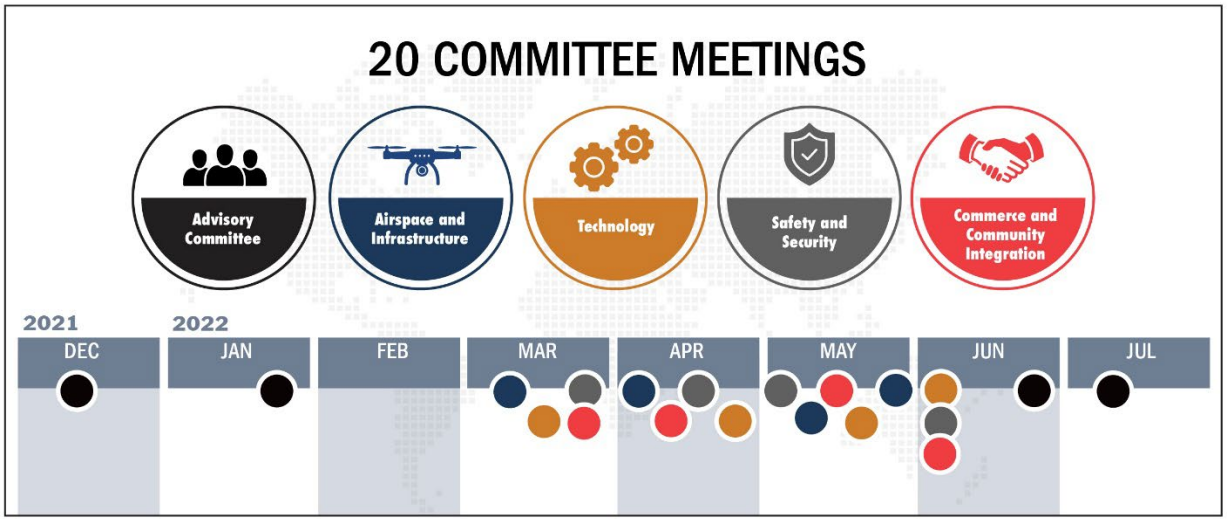


Figure 1. Timeline of Committee Meetings.

Notes and videos were taken for each of these meetings and are available at TxDOT's Urban Air Mobility Advisory Committee website: https://www.txdot.gov/inside-txdot/division/planning/urban-air-mobility-advisory-committee.html.

PURPOSE

The purpose of the Urban Air Mobility Advisory Committee and its efforts is clearly laid out in the legislation. The advisory committee is "to assess current state law and any potential changes to state law that are needed to facilitate the development of urban air mobility operations and infrastructure in this state" (*1*). The entire text of the legislation can be found in Appendix A.

DEFINITIONS

Both the National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA) have been involved in the early stages of urban air mobility. For the purposes of this research and the committee's work, this report uses these entities' definitions of urban air mobility. Further, the use of the term *urban air mobility* has been largely supplanted by the term *advanced air mobility* in an effort to be more inclusive and address these same technologies and services for areas beyond our urban areas. The use of these accepted terms and definitions will provide a common baseline and foundation from which the committee's work can take place.

FAA provides the following definitions for urban air mobility and advanced air mobility (*2*).

Urban Air Mobility

UAM envisions a safe and efficient aviation transportation system that will use highly automated aircraft (crewed or uncrewed/self-flying) that will operate and transport passengers or cargo at lower altitudes within urban and suburban areas.

UAM will be composed of an ecosystem that considers the evolution and safety of the aircraft, the framework for operation, access to airspace, infrastructure development, and community engagement.

Advanced Air Mobility

Advanced air mobility (AAM) builds upon the UAM concept by incorporating use cases not specific to operations in urban environments, such as:

- Commercial intercity (longer range/thin haul).
- Cargo delivery.
- Public services.
- Private/recreational vehicles.

To build upon these definitions, NASA has developed a vision for advanced air mobility. Currently, it almost exclusively uses the term *advanced air mobility* to be inclusive of its work on urban air mobility.

> NASA's vision for Advanced Air Mobility (AAM) Mission is to help emerging aviation markets to safely develop an air transportation system that moves people and cargo between places previously not served or underserved by aviation—local, regional, intraregional, urban—using revolutionary new aircraft that are only just now becoming possible. AAM includes NASA's work on Urban Air Mobility and will provide substantial benefit to U.S. industry and the public (*3*).

Aircraft and Airport

For the purpose of clarity, the definitions of *aircraft* and *airport* are provided as defined in the Texas Transportation Code. They are as follows.

> "Aircraft" means a device that is invented, used, or designated for air navigation or flight, other than a parachute or other device used primarily as safety equipment (*4*).

> "Airport" means: (A) an area used or intended for use for the landing and takeoff of aircraft; (B) an appurtenant area used or intended for use for an airport building or other airport facility or right-of-way; and (C) an airport building or facility located on an appurtenant area (*5*).

Unmanned Aircraft Systems

Unmanned aircraft system (UAS) is defined by the FAA Modernization and Reform Act of 2012 as follows.

> The term ''unmanned aircraft system'' means an unmanned aircraft and associated elements (including communication links and the components that control the unmanned aircraft) that are required for the pilot in command to operate safely and efficiently in the national airspace system (*6*).

Some additional clarification is also warranted regarding the use of the term "unmanned" in this report. It is used in this document for clarity and consistency reasons. The industry has seen myriad terms used over the recent years to describe aircraft being flown without a pilot whether it is autonomously or remotely. "Unmanned aircraft" and "drones" are two terms that have been widely used and even adopted by governmental agencies, industry groups, and universities within their organizations and publications. There is a clear trend to replace "unmanned" with the more gender-neutral "uncrewed" across government, industry, and academia. While the FAA still uses "unmanned", some universities, governmental agencies, and industry groups including AUVSI (Association for Uncrewed Vehicle Systems International), the largest non-profit organization committed to uncrewed systems, have already made this change. This report uses the historical term "unmanned" to avoid confusion regarding the documents it cites and the work that took place in developing the Committee's recommendations. However, it is recognized that there are proposals to change this nomenclature and future reports will abide by such taxonomy once adopted by the FAA.

Automation and Autonomous Operations

There can also be some confusion when it comes to defining automation and describing what autonomous flight really looks like. The FAA, in its *Concept of Operations v1.o* document, refers to several levels of aircraft automation. According to the FAA, in a sort of evolution, there is Human-within-the-Loop (HWTL), Human-on-the-Loop (HOTL) and Human-over-the-Loop (HOVTL). With Human-within-the-Loop, a human is always in control of the automation. With Human-on-the-Loop, a human has supervisory control and actively monitors the systems and has the ability to take full control of the aircraft. With Human-Over-the-Loop, the human is informed by the automation system, passively monitors the system and is informed by the system if any action is required, and they are engaged by the automation system for any exceptions that are not reconcilable. The physical location of the pilot is expected to transition from onboard initially to remotely.

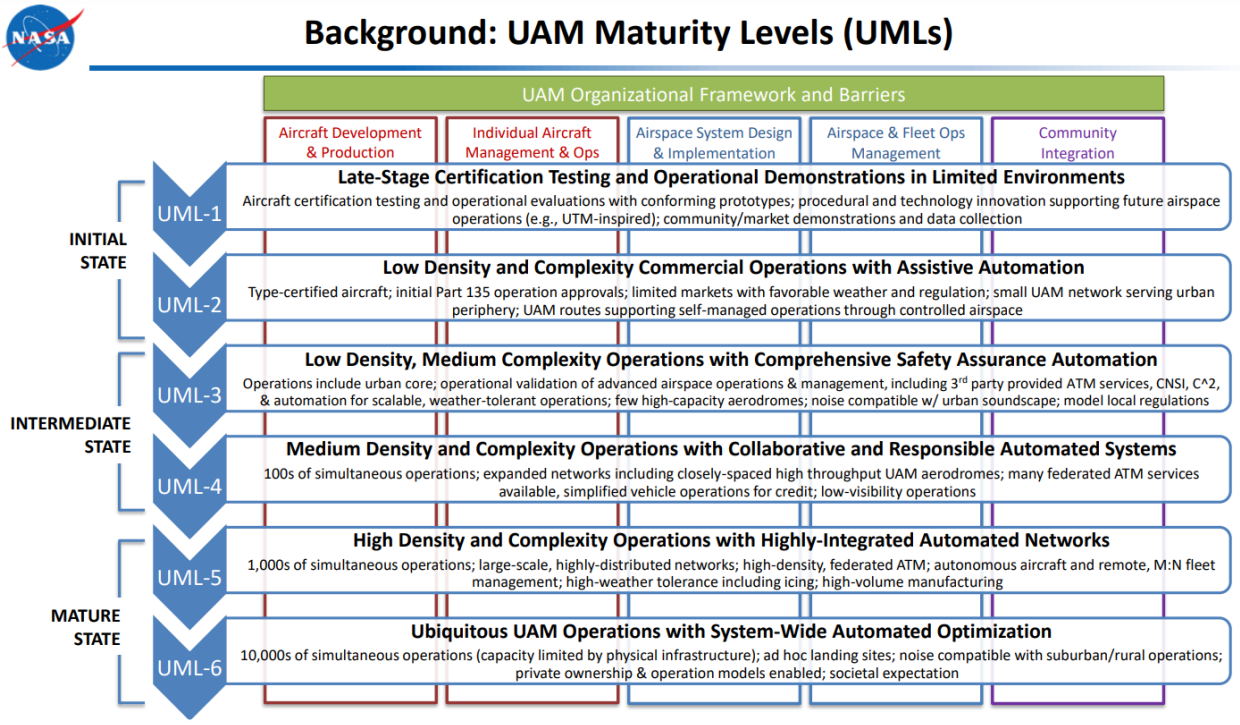
More advanced automation and piloting concepts are described by Garrow et. al. in their paper entitled *A Proposed Taxonomy for Advanced Air Mobility* (*7*). Their discussion of autonomous flight ranges from simplified vehicle operations where automation assist a pilot by reducing the necessary skills and workload of operating an aircraft through a multi-aircraft supervisor where a remote human is responsible for multiple aircraft and a remote supervisory operation (RSO) where one or more multiple aircraft supervisors are overseeing many, automated flights. While this is beyond the scope of this study, it is worth noting there is an increasing level of automation and complexity involved with AAM.

EMERGING AND EVOLVING INDUSTRY

As defined above by NASA, UAM, or AAM as it is now more commonly referred, is a quickly emerging and evolving industry that has seen significant investment from the private sector and been the focus of significant time and resources from federal, state, and local governments. The industry is rapidly changing with respect to the technologies it uses and will require widespread coordination across all levels of government and partnerships with private industry. The industry will also require unprecedented levels of coordination and cooperation as the technology is deployed. It will require integration into many aspects of our everyday life, bringing new challenges that must be met head on.

In June 2020, FAA developed a concept of operations that described the operational environment FAA envisioned that would support this industry as it grows (*8*). According to FAA, "The envisioned future state for UAM operations includes increasing levels of autonomy and operational tempo across a range of environments including metropolitan areas and the surrounding suburbs." This initial concept document specifically addresses engagement with NASA and industry stakeholders and defines the unmanned aircraft system (UAS) traffic management operating environment.

In the second concept-of-operations document, in an effort to articulate where this industry is headed and what the path toward wide-scale implementation may look like, NASA developed an organizational framework that illustrates what various maturity levels will look like (*9*). Figure 2 shows this framework.



Source: NASA (*9*)

Figure 2. UAM Organizational Framework and Barriers.

The maturity levels range from aircraft certification testing through full implementation and deployment of thousands of vehicles serving our urban, suburban, and rural populations. We are in the early stages of this complex and dynamic industry. Many of the issues outlined in this framework were the subject of significant thought and discussion by this advisory committee. This report documents the efforts of this committee over the last several months and includes the challenges and issues the committee considered and the recommendations that were developed for the state to consider in order to help facilitate advanced air mobility in Texas.

ORGANIZATION OF REPORT

This report begins with a regulatory overview of those issues most pertinent to urban air mobility. The report includes a regulatory overview that discusses recent legislation at the state level both in Texas and in other states across a number of issues including operations, privacy, noise abatement, electricity, and air rights. What follows is a discussion of the four key areas identified by the committee. Each of these four areas is served by a working group. The section is organized by working groups, and their respective subsections include background information on the associated topics, a summary of the activities and discussions of each group, and their recommendations. Each of the recommendations also has some additional context provided for clarity. The appendix includes the original legislation that established this committee as well as related state legislation from across the country.

REGULATORY OVERVIEW

The U.S. Government is given exclusive sovereignty of airspace in the United States in 49 USC § 40103(a)(1). This does not preclude states or local governments from passing any valid regulation within their traditional police powers, but courts generally recognize that Congress extensively controls much of the field. Where a state's exercise of police power infringes upon the federal government's regulation of aviation, state law is preempted. The FAA has been clear about the limitation of state and local police powers, but some grey areas may exist. The FAA has provided guidance on when to consult with the FAA as well as the FAA's authority in regulating drones (*10*, *11*).

The FAA was directed by Congress in the FAA Modernization and Reform Act of 2012 to "develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system." To this end, the FAA developed 14 CFR Part 107 that applies to the "registration, airman certification, and operation of civil small, unmanned aircraft systems within the United States." While the federal government has noted that states have limited authority to regulate aircraft operations under their police powers, states have attempted to delineate parameters for operation within Class G airspace. [1]

RECENT LEGISLATIVE DEVELOPMENTS AT THE STATE LEVEL

There is recent development in state legislatures regarding AAM that shows an interest in the possible adoption of this new technology. In early 2022, bills were enacted in Michigan and Utah establishing a task force dedicated to exploring AAM opportunities for their state. Michigan passed SB 795 creating the advanced air mobility study committee comprised of 25 members (*13*). Similarly, Utah enacted SB 122 tasking its department of transportation to create a working group to study the feasibility of adopting AAM. This bill additionally defines what constitutes a criminal offense with respect to UAM; it is a crime to commit the offense using the aircraft or if the actor commits the offense by controlling the aircraft (*14*).

Other recent legislation prohibits local government from placing restrictions on AAM such as those enacted in Michigan and West Virginia. In addition to creating the AAM study committee, Michigan, through SB 796, prohibits the county, city, or any local government from owning aircraft or regulating AAM (*15*). West Virginia's HB 4667 contains similar language restricting local government jurisdiction over AAM, but the state has enacted additional instructions to draw in the industry. HB 4827, titled Promoting Public-Use Vertiports Act, is enacted by West Virginia to "promote the development of a network of vertiports that will provide equitable access to citizens of this State who may benefit from advanced air mobility operations for cargo and passenger service, and to avoid any vertiport monopolization or discrimination" (*16*). A more complete list of UAS state legislation is in Appendix B.

[1] Per the GAO, "Class G airspace refers to uncontrolled airspace and generally extends from the surface to the base of Class E airspace, which in most areas is 1,200 feet above ground level, except for restricted or prohibited areas" (*12*).

Florida statute 934.50 regarding the use of UASs or drones was updated in 2021 to reflect the current interest in this technology. Named the Freedom from Unwarranted Surveillance Act, this law prohibits laws enforcement agencies from using drones to collect evidence or conduct surveillance. The statute does however include exceptions namely allowing the use of drones if there is high risk of a terrorist attack, if a search warrant was first obtained, and if quick action is needed (*17*). In late 2020, SB 44, Use of Drones by Government Agencies, was introduced and approved by the governor in June 2021 to amend this statute (*18*). Changes include expanding the use of drones by law enforcement to provide an aerial view of a crowd of more than 50 people, aid in traffic management except to issue citations, and facilitate the collection of evidence at a crime scene or traffic accident. Florida state agencies and political subdivisions may use a drone for the purposes of assessing damages caused by natural disasters and managing public vegetation and wildlife. The bill also introduces a security standard for drone use by a Florida agency. All Florida agencies are prohibited from using drones not on the Department of Management Services approved list. Additionally, starting July 1, 2022, all Florida agencies not using approved drones must submit a plan detailing how they will discontinue use of their drones. By January 1, 2023, all use of unapproved drones by a Florida agency must be discontinued.

THE TEXAS REGULATORY LANDSCAPE

The Texas legislative and regulatory environment has largely focused on the operations of small, unmanned aircraft systems to date, in terms of action at the state level. While unmanned aircraft is not explicitly defined in statute, Texas code regulates operations and privacy to a certain extent with protections also existing at the national level. Other portions of statute address some of the relevant issues related to UASs, such as noise abatement, electricity provision, and air rights. Table 1 provides an overview of the relevant legislation passed in Texas (*19*).

Table 1. Texas Legislation.

Year	State	Bill	Summary
1995	Texas	SB 971	This legislation requires a municipality to provide adequate soundproofing and noise reduction devices for each public building within the 65 or higher average day-night sound level contour as determined by the governing body in accordance with FAA Advisory Circulars for replacement airports (1995—recodification).
2013	Texas	HR 3035 SR 1084	Adopts two resolutions (House Resolution [HR] 3035 and Senate Resolution [SR] 1084) addressing legislative procedures needed to enact the new drone law.

Year	State	Bill	Summary
2013	Texas	HB 912	Enumerates 19 lawful uses for unmanned aircraft. The law creates two new crimes, the illegal use of an unmanned aircraft to capture images and the offense of possessing or distributing the image. *Image* is defined in the law as any sound wave, thermal, ultraviolet, visible light, or other electromagnetic waves, odor, or other conditions existing on a property or an individual located on the property. **Note: The previous provisions were impacted by *NPPA v. McCraw*.** Additionally, the measure requires the Department of Public Safety to adopt rules for use of UASs by law enforcement and mandates that law enforcement agencies in communities of over 150,000 people make annual reports on UAS use. Texas House Concurrent Resolution (HCR) 217 altered reporting requirements from the original HB 912.
2015	Texas	HB 1481	Makes it a Class B misdemeanor to operate UASs over a critical infrastructure facility if the UAS is not more than 400 feet off the ground. **Note: This provision was struck down by *NPPA v. McCraw*.**
2015	Texas	HB 2167	Permits individuals in certain professions to capture images used in those professions using UASs as long as no individual is identifiable in the image. **Note: This provision was impacted by *NPPA v. McCraw*.**
2015	Texas	HB 3628	Permits the creation of rules governing the use of UASs in the Capitol Complex and provides that a violation of those rules is a Class B misdemeanor.
2017	Texas	HB 1643	Adds structures used as part of telecommunications services, animal feeding operations, and a number of facilities related to oil and gas to the definition of critical infrastructure as it relates to UAS operation. **Note: Portions of this legislation were struck down by *NPPA v. McCraw* except for the following provision:** Prohibits localities from regulating UASs except during special events and when the UAS is used by the locality. The legislation defines *special event*.
2017	Texas	SB 840	Permits telecommunications providers to use UASs to capture images. Also specifies that only law enforcement may use UASs to capture images of real property that is within 25 miles of the U.S. border for border security purposes. The law also allows a UAS to be used to capture images by an insurance company for certain insurance purposes, as long as the operator is authorized by FAA. **Note: These provisions were impacted by *NPPA v. McCraw*.**
2017	Texas	HB 1424	Prohibits UAS operation over correctional and detention facilities. Also prohibits operation over a sports venue except in certain instances. The law defines *sports venue* as a location with a seating capacity of at least 30,000 people and that is used primarily for one or more professional or amateur sports or athletics events. An initial violation is a Class B misdemeanor, and subsequent violations are Class A misdemeanors. **Note: This provision was struck down by *NPPA v. McCraw*.**
2021	Texas	SB 1202	A *retail electric provider* does not include a person not otherwise a retail electric provider who owns or operates equipment used solely to provide electricity charging service for consumption by an alternatively fueled vehicle.

Source: National Conference of State Legislatures (*19*).

In March 2022 a ruling in the case of *NPPA v. McCraw* determined that parts of Texas's UAS law under Chapter 423 were unconstitutional as they violated the First and Fourteenth Amendments. The ruling struck down parts 423.002, 423.003, 423.004, 423.0045, 423.0046, and 423.006. The parts struck down by the ruling related to lawful uses of UAS, created offenses relating to unlawful uses, such as surveillance and operation over critical infrastructure and sporting venues. This ruling has removed certain provisions under Texas law and has therefore limited the regulatory environment for UAS within Texas. The remaining parts of Chapter 423 cover illegally or incidentally captured images not subject to disclosure, rules for use and reporting by law enforcement and regulation of unmanned aircraft by political subdivisions. The following sections provide an overview of laws relating to UAS and UAM in Texas noting where the court ruling has altered the regulatory landscape in Texas.

OPERATIONS

As it pertains to unmanned aircraft, Texas statute previously laid out multiple situations in which the use of UASs is prohibited. Within Texas Government Code Chapter 423, the operation of an unmanned aircraft was prohibited above a correctional facility, detention facility, or critical infrastructure facility. The types of facilities that qualified under these facility terms are defined within the statute and range from county jails to electrical power-generating facilities and many other things. The use of unmanned aircraft was also prohibited above sport event venues that have a seating capacity of 30,000 people or more and were primarily used for one or more professional or amateur sports or athletics events (*20*).

The caveat for unmanned aircraft operation in the situations mentioned is that operation was allowed if at a height of 400 feet or higher. However, a recent court ruling, *NPPA v. McCraw*, struck down the majority of Chapter 423 as unconstitutional under the 1st and 14th Amendments (*21*). This ruling will likely impact any proposed legislation or legislative changes related to UAM regulation of unmanned aircraft by political subdivisions. Section 423.009 does remain in effect and restricts the adoption of ordinances by political subdivisions, except for special events, use by the political subdivision, and use near property owned by the political subdivision (*22*).

PRIVACY

Previously, Texas Government Code Chapter 423 addressed the use of unmanned aircraft to capture images and creates penalties for doing so (*23*). It is illegal to use an unmanned aircraft to capture an image of an individual or privately owned real property in this state with the intent to conduct surveillance on the individual or property captured in the image. An offense is a Class C misdemeanor. However, a recent court ruling struck down the majority of Chapter 423 as unconstitutional under the 1st and 14th Amendments (*21*).

While the provisions noted above under Chapter 423 no longer apply, Texas recognizes a common law right to privacy. These violations include intrusion upon one's solitude or private affairs, public disclosure of private facts, and wrongful appropriation of one's name or likeness. All three of these violations are treated as civil torts and not criminal offenses. The Texas penal code does address specific crimes that violate a person's reasonable expectation of privacy, but these are narrow and tailored to the specific issues such as

wiretaps or invasive or inappropriate photography. Any privacy legislation will have to consider the 1st Amendment implications as well as whether current statutes provide adequate protection already.

NOISE ABATEMENT

While not specific to UAS operations, the Texas Transportation Code contains requirements for noise abatement for county and municipal airports (*24*). The governing body of a municipality that owns an airport and has a grant agreement with FAA for the planning, design, and acquisition of land for a replacement airport is required to provide adequate soundproofing and noise reduction devices for each public building within the 65 DNL or higher average day-night sound-level contour. The municipality must also comply with the Aviation Safety and Noise Abatement Act of 1979 in federal code. Although this statute is limited to airports, there are potential implications in noise abatement for UAS facilities and operations.

ELECTRICITY PROVISION

Legislation passed in the 2019 session amended utilities code to exempt a person who owns or operates equipment used solely to provide electricity charging service for consumption by an alternatively fueled vehicle from consideration as an electric utility or retail electric provider (*25*). The bill also added text that allows the utilities commission to exempt from the definition of *retail electric utility* a provider who owns or operates equipment used solely to provide electricity charging service for a mode of transportation. While this addition to code captures a lot of activity currently related to alternatively fueled vehicles, this section could impact electricity provision for UAS operations as well.

AIR RIGHTS

The Texas Government Code acknowledges the existence of air rights and defines air rights as a piece of "real property," but air rights are not explicitly defined in Texas Code (*26*). Air rights have been established within case law, and Chapter 263 of the Local Government Code does acknowledge the leasing of air rights above certain property (*27*).

FAA and local zoning ordinances have traditionally regulated airspace for travel, and airspace above a property is subject to reasonable air traffic. Reasonable air traffic and specific air rights are not defined in statute, and questions related to the use of airspace above property may arise with increased UAS operations.

Although questions remain on authority to regulate certain areas within aviation and UAM, new or updated regulations at the federal and state level may be required in certain key areas to enable UAM, such as:

- Safety.
- Equipment.
- Operations.
- Airspace.
- Land use.
- Privacy.

- Environment.

KEY AREAS IN URBAN AIR MOBILITY

The urban air mobility ecosystem has several components that may need additional regulation, legislation, or infrastructure in order to operate safely and efficiently. The chair, Dr. Choudhuri, identified four key areas for the advancement of UAM in Texas that should drive the committee's initial work. These areas were technology, airspace and infrastructure, safety and security, and commerce and community integration. Figure 3 provides an overview of the topics involved with each key issue. The four key areas formed the basis of the working groups developed by the committee. Each area included potential topics for consideration, which served as a starting point for the working group discussion. Each working group began with these topics and, in the course of their discussions, identified those that the working group should focus on and be the subject of meaningful recommendations. Those focused topics identified for discussion by each working group are discussed later in this section.

This section of the report provides an overview of current research on each key areas before presenting the discussion by the working group and finally the recommendations developed along with their rationale.

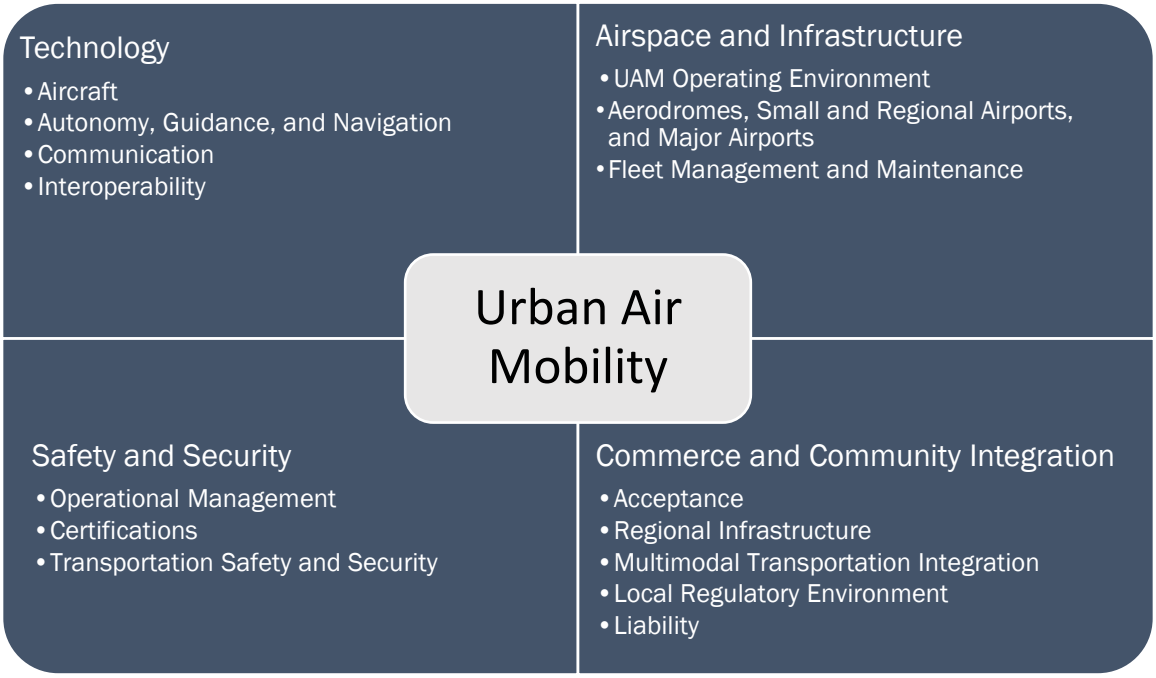


Figure 3. Key Issues for Urban Air Mobility.

TECHNOLOGY

When it comes to UAM and AAM technology, the working group decided on prioritizing airspace monitoring and testing sites, or sandboxes. Airspace monitoring technology includes from how the aircraft maneuvers around the airspace, how it communicates with other aircraft and surrounding environment, and how the aircraft itself is built, to name a few. The facility where this technology can be tested also needs to be considered to help launch UAM/AAM into commercialization. Aside from providing a controlled environment

where tests can be conducted safely, these testing facilities may help attract industry leaders as well as promote the collaboration between the public and private sectors. This section discusses critical technical components needed in UAM/AAM and provides more insight into the work conducted at several of the testing sites across the United States. Additionally, the Technology Working Group's meeting is summarized including the topics discussed and those voted to become part of the recommendations.

Literature Review

UAM technology can encompass a variety of components, but some of the most critical in a system architecture are those responsible for airspace monitoring such as communication, navigation, and surveillance (CNS). The UAM aircraft will need to communicate with ground pilots through command and control (C2). A communication network must therefore enable various aircraft to communicate with one another through an unmanned air traffic management (UTM) system. For navigation, advancement in detect-and-avoid (DAA), or sense-and-avoid, technology can improve how the aircraft processes its surroundings with minimal human intervention. In situations where visibility is low, DAA is being refined to better detect its surroundings while simultaneously avoiding obstructions, following the designated routes, and spacing itself from other aircraft. In the context of traditional aircraft operations, sense-and-avoid technology uses a vision-based approach to maneuver the aircraft, whereas UAM technology can phase out manual operations in favor of electronic separation (*28*). Beyond-visual-line-of-sight (BVLOS) technology is likewise being adapted for UAM and AAM purposes, requiring the advancement of visual technology and remote operation. Wireless communication options such as 5G and GPS can be adapted to assist with surveillance at lower altitudes (*29*).

The surrounding landscape and environment influence the early adoption of UAM and AAM to such a degree that it is a concern discussed in CNS, weather tracking, and selection of suitable cities. Where UAM aircraft can fly is limited by their surroundings, which means they are subjected to flight restrictions such as no-fly zones. UAM and AAS aircraft are prohibited from flying through an airspace if obstructions and other dangers are present at lower altitudes. A no-fly zone is determined by several factors and are classified according to the following four categories:

- Safety related.
- Social.
- Operational based on system.
- Operational based on aircraft.

The most noticeable of these factors, for example, are buildings, but wind patterns fluctuate when in close proximity to these structures, adding another layer of complexity to acceptable airspace navigation (*29*). Other factors that comprise a no-fly zone can include privacy and noise considerations, which are restrictions created through regulations. Therefore, CNS technologies must have the ability to more granularly process their surroundings to avoid obstacles that would not normally be present at higher altitudes.

Weather

The weather, in addition to physical structures, also affects the development of technology. Some efforts focus exclusively on weather tracking and visibility, while others focus on weather barriers and identifying optimal locations. Technology typically used for commercial planes may not be completely applicable to UAM. For instance, UAM aircraft flying at lower altitudes experience a greater fluctuation of wind patterns caused by high rises and must observe a variety of thermal readings from surface landmarks. Weather patterns also differ across the country, requiring the aircraft to be customized with that specific location in mind (*30*).

Meeting the demands of UAM will require improvements in how the data are collected and processed. Standards will also need to be adapted to the unique conditions of UAM such as acceptable crosswinds or turbulence (*30*). To help understand weather in relation to suitable UAM sites, one report analyzed 10 urban areas across the United States, each experiencing unique weather patterns. Using weather data obtained from different sources, hourly weather conditions were scored from 1 to 10 according to severity, with drizzle being 1 to volcanic ash scoring a 10. It was found that urban areas located in the west exhibit favorable UAM weather conditions, which experience low scoring, high temperature, and instrument flight rule (IFR) conditions (*31*). This study is an example of how variable weather can be all over the United States and highlights how not all aircraft designs may be applicable across the country.

Aircraft

CNS is not the only technological advancement. Aircraft themselves are being modified to be lighter, more fuel efficient, and quieter than the standard aircraft. How the aircraft is designed depends on several factors such as seat capacity, cruise speed, noise levels, emissions, fuel source, and costs (*32*). In contrast to traditional aircraft already in service, UAM aircraft such as electrical vertical takeoff and landing (eVTOL) or short takeoff and landing (STOL) are switching from a combustion to a fully electric or hybrid-electric distributed propulsion system. The installation of multiple low-noise rotors, as opposed to the traditionally more expensive aircraft, will also help in noise reduction (*30*). Currently, several eVTOL designs are being tested, including a vectored thrust, lift and cruise, muliticopters, and rotorcrafts. All of these concepts are essentially attempting to find a compatible means to lifting the aircraft off the ground and switching over to cruise once it is ready to move toward its destination (*33*). UAM/AAM takes advantage of a number of new, innovative, and emerging technologies. This includes advances and continuing improvements in battery technology, the advancement of electric propulsion, and lightweight airframes. It also relies on new and innovative flight control systems, sensor technology, and communications systems that will eventually allow operations to evolve on the autonomous maturity spectrum and be integrated into the existing National Airspace System.

Airworthiness standards and certification for equipment and new aircraft types are needed to ensure safety and industry standards without slowing production or increasing costs. As identified in the GAO report, GAO-22-105020, one of the significant challenges faced by stakeholders is certifying this new technology (*34*). According to Uber Elevate, the target noise level produced by an UAM aircraft should be no greater than what the current smallest four-seat helicopter produces, which influences the aircraft's design (*35*). This trend toward

electric operations requires updated regulation on electric propulsion, powered lift, and future aircraft concepts such as folding propellers. Current regulations partially address powered-lift operations but are based on conventional helicopter designs (*36*). FAA's Part 23 contains performance-based standards for normal category airplanes that help streamline the process and allow industry more flexibility in design but do not fully capture UAM needs (*34*). Building on the already existing regulations for manned aircraft and developing new standards that apply to the needs of UAM operations may prove to be the faster route to achieving certification. Operations and equipment certification are directly related to safe operation, which will be key to public acceptance and ensuring sufficient demand.

Unmanned Aerial Systems Traffic Management Systems

FAA is taking an interest in advancing UAS research across the United States through the launch of several programs. One of these programs is UAS Integration Pilot Program (IPP) (*37*). This three-year program was established to research ways to integrate UAS into the National Airspace System. Involved in the program are state and local organizations such as the Kansas Department of Transportation, the North Carolina Department of Transportation, the City of Reno, NV, and the City of San Diego, CA, with each entity focusing on research applicable to its state or region (*37*). As part of a different UAS measure, FAA has designated seven locations as UAS testing sites across states in the United States: New York, New Mexico, North Dakota, Nevada, Texas, Alaska, and Virginia (*38*). These sites were created to research and test different UAS topics of interest. Some of these sites focus their efforts into UTM as well as DAA, C2, and BVLOS operations (*39*). Additionally, the sites located in Nevada, North Dakota, and Virginia were selected to be part of phase one of the UTM Pilot Program (UPP), a program created to identify current UAS work that can improve UTM operations (*39*).

In addition to the UAS, other federal government agencies are taking an interest in promoting AAM. Although it is still awaiting approval from the Senate, HR 1339, the Advanced Air Mobility Coordination and Leadership Act, instructs USDOT to create an AAM interagency working group to work toward the understanding of safety, operations, infrastructure, and other factors related to the promotion of this new endeavor. NASA is also working with states to further AAM efforts. One of these efforts is the AAM National Campaign. The goal of this campaign is to promote AAM through public outreach to instill confidence in this movement (*40*). Furthermore, this program will serve to inform industry leaders on the changing regulatory and environmental landscape. NASA will also partner with the private sector to research barriers to AAM safety and adoption, highlight challenges associated with public perception and commercial feasibility, and identify software and system requirements for AAM. The campaign is scheduled to launch in 2022. This section will highlight the work being done related to AAM, UAS, and UTM by individual states.

Alaska

Alaska conducts UAS research through the Alaska Center for Unmanned Aircraft Systems Integration. This center is responsible for the testing of manned and unmanned operations as well as endurance testing in harsh weather conditions (*38*).

Maryland

In accordance with the Maryland Unmanned Aircraft Systems Research, Development, Regulation, and Privacy Act of 2015, which tasks the state to research the benefits of UAS, a UAS test site was created to aid state agencies in defining policies centered around UAS. The UAS test site at the University of Maryland works together with FAA, Naval Air Systems Command, and industry to further airspace integration. Consultation, airworthiness, vehicle aircraft system design, public outreach, and testing and flight operation are activities conducted at this site. Additionally, the UAS test site has access to military airspace and FAA authorizations that allow the site to be used for research usually limited by Part 107, the Federal Aviation Regulation (FAR) that governs unmanned aircraft systems.

New Mexico

The UAS testing site in New Mexico is designed to test different classes of UAS. Using resources located at the Las Cruces International Airport and the New Mexico State University, UAS is being tested for mapping, DAA, BVLOS, monitoring of UAS near airports, cybersecurity, and disaster preparedness and response (*41*).

New York

The New York UAS test site, located at the Griffiss International Airport, is managed by the Northeast UAS Airspace Integration Research Alliance, Inc. (NUAIR). This facility conducts research on UAS operations and provides consulting services. The test site's research includes UTM integration and understanding of performance requirements of UASs through the Performance Requirements Working Group (*42*, *43*). This group is tasked with researching CNS requirements such as determining testing and validation methodology for UTM operations and technology.

Nevada

The Nevada Institute for Autonomous Systems (NIAS) manages the Nevada UAS test site. This site is used to advance research on BVLOS, drone detection, and UTM. NIAS is also expanding its efforts through outreach. Its Attaining Resilience and Independence through Support and Education (ARISE!) program provides job training and mentorships in the autonomous systems field. NIAS has also partnered with other countries and is involved in state and federal organization (*38*). Furthermore, Nevada was selected by NASA to contribute to UTM research. This selection entails testing UAS flights across Reno, NV, for the purposes of large-scale services such as package delivery (*44*).

North Dakota

The North Dakota Department of Transportation is partnered with the Northern Plains UAS Test Site and with North Dakota's UAS network, Vantis, to further the research on UAS technology and traffic management (*45*). The test site is used to conduct research on UTM, DAA technology, and other communication and operations technology (*46*). Similarly, the Vantis network contains a ground control service station in addition to other operation system testing facilities used for UAS testing (*47*). The state's work in UAS has been acknowledged and was selected by USDOT, among other states and organizations, to be part of IPP and BEYOND, the next phase of IPP. As part of BEYOND, North Dakota's UAS network will be tasked with testing operations at a larger scale.

Ohio

Ohio is home to the Ohio Unmanned Aircraft Systems Center (*48*). This center manages all the work for the Ohio Department of Transportation related to UAS including flight operations, program development, and research. The center and other stakeholders have also invested in SkyVision, a DAA system designed to monitor UAS flights when they are outside of the line of sight (*49*). With respect to AAM, both the Ohio Department of Transportation (ODOT) and FlyOhio, a team made up of aircraft manufacturers, researchers, and health care professionals, are researching the impact of alternate modes. ODOT sponsored an economic impact analysis of AAM, which could help attract business. This report predicts AAM will contribute a total value of $13 billion from 2021 to 2045 (*50*). To reach this goal, the report recommends laying out a legislative and strategic framework to integrate AAM, attract businesses, and promote public awareness. FlyOhio was selected to contribute to NASA's AAM National Campaign; FlyOhio will be tasked with testing the delivery of people and good across the state.

The Springfield-Beckley Municipal Airport is investing in the National Advanced Air Mobility Center of Excellence to promote air mobility research (*51*). Located between Dayton and Columbus, OH, this airport is positioned to attract customers because it is already home to two maintenance facilities and the Ohio National Guard base. In addition, this location has the space for a 30,0000-square-foot center that will house industry and public research, specifically eVTOL.

Texas

The Texas A&M Corpus Christi UAS test site focuses on attracting economic opportunities and aiding FAA in advancing UAS research. Managed by the Lone Star UAS Center of Excellence and Innovation (LSUASC), an organization comprised of different stakeholders, the site conducts research on autonomous systems and showcased UTM capabilities, such as collision avoidance, drone communication, and operations in urban locations. The site is part of NASA's UTM efforts and has a demonstration project in downtown Corpus Christi, TX (*38*).

Virginia

Selected to contribute to UPP, the Virginia Tech Mid-Atlantic Aviation Partnership (MAAP) testing site conducts research on UTM. Flight demonstrations are conducted at this site to showcase how different UAS components work into UTM (*52*). Specifically, research is being done on UAS service suppliers (USSs), the equivalent to air traffic control software used for aircraft operations. Because USSs are created separately by different industries, the challenge is standardizing communication between the various USSs (*53*). Additionally, other research being conducted on this site includes the improvement of UAS communications and DAA.

Technology Working Group

Technology is a significant component to UAM but requires a regulatory foundation to promote its use and adoption. The challenging thing is that technology applies to several areas of UAM and subsequently impacts the development of regulations. From an aircraft perspective, airframe and propulsion dictate noise levels and areas where these can fly

over, which may require establishing thresholds. Similarly, technology surrounding operations needs to be developed to ensure proper communication is occurring between the air and ground. Operating the airspace will require knowing where aircraft are located relative to each other and how the monitoring system will be integrated into already existing airspace operations. Therefore, design, operations, and the environment will need to be considered when developing technology regulations. Instructions for certification and communication standards to ensure acceptable practices and proper communication between different hardware will also be necessary. Consequently, regulations promoting the testing of UAM technology as well fostering collaboration between the private and public sector should be a first step. The following lists technology topics that the Technology Working Group discussed as important for the adoption of UAM:

- Design:
    - Airframe.
    - Propulsion.
- Operations:
    - System architectures.
    - Assured positioning, navigation, and timing.
    - Airspace monitoring.
- Environment:
    - Micro-weather forecasting.
    - Noise and noise thresholds.
- Regulation:
    - Airworthiness certification.
    - Communication standards.
    - UAM/AAM sandbox.
    - Fostering of collaboration.

However, due to time constraints, they key areas for Texas that will form the basis of the committee's recommendation in regard to technology are:

- Development of a UAM/AAM sandbox.
- Airspace monitoring.
- Fostering of collaboration across public and private entities.

Development of a UAM/AAM Sandbox

An opportunity has presented itself for public-private collaboration through what the industry is calling a *sandbox*. As defined in the meeting, the term *sandbox*, in technology policy, refers to a designated place, either geographical or digital, where new technologies can be tested under liberal rules for a predetermined duration before a commercial rollout to the public. This sandbox is a site where UAM technology and operational procedures can be tested in a safe, controlled environment and include four main considerations:

- Convenor.
- Funding.
- Infrastructure.

- Transition to commercialization.

These sites can serve to showcase progress to stakeholders and the public while simultaneously attracting interest, possible investment, and collaboration. Public awareness and trust can also be generated through these sites by allowing the general population to be involved in the development of these technologies. FAA and other federal agencies understand the importance of properly testing and ensuring the safety of passengers and are well underway in funding UAM programs across the country.

Texas already is home to a UAS testing site that can be used to support sandbox activities, but other opportunity exists where available land or underutilized airports can be retrofitted for AAM purposes. Additionally, these sites can be tailored further to incorporate use cases of interest to the state. These can include uses for border patrol, oil and gas, agricultural, package delivery, and others. These use cases can also help distinguish the different operation considerations for urban versus rural flight, for example the difference between package delivery in a city or oil and gas monitoring in more remote areas of the state. Through the development of testing, legislative and regulatory considerations or challenges may also be highlighted that otherwise would not have been possible without these sites.

Airspace Monitoring

Airspace monitoring is an area where the state has minimal say on airspace, but Texas is in a position to help lead the conversation. Potential sandboxes established around Texas can be used for policy guidance that the federal government can use. The state can also help differentiate areas where the federal government has clear guidance and areas where Texas can provide some input. However, this will not be an easy task given that the evolving technology will shape the airspace regulations needed.

Another concern is operability in other states. Although the state can provide input that will best serve its needs, ensuring that cooperation and communication can still occur in other states as well as different networks will make airspace operations more feasible. Texas can look at the work completed by the North Carolina Department of Transportation and ODOT, for example. These two agencies have deployed technology that allows emergency medical services (EMS) and law enforcement to operate under the same network.

Texas should work with FAA on the potential for testing and sandboxes to help provide additional data and options for airspace monitoring. The potential for technological solutions to assist in the airspace monitoring should be followed by the state. New procedures, in terms of sense-and-avoid and enforcement of no-fly zones, and other regulations could benefit from new monitoring techniques. Communication across these technologies as well as data sharing will remain critical to ensure safety, security, and efficiency across all U.S. airspace.

Fostering of Collaboration across Public and Private Entities

The state can foster private-public partnerships through UAM and AAM technological innovation. The state can establish sandboxes and other infrastructure to serve public and private interests while still remaining a neutral participant. Collaboration and advancement can be further promoted by easing permitting restrictions and creating flexible regulations.

The state can also partner with cities and observe how they are working together with the industry, such as Wing in Little Elm, TX, and Flytrex in Granbury, TX, and determine options for scaling these arrangements to benefit Texas. Additionally, the state can note these companies' public engagement efforts and use them to gauge public acceptance as a whole.

On a federal level, the state is encouraged to engage with FAA, given its jurisdiction over airspace, and NASA due to its knowledge and ongoing efforts in the UAM/AAM space. The state can potentially draw in these agencies by allowing them access to their testing sites, thereby fostering the exchange of information between the federal and state level.

The state should also maintain an awareness of potential policy or permitting restrictions that may reduce technological development. Any regulatory decisions relating to technology should remain flexible to ensure the regulation does not hinder future developments or cause issues for local governments. In addition, any legislation or regulation should maintain neutrality in terms of technology selection but should support collaboration between different operators and manufacturers to ensure interoperability.

Recommendations

The third and fourth working group meetings focused on the drafting and development of recommendations related to the three topic areas identified in the first working group meeting. For example, the discussion focused on the possible needs and structure of a UAM sandbox, which use cases might be tested, and how best to recommend the idea of a regulatory sandbox. The working group also discussed issues surrounding standardizations and technology options. Because the UAM/AAM industry is in a stage of innovation and is constantly evolving, progress in technology should drive possible standardizations. In addition, it may be in the best interest of the state to maintain a technology-neutral approach so industry can develop and adapt as necessary. The Technology Working Group developed the following four recommendations:

1. **Encourage the development of an urban air mobility/advanced air mobility sandbox by:**
    d) **Directing the preparation of a feasibility study to understand the market, differentiating factors from similar existing facilities, potential market/players, funding sources, revenue opportunities, locations, necessary digital and physical infrastructure, and potential use cases; and**
    e) **Pursuing the development of a facility that will provide opportunity for testing and commercialization that will attract business and move the industry and state forward.**
    f) **Having the State take the initiative to work with industry to determine additional standards in terms of communications, technology, and environmental awareness systems to encourage consistency and harmony at all levels of government and stakeholders.**

An UAM/AAM sandbox will serve to advance this technology as well as promote public and private collaboration. The committee's discussion regarding a sandbox focused on the concept of a designated place, either geographical or digital, where new technologies can be

tested under liberal rules for a predetermined duration before a commercial rollout to the public. Several facilities across the United States are already testing different aspects of AAM, including communication and environmental awareness systems such as micro-weather, air traffic, and micro-radar. Use cases specific for Texas such as gas, oil, border security, and package delivery can all be tested for the benefit of the state. Innovators and industry leaders can test the applicability of UAM/AAM in a controlled environment before launching at full scale. It may not be completely necessary to build new facilities for sandboxes because underutilized airports can be retrofitted or be integrated into Texas colleges to test advanced air mobility technology. In addition to finding solutions to current technological issues, through the use of these facilities, new issues may be identified that will place Texas at the forefront and enable the state to assist all levels of government.

Another opportunity derived from a sandbox is the potential for collaboration and coordination between public and private entities and across different levels of government. By establishing one common place where ideas can be exchanged, harmonization can occur across the board. This promotes the standardization of technology and communication, and ultimately commercialization, without discriminating against industries with limited resources. Additionally, this recommendation is not intended to discourage the use of certain technology or dictate what localities are allowed to use the sandbox. Rather, this recommendation is meant to attract industry participation while still allowing localities to provide their input.

2. **Consider the initial funding for a UAM/AAM Sandbox Feasibility Study and ultimately its development along with an incentive program to attract industry with the ultimate objective of using user fees to fund the ongoing operations and maintenance of the sandbox.**

Developing a UAM/AAM sandbox for Texas could require a feasibility study to determine the primary test use cases, the location, and potential industry partners. This study and the eventual development of a sandbox would benefit from state funding in the initial stages with the eventual goal of commercialization. Start-up funding would drive investment, testing, and data collection by industry for Texas-focused use cases and would provide possible industry-wide standards for operations, safety, and efficiency. Once regulations and standards are in place at the requisite levels of government, the site would transition to a self-sustaining mechanism such as a user fee to fund future operations to launch UAM/AAM into commercialization.

3. **Encourage state agencies to adopt a technology-neutral/open architecture approach to the urban air mobility/advanced air mobility industry to allow easier adoption of new technologies and deployment into new regions.**

A technology-neutral or open architecture approach will provide the necessary flexibility and allow the technologies to grow and evolve without regulatory harm. A technology-neutral approach has been taken with other emerging industries, such as connected autonomous vehicles, and UAM/AAM would also benefit from that flexibility. This would not prohibit the development of standards for safety and operations but would promote development of the best technologies while maintaining Texas' economic competitiveness in regard to UAM/AAM.

4. Identify areas where technology will drive standardizations.

Technologies that support UAM/AAM are evolving rapidly. Supporting the development of the industry will require the state to remain neutral on the different technology options while also setting standards to ensure safety. In order to avoid disrupting industry progress, the state can focus on areas where available technologies will drive standards and required standardizations. These areas could include but not be limited to speed, operating hours, and density.

AIRSPACE AND INFRASTRUCTURE

Monitoring and managing airspace as well as providing the ground infrastructure necessary for UAM operations are two key components in enabling this new mode of transportation in Texas. This section presents a literature review on the core concepts within both airspace and infrastructure for UAM before presenting the committee's work on this topic. Airspace and Infrastructure are both broad, critical topics for UAM that offer a number of areas for state consideration; however, the committee chose to focus on three topics due to the time constraints of their effort:

- Alignment with FAA and airspace harmonization.
- Fostering of a competitive environment for UAM within the state.
- Identification of existing policy and permitting gaps that may hinder the development of UAM.

The recommendations to the State of Texas will focus on these three areas and the role in which legislation and regulation can ensure UAM safety and success.

Literature Review

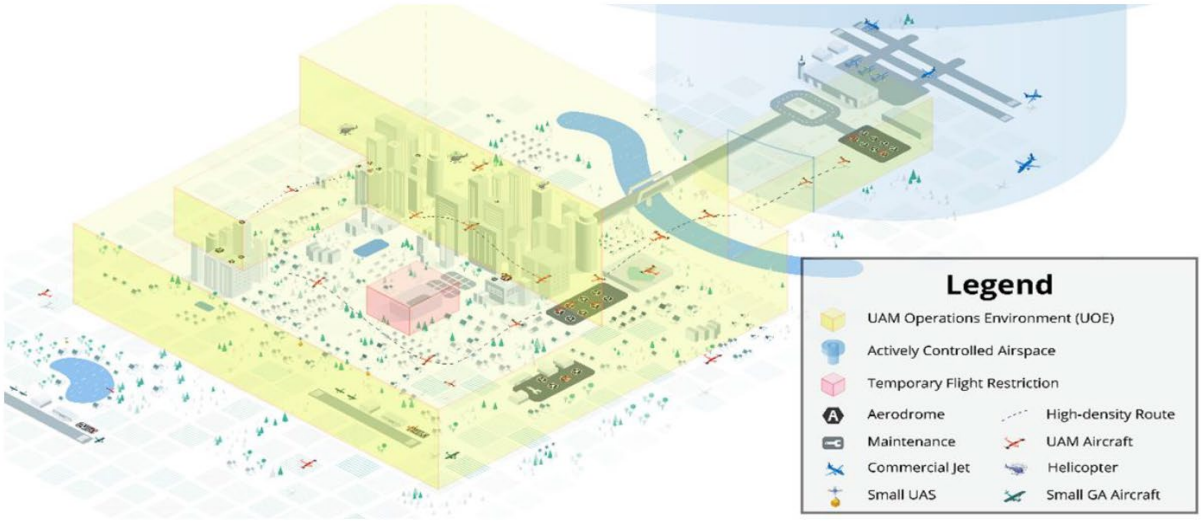
The literature review considers both airspace and infrastructure challenges and opportunities identified in the literature separately, and addresses areas of overlap, such as takeoff and landing area (TOLA) selection with respect to surrounding airspace rules and regulations.

Airspace

Airspace Design and Regulatory Environment

The UAM Operating Environment (UOE) is still in the conceptual stages with the understanding that any rules and regulations should maintain flexibility toward new technological developments and operational changes, as well as FAA's full regulatory authority over the airspace (*30*).

Figure 4 shows an overview of the potential UOE from the concept of operations. The current UAM/AAM maturity level (UML-4) assumes that these services would be operating primarily within urban environments, but future maturity levels will move beyond the urban environment to consider regional and even rural considerations for the technology. Urban environments likely pose a greater regulatory challenge in terms of airspace due to the greater presence of structures, both permanent and temporary, in the proposed UOE.



Source: UAM Vision Concepts of Operations (*30*)

Figure 4. Isometric Operational View of a Representative UOE.

It is possible that FAA's role in terms of airspace would not include air traffic management (ATM) for the operators of UAM/AAM services. In early stages, only basic ATM services would be required to effectively manage the low level of traffic operating outside controlled airspace. However, even in those early stages, the ATM would need a way to communicate with air traffic control (ATC) to ensure safety around controlled airspace, such as airports, and in emergency situations. The intent is to reduce the burden on the human-operated ATC and maintain the greater efficiencies throughout the system. Although FAA would not be providing ATM, private or public operators that do would have to work under FAA rules and direction, with the ultimate regulatory authority falling to FAA. FAA describes a UAS UTM in its UTM Concept of Operations as "a community-based traffic management system, where the Operators and entities providing operation support services are responsible for the coordination, execution, and management of operations, with rules of the road established by FAA" (*9*). Ultimately, FAA would provide the regulatory and operational framework for operations and retains authority over aircraft operations in all U.S. airspace. FAA would exchange data with service providers and operators and would certify safety-critical elements within the UOE, which would include the providers and operators as well as their UTM system. Airspace constraints would also be communicated by FAA. While FAA would maintain the ultimate regulatory authority over airspace, leaving ATM to providers and operators offers a chance for state or local governments to play a role in developing a system that allows for interoperability rather than a patchwork of different UTMs that must communicate across a state or region.

The state and local government role will be greater under the current concept of operations, UML-4, than traditional aviation because of the UOE (*30*). The current expected urban operating environment provides a clearer role for state and local governments because zoning requirements, noise ordinances, and land use laws will allow them to influence the operation of UAM/AAM. The location of vertiports or TOLAs will be subject to those state and local laws and regulations, and this will ultimately impact the number of UAM flights and their routes. High-density routes will need to be determined in coordination with FAA, however. This will ensure communication and coordination with ATC as well as across

controlled airspace. While ATM is assumed to be under the purview of the operator, coordination within the UOE will be required, which could benefit from an enhanced state and local role. Standards for such coordination are intended to be developed by industry, with FAA certifying and accepting these standards before they enter operation. Overall, the connection of airspace to ground infrastructure requires a greater state and local government role in managing air traffic, and there is the potential for a state or local role in managing or developing the framework for a UTM.

Operations

UAM operations concern both the operational mode of the aircraft and the airspace in which the aircraft will operate. Operational modes can differ significantly from traditional aviation through the use of autonomous, non-piloted operations or remote, ground-piloted, operations. Piloted operations also need to be considered in terms of passenger transport in UAM (*54–57*). In terms of airspace, questions remain over integration with traditional ATC and the need for a dedicated management system for UAM. Operational considerations also include integration into the existing transportation system, and the impact of weather and noise on operating areas.

The potential for new operational concepts, such as remotely or autonomously operated, provides new challenges for aviation alongside the introduction of UAM as a concept. The new operational concepts can be viewed as two different paths; the first uses traditional piloted operations with a steady move to remote operations, while the second path focuses on automation and views the mid-term phase of UAM as non-piloted (*57*). Piloted operations could function effectively under the current regulations and, as technology progresses, can implement remote operations to the greatest extent possible. Both remote and autonomous operations will require accurate, real-time data on hazards and obstacles that exist within the UAM environment as well as weather sensors to enable decisions relating to risk and handoff from autonomous to remote piloted operations (*54*). Estimates suggest that about half of the daily operations in Texas would be affected by weather conditions such as thunderstorms, IFR conditions, and vertical wind shear (*58*). In terms of weather, while vertical takeoff and landing (VTOL) suffers from rotor noise and vehicle efficiency issues, VTOL are less susceptible to weather conditions than STOL operations (*59*). VTOL may operate best for intracity trips, with STOL being capable of providing intercity operations (*32*).

The different operational concepts could interact in airspace differently and could require a separate management system from traditional ATC. While the use of ATC for piloted operations is considered (*56*), a framework for on-demand mobility highlights the need to separate out UAM operations (*28*). The framework has six key principles:

1. Should not require additional ATC infrastructure.
2. Will not impose an additional workload on ATC 3.
3. Does not restrict the operations of traditional airspace users.
4. Meets safety requirements.
5. Prioritizes operational scalability.
6. Allows for flexibility when possible and adds structure if necessary (*28*).

In enabling such a framework, the potential for geofencing or airspace cutouts is discussed; this would allow for the greater densities required to make UAM economically feasible (*54*, *60*). Airspace cutouts would not already be allocated for traditional operations and could be designed with minimum separation requirements that would eliminate the need for coordination with ATC. Both IFR and visual flight rule could be considered for these cutouts (*60*). While reducing conflicts and the need to coordinate with traditional ATC is key to "efficiency for UAM, trips with origins and destinations on or near airports would need to coordinate with ATC (*28*).

Infrastructure

Placement, Policy, and Permitting Considerations

The primary concern related to infrastructure is identifying TOLAs, or vertiport, site location. Finding a suitable location requires the consideration of several factors including development limitations, passenger handling, topology and aircraft handling, and regulation and policy (*61*). Infrastructure placement is an area of regulation that will likely fall under state or local jurisdiction due to their control over land use. Potential state or local regulation would cover landing areas and space requirements or separations from residential areas, and the potential need for traffic management at lower altitudes, as well as privacy and environmental conditions (*32*, *54*, *62*, *63*). Landing areas and vertiports or pads will need to be built to legal requirements. International standards for short takeoff and landing ports exist under the International Civil Aviation Organization, as do broader requirements under International Civil Aviation Authority Annex 14 (*64*–*66*). States may be responsible for ensuring compliance and regulating the location of these facilities; a key piece in regulating the UAM environment will be to establish a common language across governmental, industry, and regulatory partners (*67*). Privacy, environment, and noise may be regulated already at either the state or local level; these areas will require a greater consideration with respect to specific UAM use cases (*62*).

Several studies have looked at space availability to determine where TOLAs can be placed in different states. One such study narrowed down optimal vertiport locations according to three factors:

- Aircraft cannot fly below 500 feet above private property.
- Aircraft must be able to take off even at 45-degree crosswind.
- The site needs to be free of any obstructions according to FAA guidelines (*68*).

Other studies propose taking advantage of the already present surface infrastructure. One of the easiest suggested solutions is to place vertiports on barges, clover leaf intersections, and even the roof of parking garages (*28*, *68*). However, regulatory requirements for different cities and states will play a role in determining infrastructure site selection. Almost all states have statutes or requirements for local airport compatibility zoning ordinances; only five states do not have local initiatives that have led to compatibility zoning (*63*). *Airport Cooperative Research Program Research Report 206* found that state-level challenges can induce problems with local compatibility zoning, such as narrowly focused and rigid zoning laws and standards that do not take into account the nuance of different airport types (*63*). These challenges will likely be exacerbated for a new mode such as UAM. In addition, environmental review or environmental impact studies, community engagement and input,

and local government codes can all impact the development of TOLAs. Streamlining these processes and removing barriers to development may require innovative methods; digital policies have been established by cities to manage emerging transportation technologies such as e-scooters. A digital policy establishes the framework for an operator or industry to work within a city or region and ensure regulatory compliance (*67*). In addition to cities, state aviation planning offices will have a role in setting standards, addressing appropriate land use, and guiding the necessary environment review and community engagement based on their experience with traditional airports.

The placement of UAM infrastructure also depends on the availability of airspace above private property, especially above highways. Rules dictating where and how high aircraft can fly limit UAM airspace availability. Additionally, complications such as nuisance, trespassing, and takings can arise if UAM operations occur above private property. Municipalities will be a key partner in terms of airspace through the provision of data on building height, other obstacles, and potential land use and zoning considerations (*67*). A proposed solution to avoid concerns over airspace availability is the leasing of airspace above highways. It is argued that choosing this route will give local and state governments more control over UAM operations, will discourage lawsuits, and will generate additional revenue (*69*). A report evaluating individual UAM state statutes generated a scorecard to show which states have the potential for an airspace surface network above highways. The states were scored according to present airspace lease law, vesting of air rights with landowners, avigation easement laws, drone program, and impact on jobs. The state with the highest score was North Dakota, while Texas was ranked ninth (*69*). With respect to Texas, previous efforts have been conducted to show how the leasing of the airspace above the right of way could be used to benefit the state. A 1992 report by TTI observed how other work done by states related to airspace could be applied to Texas. It was concluded that revenue could be generated if the state hires the necessary employees to manage the program, if property marketing and outreach are conducted, and if the program was made to be flexible to accommodate any changes in regulation and need (*70*).

Funding and revenue generation for infrastructure will be key concerns for state and local governments that want to promote the development of a UAM system. Beyond reducing regulatory roadblocks and promoting competition between operators of UAM services, governmental entities will have to consider the cost of infrastructure development for TOLAs and any support infrastructure or intermodal facilities (*34*). Leveraging existing federal funding may be possible to develop facilities at underutilized airports, but other federal programs may require changes to requirements or flexibility to assist UAM. States could consider developing their own funding programs or establishing a framework to enable public-private partnerships in this space. While funding will be a key piece of ensuring the necessary infrastructure is in place to support UAM, these technologies are in the early stages, so possible models and sources are still being determined.

Supporting Infrastructure

In addition to infrastructure sites, another concern is how well equipped the electrical grid is to handle the adoption of eVTOL. As one of the major challenges identified by stakeholders, electrical infrastructure may not have the capacity to handle the quantity of energy to charge eVTOL batteries and supporting operations (*34*). Another complication is how electricity will

be provided given that utilities can be operated by multiple parties, which may require some time to coordinate. To illustrate the role of electricity in UAM, a market study focusing on the current grid and energy infrastructure, airspace characteristics, and the overall market for Los Angeles, Houston, and Baltimore/Washington, DC, examined the growth and cost of electricity infrastructure. For each city, the study identified the party responsible for managing the electrical grid and the number of airports and helipads in the city. Obtaining this information helped researchers narrow down further electrical infrastructure needs, specifically those requiring upgrades to meet the energy demand from eVTOL. These upgrades were broken down by charger, building, airport requirements, on-site energy storage needs and use, and estimated costs. Put together, the cost of upgrading and installing charging stations on five-story buildings, parking garages, and at ground-level can range from $900,000 to $10 million (*71*).

Although this report mostly covers infrastructure needs for eVTOL, it does acknowledge future efforts that will be needed to make UAM a reality. Among these is safety in the form of permitting, grid signaling, and cybersecurity. Collaboration with government agencies, building owners, transportation providers, and others will also be needed to better integrate UAM into the grid and to optimize communication with air control facilities. Ultimately, this report focuses on currently expected infrastructure needs, but further research into use cases and different UAM or AAM scenarios would provide greater context on infrastructure and design standards.

Vertiport Standards and Design

FAA is currently working on developing design standards and guidance for vertiports. Ironically, an FAA Advisory Circular on vertiport design was canceled in 2010 long before the boom of development of the current eVTOL aircraft (*72*). FAA also has a draft advisory circular on heliport design that is out for review. However, the draft advisory circular clearly states that it is not intended for operations by vertical takeoff and landing aircraft or unmanned aircraft (*73*). Instead, FAA has been working on the development of new standards and guidance for vertiports that are applicable to the new generation of eVTOL aircraft being developed. One of these efforts is vertiport design as drafted in FAA's Engineering Brief No. 105. This guidance draft was open for public input, is now closed for comments, and is intended to be a temporary solution until a more comprehensive, performance-based vertiport design is created. Among the guidance covered in this draft are markings, lighting, charging and electric infrastructure, vertiports located on airports, and site safety elements such as winter operations, weather, turbulence, and visual flight rule approach and departure (*74*). A new, performance-based Vertiport Advisory Circular is scheduled to be issued in 2024 or 2025 (*75*).

FAA has outlined a path toward this development that is already well underway. The agency issued a request for information from the industry to better understand aircraft design specifications, concept of operations, infrastructure design, and takeoff and landing profiles (*76*). In addition, the FAA path includes collecting information through the NASA National Campaign (formerly the Grand Challenge), through outreach to industry, and through additional research studies and gap analyses that have already taken place, testing and simulation, and a vertiport electrical infrastructure study (*76*). FAA is expected to develop interim guidance at some point in this process.

The vertiport design goals including addressing the operational requirements for landing areas (layout/geometry), approach/departure paths, load bearing requirements, electric propulsion and charging stations, safety requirements for batteries and other hazardous materials, and noise requirements. The dimensions will depend on the aircraft using the facility, and the agency understands there is no one-size-fits-all facility. FAA will, however, outline what a minimally developed facility will be required to have with respect to boarding and discharging of passengers and cargo (*76*).

Airspace and Infrastructure Working Group

Operational UAM requires a safely regulated airspace as well as strong supporting infrastructure on the ground. Airspace considerations must comply with current guidelines and laws under FAA, as well as coordinate with the agency to ensure regulation and ease of use outside of traditional air traffic-controlled space. Airspace considerations are also heavily linked to infrastructure, from vertiports and other takeoff and landing sites, such as underutilized airports, to power supply frameworks. The infrastructure environment for UAM involves a range of public and private actors including operators and general contractors. Development of UAM will require coordination between these actors, the leveraging of public funds to ensure strict design standards for safety, and assistance to local governments in incorporating this new mode into their transportation network and built environment. Since UAM is an emerging mode of transportation, policy and legislation may be needed to enable the build-out of supporting infrastructure while maintaining flexibility for municipalities on zoning and permitting. The discussion on airspace and infrastructure involved a range of topics including:

- Airspace:
    - Alignment with FAA.
    - Harmonization of rules across Texas.
- Funding:
    - Public infrastructure funding possibilities at the federal and state level.
    - State/federal/local match requirements and sources.
- Policy and legislation:
    - Existing policy and permitting gaps.
    - Areas for legislative change in relation to airspace and infrastructure.
    - Encouragement of growth of UAM/AAM, and collaboration between public and private industry under Texas law.
- Infrastructure environment:
    - Consideration of full infrastructure package.
    - Roles and responsibilities of public and private operators.
    - Fostering of a competitive environment.

However, some key areas for Texas are:

- Alignment with FAA and airspace harmonization.
- Fostering of a competitive environment for UAM.
- Identification of existing policy and permitting gaps.

Alignment with FAA and Airspace Harmonization

With the understanding that ultimately airspace will be regulated at the federal level by FAA, the committee focused on ways to align FAA, provide it with additional resources and data from testing in Texas, and ensure airspace harmonization across the state. FAA is working toward guidance for UAM, but issues remain on monitoring, traffic management, and safety procedures at lower altitudes. Texas could establish guidelines in coordination with FAA to enable UAM operations within the state and ensure that the guidelines reflect the operational standards and procedures seen in the industry. In addition, airspace regulations would need to expand past airports and current avigation easements. This provides room for states to propose regulations supported by data to FAA. One area that will fall under state and local jurisdiction will be takeoff and landing areas. Standards related to infrastructure and operations on the ground will also have implications for the use of airspace.

Ensuring airspace harmonization and reducing the likelihood of a patchwork of regulations will require both state and federal oversight of operations under local jurisdictions. HB 1643 (2017) prohibited local regulations on unmanned aircraft except during special events and to protect critical infrastructure owned by the local government (77). This preempts local governments from enacting different regulations and should ensure a smooth operating environment for unmanned aircraft; however, early UAM operations may still use manned or crewed aircraft, which would require a legislative change to address.

Fostering of a Competitive Environment

Ensuring a competitive environment within the UAM industry in Texas will provide greater benefits to the state and communities by enabling a range of different operators to meet demand. While the committee does not want to detract from first-mover advantage, there is a need to ensure competition and availability for a variety of different operators at vertiports or takeoff and landing areas for UAM. (78). Any legislative efforts by Texas would need to be mindful of FAA jurisdiction as well as their requirements or grant assurances for competitiveness. In addition to ensuring access to UAM infrastructure, the state could play a role in developing zoning and vertiport standards as well as other infrastructure regulations. Ensuring uniform and flexible standards across the state rather than varying from jurisdiction to jurisdiction promotes entrance into the market.

Rules and cost-sharing agreements may drive the public access or use by different operators of vertiports and other infrastructure. Vertiports will be needed outside of traditional airports as this mode and industry expands, and this infrastructure will require funding and revenue generation capabilities if public agencies will be building and/or operating them. Private vertiports needs to be included within current system planning efforts. There may be a concern with operators having exclusive access to vertiports, which could lead to inefficiencies if development of multiple sites within a small area occurs to accommodate the different operators. As UAM/AAM matures, the different models for vertiports, including public and private operations, will develop to reflect the needs of both the communities involved and industry.

In addition to supporting UAM operators and infrastructure developers, the state could highlight the opportunities for other industries, such as real estate developers, construction companies, and legal firms. Enabling this new mode of transportation and essentially new

industry will require coordination and cooperation across multiple industries to determine site selection, build the infrastructure, and ensure all regulatory requirements are met. Highlighting the path for these industries to become involved in the UAM space could drive investment and create more opportunities.

Identification of Existing Policy and Permitting Gaps

Restrictive legislation and policy and permitting gaps can create unnecessary barriers to the development of the UAM industry. Identifying the potential policy and regulatory gaps is the first step in ensuring that the UAM industry can enter the Texas market. Any new legislation or legislative changes should take into account local needs and *the desires of the community, as well as accommodate evolving technological developments*. Avoiding a patchwork of regulations and ordinances across local governments in Texas is ideal, but there does need to be flexibility in any state-level law that reflects important differences between urban and suburban environments. Specific areas that could benefit from state-level technical assistance are zoning considerations and regulatory standards for vertiports. Municipalities may not have the resources or capacity to consider changes to zoning law or to develop their own codes for vertiports, so leveraging both federal- and state-level resources to provide technical assistance can better prepare them for introducing UAM.

New policy and permitting guidelines should be determined in coordination with the Texas Airport System Plan (TASP) (*79*). The last TASP was completed in 2010, and efforts are currently underway to update the TASP. Coordination with the TASP will assist with infrastructure placement and permitting issues and will identify related airspace considerations. Discussions around leveraging underutilized airports for both testing and operations would again need to consider the TASP and may be informed by those planning efforts.

Recommendations

The third and fourth working group meetings focused on the drafting and development of recommendations related to the three topic areas identified in the first working group meeting. The discussion considered the different policy considerations and regulatory efforts that may be required at each level of government. Reviewing current statutes and regulations is the first step to ensure a smooth introduction for industry. The working group identified the critical need for data in terms of operations within airspace as well as infrastructure design and standards. This discussion concluded with the following four recommendations from the Airspace and Infrastructure Working Group.

1. **Provide consistency across Texas law by creating statutory uniformity and standard definitions pertaining to unmanned aircraft operations and urban air mobility/advanced air mobility.**

UAM/AAM introduces a unique set of technologies, operational models, and physical infrastructure that may not currently be covered under Texas state laws. Vertiports and UAM aircraft should be included under current relevant statutory definitions to reduce the regulatory burden for UAM's introduction. Reviewing current statutes and regulations to ensure definitions meet the evolving industry standards enables Texas to remain ready to

introduce UAM and to maintain safe operations. Statutes should remain flexible because UAM may transition from manned to unmanned operations as the technology progresses.

2. **Develop an urban air mobility/advanced air mobility–centric research facility to test and evaluate technology, provide data collection opportunities, and coordinate with federal entities to share information and help guide data-driven public policy. The Texas Legislature is encouraged to consider the benefits of state funding for the successful development and operation of this facility.**

This recommendation has similar goals as the Technology Working Group's recommendation on a UAM/AAM sandbox. One of the core needs for the industry today is data related to operations and safety, both of ground infrastructure and movement in airspace. Developing a research facility would allow the State of Texas to evaluate potential technologies or operators and to collect the data necessary to allow for the eventual scaling up of UAM/AAM for passenger and goods movement. Potential areas for testing at such a research facility include remote ID and traffic management. In addition, the facility may benefit from being co-located at or near a university that could support research activities and data collection efforts. The advisory committee also recommends that the legislature consider state funding for such a facility to allow for testing to occur outside of larger airports. Smaller communities may not have the resources or technical capacity to develop their own test site or facility and so would benefit from state support.

3. **Develop a statewide plan, or integration within the Texas Airport System Plan, that addresses the potential locations for and classifications of vertiports and other associated infrastructure to help define the future operational environment of urban air mobility/advanced air mobility.**

UAM/AAM will be a mixed aircraft environment that may include drones, helicopters, and crewed or uncrewed/self-flying eVTOL or STOL aircraft. Statewide planning efforts can provide clarity on the proper placement of vertiports or other required infrastructure. A statewide plan would provide recommendations on the conditions necessary for vertiport locations, rather than prescribing specific locations as well as help provision the infrastructure for the future to enable new technologies. Recommendations could address land use, airspace, and other safety and operational considerations to avoid gaps in infrastructure across the state. The TxDOT Aviation Division has begun a new TASP update effort that will incorporate some of these considerations.

4. **Direct the state to work with municipalities to provide technical assistance to local governments in adapting and integrating urban air mobility/advanced air mobility in their communities.**

UAM/AAM operations will require coordination with municipalities to develop ground infrastructure and to begin operations with public support. Municipalities may require assistance in adapting their current environment or integrating these operations into their city. The state should provide leadership in this area if UAM/AAM is to be effectively introduced into Texas. Technical assistance could range from guidance on interactions with FAA and airspace considerations to a roadmap for installing the appropriate ground infrastructure.

SAFETY AND SECURITY

Ensuring safety and security of UAM requires the consideration of risk at all levels, from the aircraft and related technology to the management of airspace to infrastructure considerations. This section presents a literature review on the core concepts within both safety and security for UAM before presenting the committee's work on this topic. Safety and security are broad topic areas that may offer a number of areas for state consideration; however, the committee chose to focus on safety in aircraft operations and areas for standardization in relation to safety and security due to the time constraints of the effort. The recommendations to the State of Texas will focus on these two areas and the role in which legislation and regulation can ensure UAM safety and success.

Literature Review

The literature review considers safety and security across the UAM/AAM landscape. This includes operational concerns and management, certifications, and standardization, as well as the safety and security of the public. Transportation safety and security under UAM will have to consider both passengers and the general public that this new transportation mode will operate above.

Safety

Operational Safety

Regulations could be developed at federal, state, and local levels; the literature generally agrees that safety, equipment, and operations will be regulated at the federal level with land use, privacy, and environmental issues more likely to fall to either the state or local levels (*32*, *36*, *55*). While Airspace will be regulated at the federal level, coordination may be required between multiple levels of government to ensure safe operations (*80*).

At the federal level, the current regulations are limited when considering operations, equipment, and safety (*36*, *55*). Operating within low-altitude airspace, generally below 500 feet, may require alterations to the current standards from legal separation to design separation. This would provide greater flexibility while ensuring safety of operations in denser traffic (*54*). The different operational concepts and business models may see automation entering the UAM space as well as greater data requirements and standards. CFR 14 does not include regulations relating to autonomous or no-pilot operations at this time, and while a "user certification" is mentioned in the regulation, no standards or requirements are presented (*81*). The current rules adequately cover onboard, certified, single-pilot operations under visual flight rules and instrument flight rules. However, the rules do not consider the potential for remote operations or ground-piloted operations, or allow a certified user to operate the aircraft when necessary (*36*). New flight crew licensing and training could be required to support nontraditional operations (*32*). If these regulations are not updated, an alternative means of compliance may be necessary to allow for more advanced UAM operations that incorporate autonomous technologies (*56*).

Incorporating autonomous technologies into the safety regulation environment for aviation also requires consideration of a mixed operating environment in the early stages. Both autonomous and non-autonomous operations will be occurring at certain stages, and the proposed method for ensuring safety is an in-time aviation safety management system

(IASMS) (*82*). An IASMS would augment the current safety systems of today and would allow operators to tailor their safety management system to their use case. For example, different safety considerations are necessary when handling cargo versus passengers. These systems are intended to be responsive and able to meet specific safety goals and performance measures based on need and operating environment. The basic components of the system would be to monitor, assess, and mitigate. Monitoring includes hazard identification and data collection. Assess requires data analysis and risk mitigation (RM) controls. Mitigation is based on safety performance and resource prioritization. The purpose of an IASMS is to monitor and consider all risks in an overarching framework, but each specific system will be based on defined risks and the expected use case (*82*). Safety management systems will be critical to operation of UAM/AAM, especially in mitigating the risk to passengers and the public impacted by these services.

Safety Standards and Certifications

Safety is a core concern for the public when considering a new mode of transportation. UAM represents an exciting new offering but one that will require strict safety requirements for both equipment and operation. In addition, the potential for autonomous or remote operations presents a new area for safety standards and regulations in aviation. Ensuring public acceptance of autonomous operations necessitates stricter safety standards than traditional aircraft or aviation practices (*54*). These standards should take into account handoff situations where the remote operator takes control of the aircraft (*56*). Handoff situations could include severe weather conditions, equipment or sensor malfunctions, and periods of dense traffic in the early stages of operation. The higher densities and greater number of origin and destination pairs present a key challenge for UAM; arrival and departure safety will be critical in terms of safety (*83*). In addition, safety standards and certifications are required for the new aircraft that will be operating in the UAM environment. Current regulations do not adequately cover electric propulsion, title wing powered lift, and future concepts such as folding propellers (*36*).

Regardless of operational concept, automated or piloted, UAM could benefit from collecting additional data that will allow for more effective decision-making. A new system for monitoring risk within the UAM environment could ease public concerns and ensure greater safety (*84*). UAM safety considerations will likely consider a mixture of human and autonomous control but should cover these key categories: safe separation, vehicle control, and mission and vehicle management (*56*). New standards for the vehicle and equipment and for operating within the defined airspace are critical for the safety of UAM operations. Strong traffic management that accounts for aircraft separation and control, either piloted, remote, or autonomous, is also crucial at the expected densities of UAM.

While standards exist that can ensure safety across approximately 80 percent of proposed UAM operations, some standards and protocols need to be expanded or revised to meet the needs of new eVTOLs and autonomous operations. ASTM International is working to develop these updated standards to ensure the safety of the industry throughout its operation (*85*). Furthermore, because no certification for AAM aircraft currently exists, FAA plans to certificate them using a process for aircraft that do not fall within the standard aircraft class. One approach to certifying AAM aircraft will be by adding special conditions to Part 23 that considers the uniqueness of these types of aircraft. Another approach FAA is considering is

using the certifications standards of Part 23 as a foundation and combining other FAA regulations, such as those used for helicopters, to classify a new type of aircraft (*34*).

Security

There are two key elements to consider in terms of UAM security: the physical security at the vertiport and in the air; and cybersecurity related to equipment, operations, and passenger screening. Both elements play a role in the safety of UAM operations; however, physical security considerations may see the greatest departure from current aviation norms in an attempt to create faster and more efficient air travel.

Physical Security

Physical security encompasses a range of issues including access, transfers, and screening of both passengers and crewmembers. In terms of access, vertiport security and partnerships with law enforcement, fire departments, and emergency services are critical to maintain the integrity and safety of the UAM service while effectively coordinating with local agencies for emergency or incident management. The operational use of the vertiport or takeoff and landing site will play a large role in determining access to the area and the specific security considerations, such as perimeter security (*86*). In addition to operations, the location of the vertiport will determine the requisite security needed around airspace monitoring and communication, which links to cybersecurity issues as well.

One potential use case for UAM/AAM would bring in additional security challenges. Trips into airport environments would require different procedures if the UAM operations were dropping off passengers landside or past traditional security procedures controlled by the Transportation Security Administration (TSA). Beyond landings at airport, transferring between different modes or the use of intermodal facilities for UAM will have to consider the specific airspace, perimeter, and access security at those transfer points.

Finally, screening of those working at vertiports and passengers will be required to a certain extent, especially as UAM operations grow (*86*). While traditional TSA operations may be too burdensome in terms of the time and space required, the ability to vet crewmembers and ensure the safety of both the crew and passengers will be required for airborne operations. Industry groups are intending for short dwell times within the terminal to both expedite service and maintain low levels of passengers on site. This short dwell time has the advantage of minimizing the terminal space required at the vertiport or TOLAs and allowing for a limited crew to be able to monitor and assist passengers. The intent is to leverage technologies for expedited security checks as UAM operations grow, but in the early stages, passenger profiles would be the main screening check (*86*). TSA is working with industry groups to determine the potential security risks and needs as UAM develops.

Cybersecurity

The technological nature of UAM/AAM services, especially when considering remote or autonomous operations, will require strict cybersecurity protocols and standards. The confidentiality, integrity, and availability (CIA) triad is often used in discussing the cybersecurity needs of TOLAs and the aircraft and management systems (*86*). Ensuring *confidentiality*, or privacy, of data requires authorization and authentication of users to restrict access to data. Data classification and labeling determine the necessary security

measures and protocols for each type of data. In addition, industry may follow data privacy laws from outside the United States to enable interoperability. For example, the General Data Protection Regulation sets the standard for the European Union, and operators wishing to conduct business in Europe may benchmark their data protection protocols against this standard even in the United States. *Integrity* refers to data security; the key components of integrity are preventing data tampering, using digital certificates to minimize risk, and ensuring data are encrypted at all points. Finally, *availability* refers to the redundancy functions and the ability to audit the cybersecurity or data protection framework. This involves building in redundancy within the system, ensuring hardware fault tolerance, and developing plans to recover data and enacting denial-of-service protection mechanisms.

In terms of specific threats to cybersecurity, recent research has highlighted four main components:

- Cyber physical systems.
- End users.
- Cloud services.
- On-premises computing (*87*).

End users include operators, the public, and partners such as public safety agencies. Threats were categorized using a MITRE Adversarial Tactics, Techniques, and Common Knowledge framework. These threats include:

- Eavesdropping.
- "Man in the middle" attacks. These can be eavesdropping but more often alter data and compromise data integrity.
- Phishing attacks.
- Distributed denial of service (DDOS). DDOS attacks disrupt an entire environment and can degrade service.

These threats pose a great risk to UAM, especially in terms of degradation of service. Cybersecurity moves beyond a privacy or data protection concern and can lead to safety issues. Potential safeguards against these threats would include:

- Encryption of data.
- Testing of application programming interfaces for vulnerabilities.
- Training and awareness, especially in terms of phishing attacks.
- Security detection methods in coordination with temporary automatic lockouts.

Ensuring safeguards and security management practices are in place will require regulation across all aspects of UAM; one potential method for cyber and information security would be through standardization. The International Organization for Standardization (ISO) has a certificate for information security management that could be referred to as a benchmark or required of industry partners. ISO/IEC 27001 provides requirements for information security management systems (*88*). While ISO does not certify, other certification bodies can be used to certify an agency or corporation. Understanding the benchmarks used for information security and cybersecurity will be critical in ensuring safety and security across UAM.

Cybersecurity will be key for both ground infrastructure and airspace monitoring and traffic management systems and will support physical security through screening processes.

Safety and Security Working Group

Safety and security in UAM are crucial to the development of UAM, not just in Texas but across the globe. While many standards and regulations will be set at the federal level, states have an opportunity to assist in the development of these standards through pilots and testing in different settings. Safety forms a component of a number of different aspects within UAM and AAM, infrastructure and operations safety, safety guidelines and regulations, cybersecurity, and education of the public and public agencies. Each of these broad areas has specific subtopics, which were discussed by the working group:

- Infrastructure and operations safety:
    - Vertiport safety.
    - Recommendations for vertiport structural requirements, especially in non-airport settings.
    - Safety of aircraft operations, including safety management systems.
    - The need for blackbox safety standards for UAM/AAM crash review.
- Safety guidelines and regulations:
    - Study rules and guidelines from a safety perspective.
    - Review of Government Code 423.
    - Review of *aircraft* definitions across statutes to identify possible hinderances to UAM/AAM.
    - Recommendations on standardization.
- Cybersecurity:
    - Security in manufacturing.
    - Potential interference scenarios and penalties.
- Education:
    - First responder safety and security education.

However, some of the key topics that the working group feels Texas can play a role in shaping are:

- Safety in aircraft operations.
- Standardization relating to safety.

Safety in Aircraft Operations

Safety in operations will be key to public acceptance of UAM, and safety must consider passengers, the public on the ground, and the crew or staff at vertiports. UAM will be operating in airspace that usually sees limited traffic, which could raise concerns over aircraft and flight safety as well as noise and environmental considerations. Safety management systems must incorporate public safety as their main consideration to ensure that operations do not disrupt or cause harm, especially in dense urban environments where operations can be more complex. Urban operating environments will also necessitate data sharing between public agencies and operators. There should be some consideration of data interoperability standards and the mechanisms to share the data with the state. The

Texas Department of Public Safety uses a flight risk assessment tool that helps pilots navigate in denser environments and report structures that impact the airspace. This is currently reported by pilots, and for UAM, operators will likely need a real-time reporting system and mapping capabilities to identify both permanent and temporary structures that impact operations. Current systems suffer due to interoperability constraints that would need to be addressed before UAM can scale.

Any guidance provided by the State of Texas in terms of safety or safety management systems would have to follow the FAA guidelines on the topic. However, since UAM safety standards are not fully established, there may be a role for testing and operations in Texas to develop models or minimum standards for safety and safety management systems. While any regulations or standards related to operations in the air would be under FAA's purview, ground infrastructure and the location of that infrastructure can be regulated at the state level. This would include safety in terms of ground operations with regard to both power supply and manufacturing issues.

While vertiport design standards are being developed at the federal level, the state does have minimum standards for general aviation airports that follow federal standards. A similar set of standards could be developed for UAM that would guide vertiport design as well as takeoff and landing areas to ensure safety. Since UAM is an emerging industry, standards would need to be developed in coordination with FAA and remain flexible to changing technology and power supplies. Recommendations could also be made in terms of passenger movements in and around vertiports to ensure security.

Standardization Relating to Safety

Safety in operations will require standardizations in procedures at various stages of the process. Passenger movements and interactions with ground crew will require a screening process, especially if the movement enters controlled airspace. Coordinating with TSA and other agencies to ensure the security of passengers, crew, and the public will be necessary. For movements that do not enter controlled airspace, some form of screening will be required but will need to be less burdensome than traditional airport security. Other areas that will require standardization are flight operations and incident review. Ensuring thorough procedures before and after takeoff as well as safety reviews after incidents should improve the overall safety of operations and assist with public acceptance. Penalties and regulations relating to interference with operations were also discussed as critical to safety and security. However, any standards should focus on maintaining safe operations without pushing smaller companies out of the market due to difficulties with enforcement or compliance. While many of these standards will ultimately be determined and regulated at the federal level, the current status of standards within the UAM industry provides an opportunity for Texas to guide these standards through the work that is ongoing in the state.

Entirely new standards are not necessary at this stage, and the committee recognizes that existing standards can be used and updated to reflect the unique challenges of the UAM industry. Standards organizations, such as ASTM International, are taking a similar approach by modifying and updating existing standards to ensure safety. TxDOT's Airport Rules and Standards webpage provides a starting point to determine the appropriate standards for UAM and where modifications or expansions will be needed (*89*). Using existing standards

where possible can ease the burden on operators entering the market as protocols are established and are not relying on new review processes.

Recommendations

The third and fourth working group meetings focused on drafting and developing recommendations related to the safety and security of UAM in Texas and across the United States. The working group understands the significance of safety to introducing and developing the UAM industry both within the state and in interactions at the federal level. FAA will take the lead in developing broad standards, requirements, and certifications, but the state should work in coordination with both FAA and other federal entities to provide available data that can assist and support safety standards. Where possible, the state can review current aviation safety regulations and training to better prepare the state for UAM/AAM's introduction. In support of those goals, the Safety and Security Working Group developed the following seven recommendations.

1. **In collaboration with the appropriate federal entities, the state will work to encourage the development of minimum standards/safety management systems for vertiport operations including passenger and goods movements and ground infrastructure.**

Federal regulations surrounding AAM are still in development. In March 2022, FAA posted *Draft Engineering Brief No. 105, Vertiport Design,* for public comment. The intent is for FAA to review comments and finalize the engineering brief. The original expectation was that this would occur in June 2022. This brief provides interim guidance on the design of vertiports for VTOL operations, which is subject to change as new data or analysis becomes available. The UAM Advisory Committee recommends that the State of Texas encourage the development of these standards and collaborate with FAA where possible to ensure the safe movement of passengers and goods under AAM. An FAA Advisory Circular on vertiport design is not expected until 2024 or 2025.

2. **Extend the work of the Urban Air Mobility Advisory Committee beyond the sunset date of January 1, 2023, to continue working in key areas of this emerging and quickly evolving industry in order to remain responsive to the needs of Texas and ensure Texas' role as a leader in this industry.**

The UAM/AAM space is at a stage of rapid development, and the industry is constantly evolving. In order to best position the state for adoption and advancement of UAM, the committee should be extended to continue working in key areas. An extension of the committee should consider the industry standard terminology and alter the scope to AAM. AAM reflects the potential for regional air mobility, or connections between cities, and intracity transportation. Further, AAM allows for the consideration of UAS and the interactions between passenger and small goods movement in the same airspace. Continuing the work of this group will build on the current progress and keep the momentum going to best position the state to adopt and integrate this new technology. A similar recommendation was made by the Commerce and Community Integration Working Group.

3. **Recommend Texas law does not conflict with federal law.**

The UAM/AAM space will see an evolution of regulation and rulemaking in the next few years. Texas should remain on the forefront of any regulatory efforts to ensure safety and efficient operations. However, state law should not conflict with federal laws on UAM/AAM. Coordination with federal legislators and agencies will allow Texas to lead in this area and develop legislation that coincides with federal laws. This coordination will prevent ambiguity and uncertainty and will enable UAM/AAM operations to safely develop in Texas.

4. **Encourage the Legislature remain an active participant in urban air mobility/advanced air mobility as the industry and technology will outpace current regulations and enable the appropriate state agency to lead and manage the regulatory concerns.**

Appointing an existing agency to lead and manage concerns, especially regulatory, regarding UAM/AAM allows the state to remain at the forefront of this evolving industry. The legislature should remain informed on the progress of UAM/AAM and be aware of industry developments and federal regulations, including those from FAA and other relevant agencies. Allowing a state agency to act as a point of contact will ensure that the legislature remains informed on industry progress and any developments that may require state review or enactment of legislation.

5. **Direct the Texas Department of Transportation to review existing state aviation standards and guidelines, airport facility planning, and compatibility guidance to ensure they apply to urban air mobility/advanced air mobility.**

Existing aviation standards and guidelines may apply to new technologies developed under UAM/AAM. TxDOT is encouraged to review current aviation standards and guidelines to determine where adaptations can be made and which standards and guidelines may apply to UAM/AAM in their current form. This approach saves time and serves as a foundational starting point in developing appropriate safety standards. Additionally, to expedite regulations and standards in this area, the development of compatibility guidelines, safety systems, and facility planning could be the responsibility of TxDOT, where principals in airspace, safety, commerce, and UAM/AAM management can all be assigned within the department.

6. **Support the development of standardizations at the federal level and within industry as technology develops/changes so safety is prioritized as the technology matures.**

The safety and security of UAM/AAM operations are the most important consideration for both government and industry. Since this industry is developing and introducing new technologies, such as eVTOL and STOL, standards will be developed to ensure safe operations. Many of these standards will be developed at the federal level, especially in terms of aircraft, but the State of Texas should support these standardizations wherever possible. In addition, safety standards for infrastructure must be considered by the state due to its greater role in ground infrastructure regulation and funding.

7. **Encourage state-level cooperation with local governments to ensure appropriate preparation, training, and safety practices associated with vertiport operations**

including law enforcement, fire service, and emergency medical services associated with traditional aviation and advanced air mobility aircraft operations.

Ground infrastructure, such as vertiports, will be subject to local zoning and permitting considerations, but the state should cooperate with local governments to ensure that law enforcement, fire departments, and EMS are prepared for the unique challenges related to UAM/AAM operations. As this mode of transportation grows, operations may occur in areas with limited aviation experience. To this end, the state can provide guidance on the necessary preparation, training, and safety practices to local governments. Enabling UAM will require this cooperation between the state and local levels to ensure safety and security of operations.

COMMERCE AND COMMUNITY INTEGRATION

Commerce and community integration is a critical component to UAM that will impact the public. Public awareness and education efforts will be required to prepare and secure their approval. Safety, noise, access to UAM facilities, and privacy are some of the concerns listed as barriers to public acceptance. Similarly, because UAM is a new technology that many members of the workforce may not have been exposed to, UAM training programs will be needed to prepare the community for integration. This section discusses regulatory and infrastructure considerations, the factors affecting public acceptance, current education and training efforts and needs, and demand. A summary of the topics the Commerce and Community Integration Working Group discussed and those most important to Texas adoption is also included.

Literature Review

Legal precedent has established a right to enjoyment and use of a landowner's property; however, there is no established limit to the use of airspace by FAA. While the legal operating environment is still being established, communities should still be engaged to ensure that UAM operations and infrastructure match community needs and vision. Infrastructure placement is a key consideration in terms of both introducing commerce opportunities and integrating into the existing community. One concern is that some cities may not have the appropriate physical or regulatory conditions for UAM adoption, which could cause complications. Poor TOLA placement can lead to issues such as increased travel time, costs, and congestion. For example, by selecting Los Angeles, CA, as its case study, a study found specific instances where adopting on-demand mobility (ODM) may not be feasible. With regard to infrastructure, low TOLA availability would cause passengers to drive longer distances, leading to greater congestion, and would limit aircraft staging and deployment capacity (*61*). Another complication is regulations at the local level, often influenced by community input, that could potentially affect infrastructure placement. The California Public Utilities Code and the California Code of Regulations, for instance, both contain rules that could slow or hinder the development of TOLAs, such as requiring the approval of the city board or performing an environmental impact study (*62*). Therefore, making the public aware and educating them on AAM and UAM will set the foundation for promoting public acceptance at the community level.

Public Acceptance

Public acceptance is critical for any new technology, development, or transportation option. UAM presents new, unknown technologies, a different mode of public transportation, and large development in the aviation sector. Ensuring public acceptance will rely on promoting and proving the safety of UAM operations, providing easy access, maintaining privacy, and reducing noise where possible. Cotton and Wing believe that strict safety standards will be necessary to assuage public concern (*54*). Research is already underway to gauge public perception regarding UAM. Safety, trust, and a preference for automation were found to be key to the public accepting UAM; if automation is not initially used, safety standards will still be critical to easing public concern (*32*, *90*). While autonomy and automation are often used interchangeably, it should be pointed out that autonomous operations of an aircraft itself represents a range of control that, simplistically, includes pilot-controlled flight, pilot supervision of automation systems, and pilots passively monitoring autonomous operations and being notified if human intervention is required. In addition, the pilot may physically be located on the aircraft or at another location with the ability to control the aircraft remotely (*8*). When considering autonomous operations, lessons could be learned from the testing and deployment of AVs. Strong communication between the passenger and the aircraft can help ease concerns, as can the ability to communicate with a remote operator in certain conditions (*64*). Other measures can be taken to earn public acceptance, but it is also important to identify challenge areas.

The availability and access to UAM impact public use and acceptance. Fast access and egress to vertiports and intermodal connections will be required to incentivize UAM usage (*32*). Flight capacity and takeoff and landing availability have been cited as primary constraints for UAM adoption alongside noise (*61*). Complete trip times need to be faster than other modes to incentivize use; the access to vertiports and efficient boarding will be a key component when competing with transit or car trips. Vertiport placement should be considered to provide routes that allow the user to avoid congested highways and to provide an efficient number of flights available per day. The on-demand aspect of UAM is critical to attracting users but will present challenges when considering cost and efficiency. Stakeholders also noted in a GAO report, *Transforming Aviation*, that for the AAM industry to be accepted among the general public, equitable access must be included in the transportation network rather than be its own separate service (*34*).

Privacy concerns, both in terms of data security and the potential intrusion over private property, also play an important role in UAM adoption. Community members in Melbourne, Australia, cited a UAM application as an invasion of privacy when presented with the option of a helipad on top of a high-rise building (*91*). Data security and privacy also have an increased role with the use of on-demand mobility solutions for UAM; operators should be aware of the use and protection of user data to reduce concerns over data breaches and cybersecurity issues (*32*, *90*).

Finally, noise is considered a primary constraint and a key issue that should be addressed before adoption of UAM (*61*, *62*, *91*, *92*). Half of the respondents to a survey on UAM were concerned with the type and volume of sound that would be produced by the aircraft. This would also be impacted by the time of day flights operated and the aircraft altitude (*92*). The impact of noise on public acceptance highlights the importance of obtaining community

input when considering routes, hours of operation, and especially the location of vertiports or vertipads. Current noise mitigation strategies should be explored, as well as aircraft technology and modes of operation that reduce noise pollution (*62*). When considering technologies that reduce noise, such as electric operations, the potential reduction in environmental costs can contribute to greater public acceptance of UAM (*32*, *91*).

Demand

Public acceptance of UAM is inherently linked to demand; however, factors outside of safety, access, privacy, and noise will impact the use of this mobility option. Travel time and cost are key to ensuring demand for UAM services (*32*, *93*). A German study found that the optimal aircraft has four seats and a range of 550 km, and users are willing to pay 0.5 to 0.8 euros per kilometer, which is approximately $0.9 to $1.44 per mile (*94*). Garrow et al. believe that UAM must be price competitive with AVs in order to capture the necessary market share (*33*). When modeled, UAM ticket costs were lower under dense vertiport availability with costs ranging from $0.30 to $7.20 per km for different densities by area sizes ranging from 150 to 450 km^2 (*95*).

Although vertiport density can increase efficiency, the unpredictability of on-demand aviation will require efficient routing and cost reduction wherever possible to ensure economic success (*96*). Goyal et al. estimate that AAM could replace non-discretionary trips over 45 minutes, which represented approximately 0.5 percent of mode share under their analysis (*93*). Due to the current high cost of UAM, the key demand areas are generally viewed as dense, high-income urban environments that would benefit from an alternative travel option to reach destinations within a shorter time frame (*97*). A study on design optimization found that a double landing pad may be the best design to optimize output (*98*). Operators must consider the cost, efficiency, and travel time savings because they will have the largest impact on demand and routing decisions.

Education and Workforce Development

To generate public awareness and interest in UAM, educating the public on what this technology is and how it will affect their lives should be considered to achieve community integration. An organization already taking on this responsibility is the Community Air Mobility Initiative (CAMI). Its work prioritizes education on a local and community level by providing resources to the public in the form of brief documents highlighting various components of UAM (e.g., public acceptance, eVTOL, operation, and benefits). In addition to providing resources, CAMI hosts events dedicated to introducing UAM to state and local decisionmakers (*99*). Universities are also undertaking this effort by integrating courses related to UAM and AAS into their curriculum and housing some UAS testing sites. Recourses are also available for teachers who wish to teach their students about UAM. NASA's *Advanced Air Mobility (AAM): STEM Learning Module* for example contains guides on different of AAS topics. Students can participate in activities such as air taxi design challenges, coding, package delivery, and others as instructed in the educator and student guides (*100*). It will also be essential to earmark funds to support these programs, especially those in disadvantaged communities.

Commerce and Community Integration Working Group

Although major decisions regarding UAM will be made at the federal and state levels, preparing local communities for the introduction of this new technology is a wise action for the acceptance of UAM. The working group discussed a number of topics, including the following:

- Education and workforce development, including the recommendation for the state to offer more educational grants for training.
- Law enforcement integration, including training opportunities for law enforcement and the public.
- Public awareness, including consideration of a community integration bill at the federal level.
- Economic impact, including reviewing what other states do in regard to fund generation, environmental impacts, and impacts on mobility.
- Review of recommendations originally based on HB 2340.
- Review of the best practices on how UAM can integrate with the physical build of an area.

However, the key issues the working group focused on related to education, workforce development, and public awareness.

Education and Workforce Development

Providing education and public awareness programs will have an impact on readiness and acceptance; therefore, the reallocation of training and educational grants will be required. Strategies need to be developed for disaster and incident management as well as public education and awareness training in matters related to UAM and AAS. Identifying appropriate education and workforce development programs that can promote UAM/AAM will be critical for preparing those who will often need to interact with this technology. Similarly, identifying those in need of training will influence how the education and workforce programs are developed. With the advancement of this new technology, the workforce needs to be prepared for how to properly interact with aircraft. This could include involving emergency responders, law enforcement, community leaders, and others early in the decision-making process. Additionally, introducing the younger population to this technology while they are still in school may encourage them to join the UAM workforce. Schools can introduce AAS programs into their curriculum or clubs that give students firsthand experience. However, securing funding for these education and training programs may require legislative changes or the creation of new grant programs.

Workforce development and training will have to shift focus to electronic and autonomous travel. It is expected pilots will be needed to operate UAM aircraft in the short run. The challenge, however, is attracting talent in a field whose future is uncertain, will eventually be replaced by autonomous piloting, and where skills may not be entirely applicable in other areas (*101*). In addition to pilots, EMS and fire department officials will have to adapt to carry out emergencies involving UAM. The role of law enforcement will need to be redefined, potentially using HB 2340 as a foundational guide. For pilots, streamlining certification standards could be a viable solution given the amount of time and complexity of current

training programs. Not all commercial piloting skills will be required for UAM operations; some of the certification requirements have already been eliminated (*101*). Furthermore, states already offer funding opportunities for training programs in similar fields (*102*). To take advantage of these resources and because not all programs are applicable to UAM, it would be necessary to create new classification codes to allow for the specific funding of UAM and AAS training in the future. It will also be essential to create public-private partnerships to contribute and fund the development of this new workforce.

Public Awareness

Public awareness is the first step to ensuring public acceptance of UAM services in the future. It will be critical to educate the public on the different uses of these technologies, the operational considerations, and especially the safety standards and design of these systems. Making the public aware of the safety protocols, standardizations, and operational design that has been vetted for safety should ease concerns over the introduction of this new mode. The different operational styles in terms of VTOL and eVTOL need to be explained to the public to pave the way for community integration and eventually use of UAM services. Promoting the benefits of this new mode, such as use by emergency services, could also help to ease concerns. The committee discussed the potential for leveraging existing federal resources, such as the community engagement toolkits (*103*), and the possibility of planning grants if HR 6270 were to pass at the federal level (*104*).

To successfully generate public awareness, it is necessary to tailor each action to the appropriate community. These communities include community leaders, elected officials, community members, and others, with each having their own interest. Some industries have already established guidelines for how to best improve public awareness, as in the case with Wing, which launched small-scale UASs at two locations in the United States, Finland, and Australia. Wing and Virginia Tech's MAAP developed a community engagement guide based on their experience in establishing small drone delivery services in cities (*105*). Their strategy involves engaging the community through three pillars: education, listening, and responding. Before launching this kind of service around the community, it is advisable to educate the public on how it will impact their community. Being present in person also enables the community to be heard and part of the process. Responding refers to considering community input and employing those changes in the industry's operations; this demonstrates the industry values what community members have to share and will take action to solve any concerns. This guide also identifies outreach opportunities within the community such as setting up a station in farmers' markets, festivals, or conferences (*105*).

Lastly, materials need to be presented in a manner that is visual and quick and easy to understand. Some examples include social media, press releases, interviews, videos, and websites (*106*).

Engaging the federal government, especially FAA, will require a different approach that is more focused on providing information to this agency in order to help it make informed decisions. One approach is to contact FAA's Noise Ombudsmen and Office of Environment and Energy, which respond to community concerns. Providing data to FAA obtained from noise and annoyance measurements will ensure that proper decisions are made concerning noise levels and minimal inconveniences to the public. This extends to crafting noise and

environmental standards that most of the public accepts, which FAA could be made aware of based on data provided to it (*106*).

Recommendations

The third and fourth working group meetings involved the drafting and development of recommendations that would spur commerce and economic development and would integrate this new technology into Texas communities. The working group discussed the need for education and workforce development within the state to ensure Texas remains competitive. In addition, leadership and guidance at the state level will allow local and regional governments to effectively introduce UAM/AAM within their communities with public support. With that in mind, the Commerce and Community Integration Working Group developed the following five recommendations.

1. **Direct all law enforcement and first responder agencies to adopt education and training recommendations as identified in *Unmanned Aircraft: Responding to and Recovering from Disasters* (State of Texas, November 2020), a report born out of House Bill 2340 (86R, 2019), establishing a small unmanned aircraft study group for a statewide response team.**

Previous work relating to UASs and their use relative to emergency preparedness was conducted to acclimate first responders to this technology. First responder input was obtained to develop the report and assessed pilot selection, funding allocations, and the best approaches to educating law enforcement. Not all law enforcement and first responders will have experience with this technology, so it is important to reach out and educate them at the local level.

2. **Extend the operation and activities of the Urban Air Mobility Advisory Committee to continue addressing the current and future issues associated with these emerging technologies in this quickly evolving industry to maintain Texas' economic competitiveness and create economic development opportunities.**

The UAM/AAM industry is rapidly evolving, and the work of the Urban Air Mobility Advisory Committee should extend beyond the current sunset date of January 1, 2023, to maintain Texas' economic competitiveness. Texas is on the forefront of planning for this industry but ensuring sound economic development will require continued communication and coordination with the industry, government, and other stakeholders represented through this committee. A similar recommendation was made by the Safety and Security Working Group.

3. **Create a statewide primary point of contact to direct urban air mobility/advanced air mobility workforce development efforts, lead public awareness and education efforts, and collaborate with local, regional, state, and federal entities to encourage more input and participation.**

A statewide primary point of contact would smooth the introduction of this industry through increased input and participation from relevant stakeholders. The point of contact would also provide a place to consider the workforce development, public awareness, and education needs for the state to remain economically competitive in this area. The point of

contact should be a public agency to ensure that Texas remains neutral in terms of technology and other industry considerations. Considerations by the committee for the point of contact included TxDOT, specifically the TxDOT Aviation Division, whose purview includes both facility development and aviation education. A similar recommendation was made by the Safety and Security Working Group.

4. **Direct the State to provide resources and assistance on the use of urban air mobility/advanced air mobility technology infrastructure for cities, local and regional governments, transportation planning organizations, other entities, and industry to better identify what the different levels of government can do to integrate industry innovation and community vision and help promote urban air mobility/advanced air mobility technology.**

Information asymmetries exist across a number of industries, but UAM/AAM is likely to use areas and environments that do not have the current expertise, capacity, or resources to effectively integrate operations in their region. This recommendation focuses on promoting communication and cooperation across levels of government, industry, and other relevant stakeholders to ensure that information and resources are effectively disseminated across all levels of governments, especially to smaller regional and local entities. Research and planning are ongoing at regional entities, such as council of governments and metropolitan planning agencies, but this is often not communicated across the state to smaller, local, and rural entities. Providing these resources and assistance can ensure that UAM/AAM operations and infrastructure reflect the community's vision for transportation and do not disrupt quality of life.

5. **Direct the appropriate state agencies to jointly collaborate with local school districts, higher education institutions, and any interested private and/or public stakeholders on educational opportunities related to urban air mobility/advanced air mobility technologies.**

A key component of economic competitiveness will be a prepared workforce. Texas should promote efforts on workforce development that begins with current school curriculums. Appropriate state agencies to lead this collaborative effort could be the Texas Education Agency and the Texas Higher Education Coordinating Board. The Texas Innovation Alliance could also play a key role regarding the involvement of cities, transportation agencies, and research institutions. Collaboration with the private sector is also encouraged for industry to share its expertise, provide training, and provide equipment that can advance educational opportunities around UAM/AAM. While certain cities and school districts are working on educational options that would support the knowledge, skills, and abilities required for UAM/AAM, rural school districts and those without adequate resources will need greater assistance. Any educational opportunities or curriculum updates should emphasize equity and ensure programs or educational development opportunities are accessible to all. Efforts in all areas of UAM/AAM should focus on equity and accessibility but especially efforts surrounding education and ultimately workforce development.

CONCLUSION

The recommendations developed by this committee represent the culmination of many meetings and hours of discussion on how best to position our state to facilitate the emerging and quickly evolving advanced air mobility industry. The advisory committee discussed the numerous topics and challenges that such an emerging industry presents while keeping focused on those that the state could more readily pursue. Over the last six months, the full committee met four times including two in-person meetings. These meetings were also public meetings and duly posted as such with public comment noted on the agenda and the committee chair presiding over a public comment period.

The committee chair also established four working groups to cover this vast topic. Each working group met four times in meetings that were also open to the public. Many members of the public provided comments during all 20 of committee's and working group's meetings.

Each working group developed its own set of recommendations that fell within its purview. They were voted on, and those receiving a majority of votes were sent up to the full advisory committee. The full advisory committee then reviewed, amended, and voted on the entirety of the recommendations, approving 20 recommendations in all.

The recommendations range from specific changes to legislation and policy and the ongoing work efforts of some state and local entities to larger, more foundational issues that would better position the state going forward. The committee recognizes that many of the recommendations may add additional workload to some agencies such as the TxDOT Aviation Division. The Aviation Division, which currently has responsibilities surrounding the planning, programming, and funding of airport projects across the state as well as some aviation education responsibilities, is likely to find itself as the focal point for several of these recommendations. The committee understands that many of the additional roles and responsibilities imbedded within its recommendations will be best addressed and carried out with appropriate accompanying resources.

The committee would like to thank the Texas Legislature and TxDOT for the opportunity to participate in this important work and their commitment to advanced air mobility.

The committee was supported by teams at TxDOT and TTI:

- TxDOT team:
  - Darran Anderson.
  - Dan Harmon.
  - Zeke Reyna.
  - Brenna Lyles.

- TTI team:
  - Jeff Borowiec.
  - Brianne Glover.
  - Jacqueline Kuzio.
  - Bill Prieto.

URBAN AIR MOBILITY ADVISORY COMMITTEE BIOGRAPHIES

AHSAN CHOUDHURI, THE UNIVERSITY OF TEXAS AT EL PASO

Dr. Ahsan Choudhuri is the Associate Vice President of the Aerospace Center at The University of Texas at El Paso. The Aerospace Center has expanded beyond its initial research focus when Dr. Choudhuri founded it in 2009 as the Center for Space Exploration Technology Research. In partnership with NASA, the Department of Defense, the Department of Energy and many industry partners, this premier, minority-serving research center explores new technologies and challenges in space, aeronautics, defense and energy using digital tools and skills that are transforming the way we design, build and test systems. Under Dr. Choudhuri's leadership, the Aerospace Center has developed an expansive vision to exponentially expand our nation's talent-force by unleashing new opportunities for students from every background and every zip code through cutting-edge, applied research in aerospace, defense and energy. Fully embracing UTEP's commitment to access and excellence, the Aerospace Center has developed a student-centered model that is an engine of social and economic mobility for the students who are hired as research assistants.

Dr. Ahsan Choudhuri is an internationally renowned expert in aerospace and defense systems and has led the growth of UTEP's aerospace, defense and energy education and research program from its infancy to a program that is nationally recognized. Under his leadership, the Aerospace Center has grown from a 3,000 square foot lab employing 30 students as research assistants to over 35,000 square feet in laboratory space and 8,000 acres of test facilities employing 200 students today. In 2021, The University of Texas System Board of Regents approved a new degree proposal by UTEP to establish a Bachelor of Science in Aerospace and Aeronautical Engineering, and the Aerospace Center is developing the skills and curriculum for digital engineering which will transform the way we design and build the aerospace and defense systems of tomorrow. Dr. Choudhuri has formed strategic collaborations and partnerships with NASA, DOE, DOD, and aerospace and defense industries that have fueled the Aerospace Center's growth and created unparalleled opportunities for students. His new mission focuses on leveraging the research preeminence of the Aerospace Center and our sister center, the W.M. Keck Center for 3D Innovation, to create jobs and business opportunity in aerospace, defense and advanced manufacturing in El Paso. Dr. Choudhuri is a member of the Executive Committee of the Lunar Surface Innovation Consortium (LSIC), which supports NASA's Space Technology Mission Directorate. Dr. Choudhuri chairs the Urban Air Mobility Committee that advises the Texas legislature on a strategic and regulatory framework to take advantage of the economic opportunities of unmanned aerial systems while ensuring maximum safety.

Dr. Choudhuri is a proud alumnus of Khulna University of Engineering and Technology, where he received his B.S. in Mechanical Engineering. He received his M.S. and Ph.D. from the University of Oklahoma School of Aerospace and Mechanical Engineering.

CHAD SPARKS, BELL

Chad Sparks currently serves as the director of strategic campaigns and business development focused on building technology partnerships and customer relationships for Bell's newest innovation products including unmanned vehicles.

Prior to this role, Mr. Sparks was the commercial program director for medium helicopters and responsible for leading the integrated team executing the product strategy, aircraft deliveries, and product support for the Bell 412 medium twin product line. Previously, he was responsible for the development and flight demonstration of advanced capabilities and upgrades for the V 22 program including reliability improvements, aerial refueling, and advanced weapons. He has also led the team responsible for the tactical and strategic procurement of approximately $200 million in annual purchases of complex aircraft systems for Bell's commercial and military platforms. From 1996 to 2009, he served as an engineer at various levels of increasing responsibility in the Bell Military Research and Development organization.

Mr. Sparks holds a B.S. and M.S. in aerospace engineering from Texas A&M University and The University of Texas at Arlington, respectively. He is also certified in Six Sigma design practices.

AMANDA NELSON, BRISTOW GROUP, INC.

Mandy Nelson was appointed to the role of director of strategic relationships, AAM, in January 2022. In this role, she supports Bristow's global AAM efforts through cultivating robust and productive strategic relationships with AAM partners, manufacturers, and other key global AAM stakeholders. Prior to this, Ms. Nelson served as Bristow's director of government affairs, focusing much of her time on policy engagement related to the emerging AAM space. Earlier in her career, she served in the role of global account manager for Era Helicopters, where she focused on market diversification initiatives and growing Era's core vertical flight business. Ms. Nelson served in various commercial and managerial functions supporting Era's Alaska and tour business units. She is also a commercial pilot (Multi-Engine Land [MEL], Single-Engine Land [SEL], and Instrument Airplane).

BEN IVERS, THE BOEING COMPANY

Ben Ivers has been the director of autonomous systems for global safety and regulatory affairs since August 2020. He leads enterprise-wide regulatory affairs and advocacy for AAM, UAS, and autonomous systems. Prior to this role, Mr. Ivers led commercial airplanes product development for systems and autonomy. There, his team was responsible for research and development of new and derivative airplane systems as well as advanced technologies. Other past Boeing assignments include leadership roles in electronic systems, airspace design/air traffic management, certification, and electrical design. Mr. Ivers joined Boeing in 2004. He has a bachelor's of science in electrical engineering from California State Polytechnic University, Pomona and an MBA from the University of Washington.

BILL GOODWIN, JOBY AVIATION

Bill Goodwin works on law and policy at Joby, a company building the most advanced and comfortable electric vertical takeoff and landing aircraft the world has ever seen. He leads policy development in markets and spends most of his time thinking about how people move and live in cities.

Previously, Mr. Goodwin was the head of the government affairs team and the first legal hire at Skyryse. Skyryse operated an air taxi service in Los Angeles, CA, while building the

technology foundation for self-flying helicopters. Before that, he was the first lawyer and general counsel at AirMap, a pioneer in the small UAS UTM space, where he headed the legal and policy teams. Prior to in-house life, Mr. Goodwin practiced law in the San Francisco office of Morrison and Foerster, with a split practice of commercial litigation, tech transactions, and regulatory counseling on UAS.

BRENT KLAVON, ANRA TECHNOLOGIES

Brent Klavon is the vice president of global operations at ANRA Technologies, headquartered in Washington, DC. He is a retired U.S. naval pilot and an FAA-certified commercial and remote pilot. Mr. Klavon participates in several regulatory, technical, and standards organizations helping to shape the direction for industry and government actions for uncrewed aircraft systems. He represents industry as a thought leader, being well versed in the nexus between policy, regulations, standards, technology, and social acceptance. He currently participates in autonomous aircraft programs with NASA, FAA, and the U.S. Department of Defense, and with groups in the United Kingdom, Australia, Japan, Australia, and Switzerland, collaborating with private industry and government stakeholders to forge autonomous system integration. He is an FAA-certified commercial pilot and remote pilot.

BRENT SKORUP, MERCATUS CENTER AT GEORGE MASON UNIVERSITY

Brent Skorup is an attorney and senior research fellow at George Mason University's Mercatus Center, specializing in transportation policy and telecommunications law. He has developed expertise in the areas of federal transportation and UAM policy, drone law, and wireless technology and is often invited to brief policy makers, including White House policy staff and an FAA Drone Advisory Committee (DAC) working group, about drone and UAM technology and policy. Mr. Skorup's drone traffic management recommendations were featured in DAC's Working Group 3 final report and in GAO reports to Congress. His drone and UAM research has been published in law journals and in popular media and trade publications, including the *Wall Street Journal, USA Today, GovTech,* and *Air Traffic Management* magazine.

Mr. Skorup has been appointed to serve on several federal and state advisory positions in recent years, including on TxDOT's Connected and Autonomous Vehicle Task Force, on FCC's broadband deployment advisory committee, and as a drone law adviser to the Virginia Department of Aviation.

CAMERON WALKER, PERMIAN BASIN METROPOLITAN PLANNING ORGANIZATION

Cameron Walker has practiced municipal and regional planning for over 37 years. He has worked in Victoria, TX, and Midland, TX for 30 years. He is currently serving as the executive director of the Permian Basin Metropolitan Planning Organization (since 2013).

Mr. Walker is an effective leader with proven successful endeavors with the City of Midland and the Permian Basin Metropolitan Planning Organization as well as in non-work-related settings. He serves as a member of the Midland Chamber of Commerce. He also serves on the Permian Road Safety Coalition, an agency with direct connections to the oil and gas industry and the trucking industry. The coalition exists to educate and ultimately to improve road safety in the Permian Basin. He also served on the Ports-to-Plains Advisory Committee

(I-27), the Border Trade Advisory Committee, the I-20 Corridor Committee, and a regional Freight Advisory Committee.

Mr. Walker is a professional urban and regional planner. He holds a bachelor's and master's degree from Texas A&M University. He is a member of the American Institute of Certified Planners.

CHRIS ASH, HILLWOOD

Chris Ash has been an integral part of the development and success of the Fort Worth Alliance Airport and Alliance Aviation Services fixed-base operator during the past 25 years, touching every aspect of the airport operating companies. Mr. Ash currently serves as senior vice president of aviation business development for Alliance Air Services and Alliance Aviation Services, a subsidiary of Hillwood, at the Fort Worth Alliance Airport.

Prior to joining Alliance Aviation Services, Mr. Ash was employed for three years at United Parcel Service in the aircraft division as an aircraft load master. A Texas native and graduate of Embry-Riddle Aeronautical University, he currently serves on the North Central Texas Council of Governments as a member of the North Texas Safety and Integration Task Force.

DAVID FIELDS, AICP, CITY OF HOUSTON

David Fields, AICP, is the City of Houston's first chief transportation planner. He believes a great community provides safe transportation choice for all. He is experienced planning and implementing multiple modes (walking, biking, heavy rail, light rail, on-street bus services, and transportation network companies), parking and curb management, and policy (transit-oriented development and transportation demand management)—all based on meaningful community participation. Current city initiatives include Vision Zero so that travel by all modes is safe across city streets, implementation of over 1,500 miles of high-comfort bike lanes, and conversion of the North Houston Highway Improvement Project into a project that supports the city's values and supports the local communities.

FRED UNDERWOOD, TRINITY COMPANY

Fred Underwood is president of the Trinity Company, a cotton bale storage facility in Lubbock, TX. He is past president of the Cotton Warehouse Association. He has also serviced as vice president and director of the National Cotton Council. As an aviation enthusiast, Mr. Underwood began flying in 1990. He is a commercial-rated pilot, commercial helicopter pilot, and commercial gyrocopter pilot and holds a fixed-wing instrument rating. He previously served as chairman of the Lubbock International Airport Board and as a board member of the Lubbock Chamber of Commerce, Mr. Underwood is a past member of the Texas Transportation Commission. He was first appointed to the Aviation Advisory Commission on February 23, 2017, and was reappointed on September 30, 2021. He lives in Lubbock, TX.

GUS KHANKARLI, PHD, PE, PMP, CLTD, CITY OF DALLAS

Dr. Ghassan "Gus" Khankarli currently serves as the director of the City of Dallas Department of Transportation. In his current position, he leads the department's multimodal strategic vision including the integration of transportation assets with emerging technology

needs. Dr. Khankarli has over 30 years of professional experience including 24 years in various capacity with TxDOT. He is a member of Transportation Research Board Standing Committees on Aviation Administration and Policy (AV 010) and Intermodal Freight Transport (AT 045), and serves on several North Central Texas Council of Governments committees. Dr. Khankarli holds a doctoral degree in public affairs from The University of Texas at Dallas, an MBA from the University of Dallas, a master of engineering and a bachelor of science in civil engineering from The University of Texas at Arlington. He is a licensed engineer and certified project management professional, and is certified in logistics, transportation, and distribution.

JASON JONMICHAEL, CITY OF AUSTIN

Jason JonMichael serves as an assistant director in Austin transportation where he oversees smart mobility, public-private partnerships, placemaking, mobility services, parking enterprise, and travel demand management. He leads a cross-functional team of community, mobility, technology, policy, data, and user experience specialists to deliver outcomes that improve mobility, safety, and access to Austin residents.

A national leader and subject matter expert in smart cities, Mr. JonMichael is also an executive board member and past chairman of OmniAir®, the global certification organization for vehicle communications; executive board member of the Global Autonomous Vehicle Partnership, advancing emerging and next-gen vehicle technologies; and president of the Austin Smart Cities Alliance, a local non-profit member-based organization of public, private, academic, and individual contributors.

JASON L. DAY, TEXAS DEPARTMENT OF PUBLIC SAFETY

Jason Day serves as the UAS Program Manager for the Texas Department of Public Safety. Mr. Day is a Navy Veteran with 24 years in military, civilian and public safety aviation and is regarded as a subject matter expert in the UAS community with an emphasis on public safety UAS operations and administration. Mr. Day developed, implemented and is lead instructor for the departments UAS Remote Pilot in Command training program. This training program was profiled in Airbeat Magazine and is used as a template for many federal, state and local public safety agencies. Mr. Day has assisted more than 35 public safety agencies to develop their UAS program.

Mr. Day is very active in the UAS community and has a strong working relationship with the Federal Aviation Administration. As a member of the Texas HB2340 Committee, Mr. Day has assisted in the development of policy, procedures and training standards for the use of UAS by public safety agencies in Texas during a disaster. Mr. Day is an UAS instructor for the Airborne Public Safety Association, works closely with the National Institute of Standards and Technology and is a member of the ASTM International Standards Committee on Homeland Security Applications; Response Robots (E54.09).

JEFF BILYEU, AAE, TEXAS GULF COAST REGIONAL AIRPORT (BRAZORIA COUNTY)

Jeff Bilyeu currently serves as the director of the Texas Gulf Coast Regional Airport in Brazoria County. He oversees a staff of 13 along with the day-to-day operations,

maintenance, and fixed-base operator functions of an FAR 139 certificated reliever airport for the Houston metropolitan area and Gulf Coast.

Mr. Bilyeu is a licensed flight instructor and commercial pilot with instrument and multi-engine ratings. He is an accredited airport executive and a past president of the South Central Chapter of the American Association of Airport Executives. He has served on the Board of Directors of the American Association of Airport Executives and remains active in both regional and national affairs including currently serving on the Policy Review Committee. Locally, he is involved and serves on airport and transportation committees with the various chambers and is a current chairman of the board for the Angleton Chamber of Commerce.

JEFF DECOUX, AUTONOMY INSTITUTE

Jeff DeCoux is the founder and chairman of the Autonomy Institute. The Autonomy Institute is a 501(c)(3) consortium of over 100 industry, government, and academia organizations. The core focus is accelerating the path to commerce for intelligent and autonomous infrastructure and autonomous systems. The Autonomy Institute is leading the deployment of the intelligent infrastructure that is the foundation for Industry 4.0 solutions. Industry 4.0 includes connected autonomous vehicles, UAS, and AAM. Past positions include founder/CEO of Hangar Technologies, Inc., eCustomers, Inc., SMART Technologies, Inc., and SMARTNAP. Mr. DeCoux has raised over $100 million for venture and business operations in Texas. He has over 30 years' experience within the high-tech industries where his attention has been focused on founding companies that enhance business productivity through automation.

Mr. DeCoux is the founder and chief executive officer of ATRIUS Industries, Inc. With the unprecedented advancement in autonomous robotics, ATRIUS was founded to leverage these new innovations to effect massive change across industry. ATRIUS is working with an ecosystem of partners to develop the highways and byways in order to support more efficient mobility, automated city services, autonomous cars and trucks, autonomous shuttles, air taxis, inspection drones, and many intelligent city applications. ATRIUS works with leading partners that focus on smart cities, autonomous systems, advanced wireless networks, radars, UTM, position-navigation-timing, and intelligent infrastructure supporting autonomy.

JIM PERSCHBACH, PORT SAN ANTONIO

Jim Perschbach joined Port San Antonio in 2014, leading a team that provides strategic support to grow advanced industries on the 1,900-acre technology innovation campus, including aerospace, cybersecurity, defense, manufacturing, and global trade. The port is one of South Texas' fastest-growing economic engines—home to over 80 tenant customers and their more than 16,000 employees, which generate a regional economic impact of over $5.6 billion annually. Previously, he worked as an attorney in private practice with one of the nation's largest law firms, where he counseled clients in sectors that include aerospace and advanced manufacturing.

In addition to his work at the port, Mr. Perschbach serves his community in other leadership roles. He is a past chair of both the San Antonio Chamber of Commerce's Aerospace

Committee and Alamo Colleges' Scobee Education Center/Challenger Learning Center. Currently, he serves on the boards of the United Way of San Antonio and Bexar County and Our Lady of the Lake University.

In 2018, Mr. Perschbach was appointed honorary commander of the 502nd Airbase Wing/Joint Base San Antonio. He has also been named by the *Business Journals* as one of the country's top 100 executives to watch in 2019. He holds an undergraduate degree in business administration from the George Washington University and earned his law degree from the University of Houston Law Center.

JOHN ACKERMAN, TEXAS COMMERCIAL AIRPORT ASSOCIATION AND DALLAS FORT WORTH INTERNATIONAL AIRPORT

John Ackerman serves as executive vice president of global strategy and development at the Dallas Fort Worth International Airport (DFW). He leads DFW's airline relations, cargo, aviation strategy and enterprise analytics, government relations, and quantitative pricing functions. Mr. Ackerman joined the DFW staff in January 2015. He directs DFW's efforts to raise the airport's global profile through international air service and business development. He helped develop the airport's strategic plan, which is focused on being the premier gateway between Asia and Latin America for both passengers and cargo.

Prior to DFW, he worked as Denver International Airport's chief commercial officer, was a pilot and executive at United Airlines, and was a senior director of product management at Standard and Poor's. Mr. Ackerman served as an active-duty officer and pilot in the U.S. Marine Corps and holds a Bachelor of Arts in economics from Duke University. He is active in the community and is a board member of the Society for the Prevention of Cruelty to Animals of Texas, Uptown Dallas, Inc., Visit Dallas, North Texas Commission, and Dallas Sports Commission, and serves on the Guest Experience Committee of the Dallas Zoo.

JOSH CRAWFORD, PE, GARVER

Josh Crawford is a vice president and the director of Texas aviation for Garver, leading a team of aviation professionals throughout the state. With nine years in the construction industry and 17 years of airport design and project management, his experience includes a multitude of improvements in the aviation industry for landside, airside, and terminal developments. As a licensed pilot, Mr. Crawford understands and incorporates a pilot's perspective into engineering designs, construction plans, and aviation planning documents. Other responsibilities include serving as Garver's aviation military resource, where he offers his expertise in designs for U.S. Army Corps of Engineers, Naval Facilities Engineering Command, and Air Force Civil Engineer Center projects. His approach to management and coordination with state aviation departments, FAA, and military agencies, as well as his assistance to clients for capital improvement planning, has proven to be a valuable resource for airport sponsors, assisting them in continuing growth and implementing improvements at their airports.

KEN PETERMAN, PARAGON VTOL

Ken Peterman is the founder and CEO of SpyGlass Group, an innovative thought-leading organization that has helped shape aerospace and defense strategic trajectories in the

tactical communications, mobile networking, cybersecurity, and satellite sectors since 2012. As a passionate, creative and forward-leaning leader in the global aerospace and defense market, he serves on a variety of boards and advisory groups.

A distinguished leader in aerospace and defense, Mr. Peterman has enjoyed successful executive leadership tenures at Viasat, ITT/Exelis, Rockwell Collins, and Raytheon. Broadly respected as a thought leader and innovator among U.S. and international senior leaders, he currently serves on a variety of boards and advisory groups. He received a Bachelor of Science in electrical engineering (high honors) from Tri-State University (now Trine) and completed executive programs at the Stanford University Graduate School of Business and Pennsylvania State University.

KEVIN RISTER, EXXONMOBIL

Kevin Rister is an aviation advisor with over 30 years of experience in the aviation industry. He currently holds a commercial airplane, helicopter, and UAV pilot's license.

In his position, he provides aviation consultation and oversight of operations to ensure compliance with the ExxonMobil *Aviation Operations Guide* and applicable local, state, and federal regulations. His area of responsibility includes all aviation operations in support of ExxonMobil in Texas.

Mr. Rister's specific areas of expertise include UAV programs, serving as the global ExxonMobil UAV subject matter expert, and helideck and heliport design and inspection.

KEVIN RUSSELL, CITY OF BRYAN

Kevin Russell has 30 years of municipal government experience. His current titles are director of development services, director of economic development, and airport director. His 30-year career in municipal government has been with the City of Bryan. In his current role, he has been involved in the recruitment of new industries, has helped current businesses expand, has promoted the orderly development of the city, and has recently administered over $12,000,000 of investment in the City of Bryan's general aviation airport, Coulter Airfield. Mr. Russell attends the TxDOT Aviation Conference annually and works to continue to improve the city's airport infrastructure to allow this asset to have a greater impact as a gateway into the city.

Mr. Russell attended Sam Houston State University where he earned a B.S. in agriculture economics. He is currently or has been a member of the International Economic Development Council, International Council of Shopping Centers, American Planning Association, Harvey Little League Board of Directors, Salvation Army Advisory Board, Junior League Community Advisor, and Texas Economic Development Association.

KIMBERLY WILLIAMS, METROPOLITAN TRANSIT AUTHORITY OF HARRIS COUNTY

Kimberly J. Williams heads up the Office of Innovation for the Metropolitan Transit Authority of Harris County in Houston, TX. Ms. Williams led implementation of Houston's first AV shuttle service and deployed public-private partnerships to begin Wi-Fi on transit and microtransit service. She chairs Team Houston of the Texas Innovation Alliance, a collaboration of the region and state's mobility stakeholders. She is also a member of the

City of Houston's Rapid Mobility Working Group, Smart City Advisory Council, and Resiliency Council. Active in the Houston innovation community, she is a member of the Density and Inclusion Working Group of Houston Exponential, Houston's innovation non-profit, and the Greater Houston Partnership's Innovation Corridor Committee.

Ms. Williams is active in the industry as a member of the American Public Transit Association's (APTA's) Board of Directors and co-chair of the Procurement and Supply Chain Committee, its Strategic Planning Steering Committee, Automated and Connected Vehicles Committee, and the Innovation Officer Peer Exchange Group. She is also a graduate of Leadership APTA, ENO's Senior Transit Executive Program, and Transportation for America's Smart City Program. Ms. Williams is a graduate of Howard University and Wayne State Law School, where she served as survey editor of the *Wayne Law Review*. She is a proud volleyball mom to daughter, MacKenzie.

MARUTHI R. AKELLA, THE UNIVERSITY OF TEXAS AT AUSTIN

Maruthi Akella is the founding director for the Center for Autonomous Air Mobility and the faculty lead for the control, autonomy, and robotics area within the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. His research program encompasses coordinated control aerospace systems, adaptation and physics-based learning, guidance for hypersonic vehicles, and computationally lightweight vision-based sensing solutions. For his high-impact research contributions, he was recognized by the American Institute of Aeronautics and Astronautics (AIAA) Mechanics and Control of Flight Award, the American Astronautical Society (AAS) Dirk Brouwer Award, the Institute of Electrical and Electronics Engineers (IEEE) Control Systems Society (CSS) Award for Technical Excellence in Aerospace Control, and the IEEE Judith A. Resnik Space Award. He is currently editor in chief of the *Journal of the Astronautical Sciences* and serves on the AAS Board of Directors. He is a fellow of IEEE, AIAA, and AAS, and was elected to the rank of academician with the International Academy of Astronautics.

MICHAEL HILL, VOLATUS AEROSPACE

Michael Hill is an FAA Part 107 pilot, accumulating over 2900 hours of flight time, within 4200 incident-free missions. As the director of unmanned operations for the Texas Wing of the Civil Air Patrol, he has become a certified search and rescue drone pilot, having flown over 300 search-and-rescue exercise missions throughout the United States. Serving as an uncrewed aviation consultant to organizations on integrating AAM vehicles into their respective industries, he has helped develop a training curriculum for workforce development within several organizations and school districts around the country. He regularly speaks at community and industry events on the advancements of AAM.

Mr. Hill volunteer work includes serving as the chairperson for the North Central Texas UAS Taskforce Legislative and Policy Committee, as well as a sitting member of both the Texas HB 2340 Public Safety UAS committee and the Texas SB763 AAM Committee. In these roles, he works to engage politicians, government officials, and large businesses, helps to develop UAS and AAM policies and procedures, and helps change these regulations in Texas. He is part of the leadership team for the North Texas Public Safety Unmanned Response Team. He volunteered as the team's training officer to help in establishing an organizational presence, which included offering his experience to help fire departments,

law enforcement, and emergency management teams on any number of tasks from event surveillance to flight trainings.

MICHAEL SANDERS, LONE STAR UAS CENTER OF EXCELLENCE AND INNOVATION

Since 2018, Mike Sanders has served as the executive director of Texas A&M University–Corpus Christi's LSUASC. LSUASC is a Texas A&M University System Board of Regents–designated Center of Excellence and is one of seven FAA UAS test sites. Mr. Sanders leads LSUASC's effort to advance the integration of UAS and autonomous aviation technologies across educational, public, and commercial agency interests while informing governing agencies on UAS and autonomous aviation operations in the national airspace system. Prior to joining the staff at Texas A&M University-Corpus Christi, Mr. Sanders served as an infantry and simulation operations officer in the U.S. Army for 30 years in a variety of command and leadership positions. He holds a bachelor's degree in history and Master of Science degrees in administration, industrial engineering (interactive simulation and training systems), and strategic studies.

NATHAN TRAIL, SUPERNAL, HYUNDAI MOTOR GROUP

Nathan Trail is the director of international state and local policy at Supernal, which is the advanced air mobility subsidiary of Hyundai Motor Group. He is responsible for working with international, state, and local legislators, regulators, community stakeholders to develop policies and regulations that will foster the AAM industry and drive public acceptance. He serves as an industry resource and expert for the AAM industry to governments and lawmakers throughout the United States and internationally.

Mr. Trail previously served as the director of technology policy and state legislative affairs at the Consumer Technology Association (CTA), North America's largest technology trade association. During his time at CTA, he grew the association's state and local government affairs presence and managed a portfolio of policy issues including UAS, sharing economy, micromobility, blockchain, and fintech.

Mr. Trail has testified on behalf of the technology industry in over 30 state legislatures and municipalities and frequently speaks at industry panels and events. He has also authored op-eds for legislative publications for some of the leading state and local policy organizations in the country. He holds a B.A. in government and politics from the University of Maryland in College Park, MD.

NICK DEVEREUX, WING

Nick Devereux joined Wing in 2019 as manager of policy and government affairs, where he focuses on U.S. policy on the federal, state, and local levels. He leads Wing's work on congressional relations and advocacy, and coordinates Wing policy and government relations work across numerous states. Upon initially joining Wing, he led state, local, and community engagement efforts leading up to Wing's launch of service in Christiansburg, VA—the first on-demand residential drone package delivery service in the United States.

Prior to Wing, Mr. Devereux spent 10 years on Capitol Hill, serving as legislative counsel and senior policy advisor to U.S. Sen. Mark R. Warner. In that capacity, he covered a broad portfolio of issues including judiciary, labor, transportation/infrastructure, and NASA policy,

and developed major legislative initiatives ranging from infrastructure financing to accelerating drone/UAS integration to reestablishing American leadership in aeronautics research. He received a B.A. from Johns Hopkins University in Baltimore, MD, and a J.D. from Washington and Lee University School of Law in Lexington, VA.

NIRAV VED, CAPITAL AREA METROPOLITAN PLANNING ORGANIZATION

Nirav Ved is the Capital Area Metropolitan Planning Organization's program manager for data and operations. In this capacity, Mr. Ved's responsibilities include systems and transportation network operations. He is also responsible for the Capital Area Metropolitan Planning Organization's safety initiatives and Congestion Management Program. Mr. Ved is being nominated as the regional representative for the Central Texas area.

APPENDIX A: LEGISLATION CREATING THE ADVISORY COMMITTEE

S.B. No. 763

AN ACT

relating to the creation of the urban air mobility advisory committee.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. Subchapter A, Chapter 21, Transportation Code, is amended by adding Section 21.004 to read as follows:

Sec. 21.004. URBAN AIR MOBILITY ADVISORY COMMITTEE. (a) The commission shall appoint an advisory committee to assess current state law and any potential changes to state law that are needed to facilitate the development of urban air mobility operations and infrastructure in this state.

(b) The commission shall appoint to the advisory committee members to represent:

(1) diverse geographic regions of the state;

(2) state and local law enforcement;

(3) the urban air mobility industry;

(4) transportation experts;

(5) commercial airport representatives;

(6) vertical takeoff and landing operators;

(7) local governments; and

(8) the general public.

(c) The advisory committee shall:

(1) hold public hearings in locations across the state or via electronic means; and

(2) receive comments through an Internet website, by mail, and by other methods, if appropriate.

(d) Not later than September 1, 2022, the advisory committee shall report to the commission and to the members of the legislature the committee's findings and recommendations on any changes to state law that are needed to facilitate the development of urban air mobility operations and infrastructure.

(e) The advisory committee is abolished and this section expires January 1, 2023.

SECTION 2. This Act takes effect immediately if it receives a vote of two-thirds of all the members elected to each house, as provided by Section 39, Article III, Texas Constitution. If this Act does not receive the vote necessary for immediate effect, this Act takes effect September 1, 2021.

_____ _____

President of the Senate Speaker of the House

I hereby certify that S.B. No. 763 passed the Senate on April 20, 2021, by the following vote: Yeas 30, Nays 1; and that the Senate concurred in House amendment on May 27, 2021, by the following vote: Yeas 29, Nays 2.

_____
Secretary of the Senate

I hereby certify that S.B. No. 763 passed the House, with amendment, on May 11, 2021, by the following vote: Yeas 110, Nays 33, two present not voting.

_____
Chief Clerk of the House

Approved:

_____
Date

_____
Governor

APPENDIX B: UAS STATE LEGISLATION

For the last several years, legislation concerning unmanned aircraft systems (UASs), or drones, has been introduced in different states. Even more recently, decisions on advanced air mobility bills have been approved that could encourage other states to enact similar laws. The following set of tables describe states that enacted and updated UAS legislation. For more information, please see the National Conference of State Legislatures' Current Unmanned Aircraft State Law Landscape (*19*).

In 2013, 12 states enacted laws or created resolutions to define and restrict certain activities related to unmanned aerial vehicles.

Table 2. Legislation by Other States: 2013.

Year	State	Bill	Title
2013	Idaho	SB 1134	An Act relating to Aeronautics; to Define a Term, to Establish Provisions Relating to Restrictions on the Use of Unmanned Aircraft Systems, to Provide Exceptions, to Provide for a Civil Cause of Action, to Provide for Certain Damages and to Provide that an Owner of Certain Facilities Shall Not Be Prohibited from Using and Unmanned Aircraft System to Inspect Such Facilities
2013	Illinois	HB 1652	An Act Concerning Wildlife
2013	Illinois	SB 1587	An Act Concerning Criminal Law
2013	Indiana	SR 27	Study committee on unmanned aerial vehicles.
2013	Maryland	HB 100	An Act concerning Budget Bill
2013	Montana	SB 196	An Act limiting the use of Unmanned Aerial Vehicles by law enforcement; and prohibiting the use of unlawfully obtained information as evidence in court
2013	Nevada	AB 507	An Act relating to state financial administration
2013	North Carolina	SB 402	An act to make base budget appropriations for current operations of state departments, institutions, and agencies, and for other purposes
2013	North Dakota	SB 2018	An Act to provide an appropriation for defraying the expenses of the department of commerce
2013	Oregon	HB 2710	An Act relating to drones; and declaring an emergency
2013	Pennsylvania	HR 172	A resolution beseeching the United States Department of Defense to reconsider the order of precedence for the newly created Distinguished Warfare Medal
2013	Tennessee	SB 796	An Act to amend Tennessee Code Annotated, Title 29 and Title 39, relative to surveillance
2013	Virginia	HB 2012 SB 1331	Drones; moratorium on use of unmanned aircraft systems by state or local government department, etc.

Ten states created legislation in 2014 to further define law enforcement uses or other prohibitions against unmanned aircraft operations. The states also began creating criminal offenses for certain conduct.

Table 3. Legislation by Other States: 2014.

Year	State	Bill	Title
2014	Alaska	HB 255	An Act relating to unmanned aircraft systems; and relating to images captured by an unmanned aircraft system
2014	Alaska	HCR 15	Relating to the task force on Unmanned Aircraft Systems
2014	Illinois	SB 2937	An Act concerning criminal law
2014	Indiana	HB 1009	Surveillance and privacy
2014	Iowa	HF 2289	An Act relating to the regulation and use of Unmanned Ariel Vehicles
2014	Louisiana	HB 1029	An Act to enact R.S. 14:336 and 337, relative to offenses against the public; to create the crimes of unlawful aiming of a laser at an aircraft and unlawful use of an unmanned aircraft system
2014	North Carolina	SB 744	An Act to make base budget appropriations for current operations of state departments, institutions, and agencies, and for other purposes.
2014	Ohio	HB 292	An Act to enact section 122.98 of the Revised Code to create the Ohio Aerospace and Aviation Technology Committee.
2014	Tennessee	SB 1777	An Act to amend Tennessee Code Annotated, Title 70, Chapter 4, Part 3, relative to hunter protection
2014	Tennessee	SB 1892	An Act to amend Tennessee Code Annotated, Title 29, and Title 39, relative to the protection of privacy
2014	Utah	SB 167	Establishes provisions for the appropriate use of an unmanned aerial vehicle
2014	Wisconsin	SB 196	An Act to amend 114.04; and to create 175.55, 941.10 and 972.113 of the statutes; Relating to: restricting the use of drones and providing a penalty

2015 saw the expansion of state authority to institute prohibitions and use parameters for unmanned aircraft.

Table 4. Legislation by Other States: 2015.

Year	State	Bill	Title
2015	Nevada	AB 239	Regulates operators of unmanned aerial vehicles in this State
2015	New Hampshire	SB 222	An Act relative to harassment of hunting, fishing, or trapping
2015	North Carolina	SB 446	Clarify that agents or agencies of the State or political subdivision of the State shall have authority to procure and operate unmanned aircraft systems upon approval of the State Chief Information Officer and to modify the regulation of Unmanned Aircraft Systems to conform to FAA Guidelines
2015	North Dakota	HB 1328	An Act to provide for limitations on the use of unmanned aerial vehicle for surveillance
2015	Oregon	HB 2354	An Act relating to unmanned aerial systems
2015	Oregon	HB 2534	Relating to the regulation of drones by the State Fish and Wildlife Commission

2015	Tennessee	HB 153	An Act to amend Tennessee Code Annotated, Title 39, relative to criminal offenses
2015	Utah	HB 296	Government use of Unmanned Aerial Vehicles.
2015	Virginia	HB 2125 SB 1301	An Act to amend the Code of Virginia by adding in Chapter 5 of *Title 19.2* a section numbered 19.2-60.1, relating to use of unmanned aircraft systems by public bodies; search warrant required. Unmanned aircraft systems; use by public bodies during execution of a search warrant, exception.
2015	West Virginia	HB 2515	Relating to elk restoration

In 2016, there was an uptick in states enacting unmanned aircraft legislation. Twenty states passed 32 bills or resolutions. As time progresses, the legislation becomes more specific with bills specifying law enforcement activities, flights over correctional facilities, emergency management related to wildfires, and other more granular issues.

Table 5. Legislation by Other States: 2016.

Year	State	Bill	Title
2016	Alaska	AB 1680	An act making appropriations for the operating and loan program expenses of state government and for certain programs
2016	Arizona	SB 807	Unlawful operation of model or unmanned aircraft; state preemption; classification; definitions
2016	California	HB 195	An act to amend Section 402 of the Penal Code, relating to crimes
2016	California	Executive Order	An act to add Section 43.101 to the Civil Code, and to add Chapter 4.5 (commencing with Section 853) to Part 2 of Division 3.6 of Title 1 of the Government Code, relating to unmanned aircraft systems
2016	Delaware	SB 1213	An act to amend Title 11 of the Delaware code relating to Unmanned Aircraft Systems
2016	Georgia	HB 5808	That a Commission on Unmanned Aircraft Technology appointed by the Governor is hereby created to make state-level recommendations to the Governor consistent with current FAA regulations as well as the State's business and public safety interests
2016	Idaho	HB 1013	An Act relating to fish and game; amending section 36-1101, Idaho Code, to prohibit the use of Unmanned Aircraft Systems for hunting, molesting or locating game animals, game birds and furbearing animals
2016	Illinois	HB 1246	The Unmanned Aerial System Oversight Task Force Act is amended by changing Sections 15 and 20
2016	Indiana	SB 319	An Act to amend the Indiana Code concerning criminal law and procedure
2016	Indiana	SB 249	An Act to amend the Indiana Code Concerning criminal law and procedure

Year	State	Bill	Title
2016	Kansas	HB 335	An Act concerning civil procedure; enacting the public speech protection act; relating to habeas corpus; the protection from stalking act; venue under the small claims procedure act
2016	Kansas	SB 73	An Act making and concerning appropriations for fiscal years ending June 30, 2016, June 30, 2017, and June 30, 2018, for state agencies
2016	Louisiana	HB 635	An Act to amend and reenact R.S. 3:43(A)(2) and to enact R.S. 3:48, relative to fees for unmanned aerial systems; to establish a registration fee for unmanned aerial systems; to establish an agricultural education and safety training course fee for operators of unmanned aerial systems; and to provide for related matters
2016	Louisiana	HB 19	An Act to enact R.S. 14:108(B)(1)(e), relative to the crime of resisting an officer; to add the knowing interference with a police cordon to the definition of "obstruction of" an officer; to provide additional definitions; and to provide for related matters
2016	Louisiana	SB 141	An Act to amend and reenact R.S. 14:283(A)(1), 283.1(A), and 284(B) and to enact R.S. 14:283(G), 283.1(C), and 284(D), relative to crimes affecting public morals; to amend crimes involving the observation and invasion of privacy of another to include the use of unmanned aircraft systems; to define unmanned aircraft systems; and to provide for related matters
2016	Louisiana	SB 992	An Act to amend and reenact R.S. 14:337(A), (D), and (E) and to enact R.S. 14:337(B)(3)(d) and (4)(e), relative to unlawful use of an unmanned aircraft system
2016	Louisiana	Executive Order	An Act to amend and reenact R.S. 14:63(B) and (C) and 337(D), relative to crimes involving unmanned aircraft systems
2016	Michigan	HB 2599	An Act to provide for the operation and regulation of unmanned aircraft systems in this state
2016	North Dakota	HB 4066	Amends UAS Test Site Authority
2016	Oklahoma	SB 5702	An Act relating to unmanned aircraft; defining terms; prohibiting operation of an unmanned aircraft over a critical infrastructure facility; excepting conduct of specified entities or persons; prescribing punishment for violation; providing for codification; and providing an effective date.
2016	Oregon	HB 7511 SB 3099	An Act relating to unmanned aircraft systems; creating new provisions
2016	Oregon	HB 2376	Relating to state financial administration; and declaring an emergency.
2016	Rhode Island	SB 2106	Unpiloted Aerial Vehicle Regulation. Relating to aeronautics – unpiloted aerial vehicle regulation
2016	Tennessee	HB 126	An Act to amend Tennessee Code Annotated, Title 39, Chapter 13, relative to unmanned aircraft
2016	Tennessee	HB 3003	An Act to amend Tennessee Code Annotated, Title 39 and Title 40, relative to criminal offenses

Year	State	Bill	Title
2016	Utah	SB 155	Unmanned Aircraft Revisions
2016	Utah	HB 29, HB 30	Unmanned Aircraft Amendments
2016	Vermont	HB 412	An Act relating to privacy protection and a code of administrative rules
2016	Virginia	SB 670	Budget Bill
2016	Virginia	SB 338	An Act to amend the Code of Virginia by adding in Article 1 of chapter 9 of Title 15.2 a section numbered 15.2-926.3, relating to local regulation of certain aircraft
2016	Wisconsin	AB 1680	An Act to amend 114.04; and to create 114.045 of the statutes; relating to: the operation of drones over correctional institutions and providing a penalty
2016	Wisconsin	SB 807	An Act relating to: interfering with hunting, fishing, and trapping and providing criminal penalties

The trend continues into 2017 with 19 states enacting 24 bills or resolutions.

Table 6. Legislation by Other States: 2017.

Year	State	Bill	Title
2017	Alaska	SCR 4	Relating to the Task Force on Unmanned Aircraft Systems
2017	Colorado	HB 1070	Concerning the use of unmanned aircraft systems to perform government functions relating to certain public-safety functions, and, in connection therewith, requiring the center of excellence within the department of public safety to perform a study and operate a pilot program
2017	Connecticut	SB 975	An Act concerning municipalities and unmanned aircraft
2017	Florida	HB 1027	Unmanned Devices
2017	Georgia	HB 481	An Act to amend Chapter 1 of Title 6 of the Official Code of Georgia Annotated, relating to general provisions regarding aviation, so as to provide for preemption for unmanned aircraft systems
2017	Indiana	SB 299	An Act to amend the Indiana Code concerning criminal laws and procedure
2017	Kentucky	HB 540	An Act relating to aviation safety
2017	Louisiana	SB 69	An Act to enact R.S. 2:2, relative to unmanned aircraft
2017	Minnesota	SF 550	An Act relating to natural resources
2017	Montana	HB 644	An Act revising laws relating to wildfires and unmanned aerial vehicle systems
2017	Nevada	AB 11	An Act relating to unmanned aerial vehicles
2017	New Jersey	SB 3370	An Act concerning the operation of unmanned aircraft systems and amending and supplementing various parts of the statutory law
2017	North Carolina	HB 337	An Act to make various revisions to the laws governing the use of Unmanned Aircraft Systems

Year	State	Bill	Title
2017	North Carolina	HB 128	An Act to prohibit the use of an Unmanned Aircraft System near a local confinement facility or state or federal correctional facility
2017	North Dakota	SCR 4014	A concurrent resolution supporting the development of the unmanned aircraft systems industry in North Dakota and throughout the United States, congratulating the Federal Aviation Administration on the first Beyond Visual Line of Sight Certificate of Authorization in the United States, and encouraging further cooperation with the Federal Aviation Administration to safely integrate unmanned aircraft systems into the national airspace
2017	Oregon	HB 3047	An Act elating to unmanned aircraft systems; and declaring an emergency
2017	South Dakota	SB 80	Regulate the use of drones under certain conditions and to provide a penalty therefor
2017	South Dakota	SB 22	An Act to exempt certain unmanned aircraft systems from the requirement to be registered as aircraft
2017	Utah	HCR 21	Concurrent resolution encouraging NASA to consider Tooele County for a test facility
2017	Utah	SB 111	Unmanned Aircraft Amendments
2017	Utah	HB 217	Livestock Harassment
2017	Virginia	SB 873	An Act to amend and reenact § 27-15.1 of the Code of Virginia, relating to the authority of a fire chief over unmanned aircraft at a fire, explosion, or other hazardous situation
2017	Virginia	HB 2350	An Act to amend the Code of Virginia by adding a section numbered 18.2-130.1, relating to use of electronic device to trespass; peeping into dwelling or occupied building; penalty
2017	Wyoming	SF 170	An Act relating to aeronautics; authorizing the Wyoming aeronautics commission to promulgate rules related to unmanned aircraft

Both Michigan and Virginia passed several laws in 2018 related to unmanned aircraft operations. Additionally, several states new to UAS legislation enacted bills either defining terms or creating limitations.

Table 7. Legislation by Other States: 2018.

Year	State	Bill	Title
2018	Arizona	2018 Ariz. Laws, Ch. 116	Amending section 26-314, Arizona Revised Statutes; Relating to Emergency Management
2018	California	2018 Cal. Stats., Ch. 333	Unmanned aircraft systems: correctional facilities
2018	Colorado	2018 Colo., Sess. Laws, Ch. 385	Concerning prohibiting the use of unmanned aircraft systems to obstruct public safety operations.
2018	Delaware	2018 Del. Laws, Ch. 264	An Act to amend title 11 of the Delaware code relating to unmanned aircraft systems
2018	Kansas	2018 Kansas SR 1759	A resolution urging the Federal Aviation Administration to accept Kansas' application for the

Year	State	Bill	Title
			Unmanned Aerial Systems Integration Pilot Program.
2018	Kentucky	2018 Ky. Acts, Ch.26	An Act relating to public safety
2018	Kentucky	2018 Ky. Acts, Ch.168	An Act relating to trespass
2018	Louisiana	La. Acts 2018, 630	An Act to amend and reenact R.S. 14:283(A)(1) and to enact R.S. 14:283(H), relative to offenses affecting public morals; to provide relative to the crimes of video voyeurism; and to provide for related matters
2018	Michigan	2018 Mich. Pub. Acts, Act 444	An Act to provide for the operation and regulation of unmanned aircraft systems in this state; to create the unmanned aircraft systems task force; to provide for the powers and duties of state and local governmental officers and entities; and to prohibit conduct related to the operation of unmanned aircraft systems and prescribe penalties
2018	Michigan	2018 Mich. Pub. Acts, Act 468	An Act to provide for the operation and regulation of unmanned aircraft systems in this state; to create the unmanned aircraft systems task force; to provide for the powers and duties of state and local governmental officers and entities; and to prohibit conduct related to the operation of unmanned aircraft systems and prescribe penalties
2018	Michigan	2018 Mich. Pub. Acts, Act 445	An Act to revise, consolidate, and codify the laws relating to criminal procedure and to define the jurisdiction, powers, and duties of courts, judges, and other officers of the court under the provisions of this act
2018	Michigan	2018 Mich. Pub. Acts, Act 469	An Act to revise, consolidate, and codify the laws relating to criminal procedure and to define the jurisdiction, powers, and duties of courts, judges, and other officers of the court under the provisions of this act
2018	New Jersey	2018 N.J. AR 29	Urges Congress and President to fund FAA Drone Test Site Program
2018	Oregon	2018 Or. Laws, Ch. 120	Relating to public safety; creating new provisions
2018	Pennsylvania	2018 Pa. Laws, Act 78	Unlawful use of unmanned aircraft and prohibiting local regulation of unmanned aircraft
2018	South Carolina	2018 S.C. Acts, Act 184	Drones, unlawful operation at corrections and local detention facilities
2018	South Dakota	2018 S.D. Sess. Laws, Ch. 269	An Act to revise certain provisions regarding aviation
2018	Tennessee	2018 Tenn. Pub. Acts, Ch. 970	An Act to amend Tennessee Code Annotated, Title 39 and Title 40, relative to unmanned aircraft
2018	Utah	2018 Utah Laws, Ch. 40	This bill prohibits certain operations of an unmanned aircraft system related to correctional facilities

Year	State	Bill	Title
2018	Vermont	2018 Vt. Acts, Act 101	An Act relating to prohibiting the use of drones near correctional facilities
2018	Virginia	2018 Va. Acts, Ch. 654	An Act to amend and reenact § 19.2-60.1 of the Code of Virginia, relating to use of unmanned aircraft systems by public bodies; search warrant required; exception
2018	Virginia	2018 Va. Acts, Ch. 2	An Act for all appropriations of the Budget
2018	Virginia	2018 Va. Acts, Ch. 851	An Act to amend and reenact § 15.2-926.3 of the Code of Virginia, to amend the Code of Virginia by adding a section numbered 18.2-121.3 and by adding in Article 8 of Chapter 7 of Title 18.2 a section numbered 18.2-324.2, and to repeal the second enactment of Chapter 451 of the Acts of Assembly of 2016, relating to trespass; unmanned aircraft system; penalty
2018	Virginia	2018 Va. Acts, Ch. 419	An Act to amend and reenact § 19.2-60.1 of the Code of Virginia, relating to use of unmanned aircraft by a locality; search warrant; exception
2018	Virginia	2018 Va. Acts, Ch. 546	An Act to amend and reenact § 19.2-60.1 of the Code of Virginia, relating to use of unmanned aircraft systems by public bodies; search warrant required; exception
2018	Virginia	2018 Va. Acts, Ch. 617	An Act to amend and reenact § 5.1-1 of the Code of Virginia, relating to the Department of Aviation; unmanned aircraft systems
2018	West Virginia	2018 W.Va. Acts, Ch. 61	An Act to amend the Code of West Virginia, 1931, as amended, by adding thereto a new article, designated §61-14-1 and §61-14-2, all relating to regulation of unmanned aircraft systems
2018	West Virginia	2018 W.Va. Acts, Ch. 168	Unlawful methods of hunting and fishing and other unlawful acts; Sunday hunting
2018	West Virginia	2018 W.Va. Acts, Ch. 175	Powers of the director with respect to the section of parks and recreation
2018	Wisconsin	2018 Wis. Laws, Act 322	An Act to renumber and amend 114.105; to amend 114.04 and 175.55 (1) (a); and to create 114.105 (1), 114.105 (3) and 114.105 (4) (b) of the statutes; relating to: the operation and regulation of unmanned aircraft and providing a penalty

Many of the bills enacted in 2019 created criminal offenses for violations to state laws regarding unmanned aircraft. Additionally, several states appropriated money to purchase UAS equipment or to study or continue UAS programs.

Table 8. Legislation by Other States: 2019.

Year	State	Bill	Title
2019	Alaska	2019 Alaska Sess. Laws, Ch. 2	An Act making a special appropriation from the earnings reserve account for the payment of permanent fund dividends; and providing for an effective date
2019	Arkansas	2019 Ark. Acts, Act 508	An Act concerning the offense of unlawful use of an unmanned aircraft system; to amend the definitions of "critical infrastructure" and "unmanned aircraft system"; and for other purposes.
2019	Arkansas	2019 Ark. Acts, Act 1000	An Act concerning the offense of unlawful use of an unmanned aircraft system; to amend the definition of "critical infrastructure"; and for other purposes
2019	California	2019 Cal. Stats., Ch. 749	An Act to amend Section 647 of the Penal Code, relating to privacy
2019	Delaware	Vol. 82, Del. Laws, Ch. 190	An Act to amend title 11 of the Delaware code relating to unmanned aircraft systems
2019	Georgia	2019 Ga. Laws, Ch. 67	Correctional Institutions of the State and Counties; use of unmanned aircraft systems to deliver or attempt to deliver contraband to a place of incarceration; prohibit
2019	Hawaii	2019 Hawaii Sess. Laws, Act 248	A bill for an Act relating to fireworks
2019	Indiana	2019 Ind. Acts, P.L. 136	An Act to amend the Indiana code concerning criminal law and procedure
2019	Kentucky	2019 Ky. Acts, Ch.61	An Act relating to drones
2019	Michigan	2019 Mich. Pub. Acts, Ch. 32	An Act to amend 2016 PA 436, entitled “An act to provide for the operation and regulation of unmanned aircraft systems in this state”
2019	Montana	2019 Mont. Laws, Ch. 178	An Act allowing information collected by an unmanned aerial vehicle investigating a motor vehicle crash scene to be admitted into evidence or used to obtain search warrants
2019	Nevada	2019 Nev. Stats., Ch. 551	An Act relating to aeronautics; requiring the establishment and carrying out of a program relating to certain unmanned aircraft systems; making an appropriation; and providing other matters properly relating thereto
2019	New Jersey	2019 N.J. Laws, Ch. 153	An Act concerning medical cannabis, revising various parts of the statutory law, and supplementing P.L.2009, c.307
2019	New Jersey	2019 N.J. Laws, Ch. 150	An Act making appropriations for the support of the State Government and the several public 9 purposes for the fiscal year ending June 30, 2020 and regulating the disbursement thereof

Year	State	Bill	Title
2019	North Carolina	2019 N.C. Sess. Laws, Ch. 231	An Act, consistent with house bill 966 of the 2019 regular session, to enact a budget for the department of transportation, to make additional appropriations, transfers, and reductions to the department, and to make other modifications related to the operations of the department.
2019	Ohio	Vol. 10, 2019 Ohio Laws, HB 166	Creates FY 2020-2021 operating budget
2019	Oregon	2019 Or. Laws, Ch. 337	Relating to unmanned aircraft systems; creating new provisions; and amending ORS 837.360 and 837.374
2019	Tennessee	2019 Tenn. Pub. Acts, Ch. 40	An Act to amend Tennessee Code Annotated, Title 39, Chapter 13, relative to unmanned aircraft
2019	Tennessee	2019 Tenn. Pub. Acts, Ch. 60	An Act to amend Tennessee Code Annotated, Title 39, relative to unmanned aircraft
2019	Virginia	2019 Va. Acts, Ch. 781	An Act to amend and reenact § 19.2-60.1 of the Code of Virginia, relating to use of unmanned aircraft systems by law-enforcement officers; persons sought for arrest
2019	Virginia	2019 Va. Acts, Ch. 612	An Act to amend and reenact § 18.2-121.3 of the Code of Virginia, relating to trespass; unmanned aircraft system; penalty
2019	Washington	2019 Wash. Laws, Ch. 415	An Act relating to fiscal matters

By 2020, many states were refining and adding criminal offenses to their existing unmanned aircraft laws.

Table 9. Legislation by Other States: 2020.

Year	State	Bill	Title
2020	Florida	HB 5001	General Appropriations Act
2020	Florida	HB 659	Drones
2020	Idaho	HB 486	An Act relating to restrictions on the use of unmanned aircraft systems
2020	Massachusetts	HB 5164	An Act making appropriations for the fiscal year 2021 for the maintenance of the departments, boards, commissions, institutions and certain activities of the commonwealth, for interest, sinking fund and serial bond requirements and for certain permanent improvements
2020	Minnesota	SF 3072	Use of Unmanned Aerial Vehicles
2020	Minnesota	SF 3258	Unmanned Aerial Vehicle Prohibition
2020	Minnesota	HB 1963	Modifies provisions relating to Transportation
2020	South Dakota	HB 1059	Revise certain provisions regarding hunting with drones
2020	South Dakota	HB 1065	Revise drone surveillance protections

Year	State	Bill	Title
2020	South Dakota	SB 124	An Act relating to governmental structures protecting the public health, safety and welfare
2020	Virginia	HB 30	Budget bill
2020	Virginia	HB 742	Unmanned aircraft; political subdivision may regulate take-off and landing of system, etc.
2020	Virginia	HB 1017	Commonwealth of Virginia Innovation Partnership Authority; created

By 2021 and 2022, legislation related to advanced air mobility was introduced.

Table 10. Legislation by Other States: 2021 and 2022.

Year	State	Bill	Title
2021	Florida	SB 44	Use of Drones by Government Agencies
2022	Michigan	SB 795	A bill to amend 1945 PA 327, entitled "Aeronautics code of the state of Michigan," (MCL 259.1 to 259.208) by adding section 207.
2022	Michigan	SB 796	A bill to amend 1945 PA 327, entitled "Aeronautics code of the state of Michigan," (MCL 259.1 to 259.208) by adding section 206a
2022	Utah	72-14-103	Preemption of local ordinance
2022	Utah	SB-0122	Unmanned Aircraft Amendments
2022	West Virginia	HB 4667	Use of Unmanned Aircraft Systems
2022	West Virginia	HB 4827	Promoting Public-Use Vertiports Act

APPENDIX C: PUBLIC COMMENT

As noted in the report, the primary charge and focus of the committee was to develop the recommendations found in the Key Areas in Urban Mobility section of this report. The report was put out for public comment from July 7 to July 14, 2022, and, recognizing some members of the committee and/or members of the public may hold individual, differing opinions from that of the report, all public input provided during the public comment period is included in this appendix. These public comments are not part of the Recommendations and Report as voted out by the Urban Air Mobility Advisory Committee but may reflect the separate opinions of members of the committee and or the public. The comments detailed in this appendix were based on a previous draft of the report. The final report takes these comments into account.

Comments of the UAS and AAM industries on Texas Transportation Commission Advisory Committee Report and Recommendations

General comments

The UAS and AAM industries offer extensive safety, sustainability, economic, and other benefits of these technologies. We are pleased that the Texas Transportation Commission has recognized these benefits, and we are grateful for the opportunity to work with the state to be a leader in these technologies for the benefit of its constituents. While some of our members participated in the Advisory Committee, we do not believe that the draft Report and Recommendations (the "Report") reflects a consensus view of the Committee. Over the course of the past year, those members have explained in detail their concerns with the perspective voiced by some Committee members of a restrictive view of FAA's regulatory authority and the suggestion – in our view, wholly erroneous – that property owners maintain rights in the airspace above their land that allows them to exclude or prevent aircraft overflight. We had hoped that the Report would reflect these concerns and would set out a narrative and framework on which the full Advisory Committee could agree.

Instead, the Report recites several positions that are at best controversial interpretations of disputed areas of law and at worse flatly inaccurate statements. We therefore provide the following comments on the Report, with the hope that the final Report can still be amended to reflect a consensus view of the entire Advisory Committee.

Our main concern is with the analysis on pages 11-12 entitled "Regulatory Overview." As set forth below, this analysis is replete with imprecise and, in some cases incorrect, statements of the law and, as such, would require a substantial overhaul at a minimum to address these fundamental flaws. This Regulatory Overview is also superfluous and beyond the scope of the Committee's charge under its enabling legislation to assess current Texas law and whether there is any need to change Texas law. The Regulatory Overview injects the Advisory Committee into a debate about the scope of airspace regulation on which it simply need not take a position. Because this section is not necessary as a basis for the rest of the Report and Recommendations, we believe that the simplest way to mitigate our concerns is to delete this section of the Report in its entirety. If staff believes that the final Report must contain a Regulatory Overview section, we urge that changes be made to address the following issues.

Specific comments on Regulatory Overview

The Regulatory Overview repeatedly employs the concept of "surface airspace," a term that appears to have been very recently coined by certain property rights activists based on outdated court decisions from a century or more ago, long before enactment of the Federal Aviation Act of 1958. The term betrays a bias in favor of a state and local police power role over navigable airspace, a role that does not exist under our constitutional system, in which Congress has vested the Federal Aviation Administration ("FAA") with exclusive authority over navigable airspace. Because there is no actual legal concept of "surface airspace," this term should be removed from the Report.

The Regulatory Overview should also be removed because portions appear to be taken nearly verbatim from a 2020 Mercatus Working Paper, without attribution to this paper. Moreover, statements in the Regulatory Overview are contradicted by statements in other portions of the Report.

The first paragraph (page 11) claims that the "biggest legal question seems to be who has authority to regulate" and that "Congress has not clarified the division between federal and state roles regarding airspace issued [sic]." Neither

proposition is correct. In fact, Congress has very clearly delineated federal and state roles regarding airspace issues. The Report (page 11) recognizes that Congress has granted the federal government exclusive sovereignty over U.S. airspace. As the Supreme Court put it in *Causby*, "the air is a public highway." *United States v. Causby*, 328 U.S. 256, 261 (1946). Congress has also given plenary authority to the FAA to define and regulate the navigable airspace, as the Report elsewhere acknowledges ("the FAA's full regulatory authority over the airspace") (page 28). "Navigable airspace" in the Federal Aviation Act includes not just the airspace above FAA-set minimum safe altitudes, but also any airspace necessary for takeoff and landing of aircraft, and the definition of "aircraft" includes UAS (or drones) and eVTOL aircraft.

Further, the FAA has been regulating the operations of UAS for more than a decade. In its Part 107 rule adopted in 2016, the FAA has clearly established that small UAS operations should—and, indeed, in nearly all circumstances *must*—take place below 400 feet above the ground, which of necessity means that the "navigable airspace" for small UAS is from 0 to 400 feet. *See* 14 C.F.R. § 107.51. Based on the foregoing, there is no state or local role in regulating aircraft operations in the navigable airspace, and thus there is no "division" of roles for Congress to clarify. *See* Report at 28.

The Regulatory Overview also incorrectly states at page 11 that the "federal government has not stated its legal position." The FAA's position was stated in its December 2015 Fact Sheet, *see* State and Local Regulation of Unmanned Aircraft Systems, (UAS) Fact Sheet, https://www.faa.gov/uas/resources/policy_library/media/UAS_Fact_Sheet_Final.pdf, and its Busting Myths document on its website: "The FAA is responsible for the safety of U.S. airspace from the ground up."

Simply put, state and local police powers are limited to designating landing and takeoff areas and protecting citizens from torts such as invasions of privacy, aerial trespass, and nuisance. They do not extend to regulating flight operations themselves.

While there have been proposals in Congress and by non-government organizations to create a line in the sky, below which state or local authorities would govern drone and eVTOL aircraft operations, these efforts have to date not been adopted and should not purport to reflect current law.

Indeed, while the first paragraph of the Regulatory Overview section refers to "influential law drafters" to include the Uniform Law Commission ("ULC") and the American Law Institute's ("ALI") draft "airspace trespass" provision, neither body has yet produced an operative text in this area. After studying the matter for two years, the ULC elected not to adopt a drone tort law and is currently not engaged on this matter. And while the ALI is in the process of drafting the Restatement (Fourth) of Property, the ALI's charter is to *restate* the law and not draft new law. The drone industry raised this very issue in opposing ALI's proposed "trespass-by-overflight" provision. At this point there is no clear indication of what the Restatement might say on this point when and if a draft is ultimately adopted. In any event, whatever the contours of an aerial trespass or trespass-by-overflight provision, the FAA's authority over aircraft operations in the navigable airspace is clear. Lastly, the citation links to an FAA page about Urban Air Mobility and Advanced Air Mobility; the cite is wrong and instead should likely reference the 2020 Mercatus Working Paper by Brent Skorup identified in note 14.

Furthermore, the preemption law discussion is muddled at best and suffers from several incorrect assertions. Rather than cite to a law review or state bar association article, the Report should cite solely to judicial precedent.

The Regulatory Overview also incorrectly states that the Supremacy Clause "requires that federal laws preempt any conflicting state or local regulations" (page 11). A federal law may permit a conflicting state or local regulation if that statute so provides. The Supremacy Clause declares that federal law is the supreme law of the land. It operates to invalidate state or local laws, not federal laws. It is not a command to Congress to enact preemption statutes. The sentence should be deleted.

The next sentence should be revised to state: "Congress does not need to explicitly state a purpose to preempt; a court may infer preemption from the federal law, in which case a court concludes that Congress has impliedly preempted state law."

It is also not correct that "[t]here are two types of preemption: Field preemption and Conflict preemption" (page 11). These are two types of *implied* preemption, as opposed to express preemption, where Congress uses express language to prohibit state and local regulation. In the aviation context, for example, Congress has expressly preempted a range of state and local powers in the Airline Deregulation

Act, which prohibits these governments from regulating prices, routes, and services of an air carrier providing air transportation.

Notably, the FAA explicitly referenced field preemption in its 2015 Fact Sheet when it explained that a "patchwork quilt" of differing state and local restrictions could hamper FAA flexibility in promoting safe and efficient air traffic flow. Fact Sheet at 2. The Report is too quick to dismiss the importance of field preemption in aviation safety, given the FAA's insistence that "[a] navigable airspace free from inconsistent state and local restrictions is essential to the maintenance of a safe and sound air transportation system." *Id.* (collecting cases). Quoting from the Supreme Court decision in *Arizona v. U.S.,* 567 U.S. 387, 401 (2012), the Fact Sheet stated "Where Congress occupies an entire field . . . even complementary state regulation is impermissible. Field preemption reflects a congressional decision to foreclose any state regulation in the area, even if it is parallel to federal standards." *Id.* at 2-3.

The statement (page 11) that conflict preemption "is when compliance with both state and federal regulations is impossible" is too narrow. Where compliance with both federal and state law is impossible, that indeed poses a conflict. But so-called "impossibility preemption" is only one type of conflict preemption. A conflict may also exist where a state law imposes an additional requirement than the federal law. For instance, a state may seek to require eVTOL aircraft to be equipped with ADS-B, even though the FAA has not so required. That would be a conflict, but it would not be impossible to comply with both federal and state law. A third type of conflict preemption is "obstacle" preemption, where the state or local law stands as an obstacle to the objects and purposes of federal law.

Moreover, the use of "regulations" in the text quoted above is underinclusive. Federal law preempts inconsistent state or local law no matter what form either takes. That is true whether the federal law is a provision in the federal Constitution, a federal statute, or a regulation.

The Report's statement that the court in *Singer v. City of Newton* "found that FAA explicitly contemplates state or local regulation of pilotless aircraft" (page 11) is taken out of context. The *Singer* court was referencing the FAA's 2015 Fact Sheet, which distinguishes "any regulation of the navigable airspace" from traditional police powers. If the final Report references *Singer,* it should explain that the court ultimately found that the city's drone ordinance *was* preempted, because its restrictions on drone use below 400 feet conflicted with federal law.

The next paragraph contains another general statement of preemption. This statement is an amalgam of express and implied preemption principles. It is largely duplicative of the preceding text, without classifying the preemption principles as a court decision would do. It would be preferable to quote from a court decision rather than a secondary source. The first category, "(1) Congress expresses a clear intent to preempt state law[,]" may be intended to describe "express preemption," although that doctrine follows the *words* in a statute or regulation, as this is how a "clear" expression of "intent" is shown.

Furthermore, it is incorrect to state that *Causby* "set the stage for future trespass and privacy cases involving airspace above private property" (page 12). First, *Causby* is a Takings Clause decision premised on interference with the use of property rather than rights to airspace above private property. *Causby* did set the stage for the *aerial* trespass tort in section 159 of the Restatement (Second) of Torts (1965). There is no reference to aerial trespass in the entire "Regulatory Overview," and yet it is the aerial trespass tort (as opposed to a traditional trespass tort) that is the progeny of *Causby.* Second, the *Causby* decision has had no effect on privacy law.

The statement "Surface airspace has typically been treated as real property by the courts" (page 12) is simply wrong—indeed, as noted above, *Causby* led to the creation of a specific "aerial trespass" tort that was distinct from traditional trespass precisely because courts and commentators recognized that there is a difference between traversing property on the surface and flying over the same property. As a result, aerial trespass contains elements of both property and nuisance law. While a property owner can prove trespass on the surface by merely showing that the tortfeasor intruded on her property, to prove *aerial* trespass the property holder must demonstrate that the aircraft substantially interfered with her use and enjoyment of the land. This additional element in the aerial trespass tort exists to acknowledge the reality, as *Causby* held, that the sky is a public highway and that aircraft are entitled to make use of it, so long as they do not engage in flights that are so low and frequent as to cause injury to those below. *See Causby* at 266.

Moreover, the source for this statement also appears to be incorrect. It likely should be another reference to the Skorup article at note 14, not an FAA document. As noted above, "surface airspace" is a wholly invented term and not one that has any meaning in the case law. A reading of that Working Paper does not show any

court decision in which the term "surface airspace" was used. And using the passive present perfect tense ("has typically been treated") disguises the fact that all the court decisions cited by the Working Paper antedate the Federal Aviation Act of 1958 by decades. They have no relevance in determining whether a state has jurisdiction over any airspace. At most, they concern a landowner's property rights, but the Court in *Causby* also stated that the airspace is a public highway, adding that *ad coelum* doctrine upon which many earlier cases relied "has no place in the modern world." *Causby* at 261.

It is also not correct to state that *Causby* "created an upper and lower airspace" (page 12). The citation incorrectly points to a NextGen document. It is likely instead a quote from a state bar association publication (note 18). The quoted passage refers to a 500-feet altitude, which is not part of *Causby*, but appears to be taken from a comment on Restatement (Second) of Torts 159. And while 500 feet is set by the FAA as the minimum safe altitude in many circumstances, it is not a universal dividing line. Helicopters routinely fly below 500 feet. Small UAS are generally limited by rule to less than 400 feet. And all aircraft, no matter how large or small, must "navigate" the airspace below 500 feet to take off and land.

Moreover, even if 500 feet could be said to be a dividing line between navigable and non-navigable airspace (and it cannot), the Report does correctly note that *Griggs* held that a taking of an easement can occur even in the navigable airspace. So where is this purported division between upper and lower airspace? Neither *Causby* nor *Griggs* "created" this upper-lower division, as it simply does not exist.

Finally, the quotation from the Michigan Court of Appeals decision in *Long Lake Township v. Maxon* should be removed as the Michigan Supreme Court on May 20, 2022, vacated the judgment of the Court of Appeals and remanded the case for further proceedings. It would be inappropriate at this point to rely on the reasoning in *Maxon.*

Specific comments on other portions of the Report

Page 15, the fact that Texas's attempt to regulate small UAS flights has been struck down on First Amendment grounds warrants substantially more discussion than a single, throw-away sentence.

Page 16, "Air Rights." The reference to the Texas administrative code provision on leasing of air rights should not be taken as a general license for the state to lease air

rights. Serious constitutional questions would be raised with any attempt to lease airspace.

Page 17 states that new rules may be needed in several enumerated areas, without noting that Texas may have no lawful role in promulgating rules in the first four subjects.

Pages 24-25. The concept of "airspace monitoring" is nebulous and should be clarified.

Pages 28-29, Airspace Design and Regulatory Environment. This section should be revised to clarify the limited authority for state and local governments to play a role "in airspace design." Zoning, noise, and land use may well inform airspace design, but that does not mean that states would be allowed to "govern" advanced air mobility operations in the navigable airspace, even if limited to the conceptual UAM Operating Environment (UOE), as the Report correctly notes the "FAA's full regulatory authority over the airspace."

Page 30. The statement at bottom of page 30 – "Potential state or local regulation would cover landing areas and space requirements or separations from residential areas, airspace and the potential need for traffic management at lower altitudes." – goes too far as we have explained. State and local governments may not regulate the airspace or engage in traffic management at any altitude.

Pages 31-32. The reference to leasing airspace does not appear to be relevant to the subject of placement, policy, and permitting of infrastructure considerations. It refers to an airspace leasing proposal, the legality and efficacy of which are very much in doubt. It also refers to the Scorecard of state laws published by Brent Skorup of the Mercatus Center. The UAS industry has developed a rejoinder to this Scorecard, which is attached to these comments. The paragraph ending on page 31 and continuing onto page 32 should be removed from the sentence beginning with "A proposed solution."

Page 34. The need to align with the FAA is stated three times, and these statements are necessary. Therefore, the statement that alignment with the FAA "will require both state and federal oversight of operations under local jurisdictions" is unclear and should be clarified.

Page 38, Operational Safety. The first sentence on federal and state roles is unobjectionable. The next statement – that "airspace is a more complex area for

regulation" – is not correct. Airspace regulation is within the FAA's purview, not the purview of state or local governments.

In sum, for the reasons explained above, the "Regulatory Overview" section should be removed from the Report in its entirety. In addition, the issues and inaccuracies identified in other sections of the Report should be addressed.

We hope that these comments are helpful in laying out the sources of disagreement and potential controversy in the Report, and that they also help illuminate some of the factual and legal errors in the Report as currently drafted. The commercial UAS and AAM industries look forward to continuing to work productively with the Advisory Committee to the extent that the Committee's mandate is extended. We believe it is imperative, however, that the final Report adopt the suggested revisions above to reflect the consensus of the Committee's members and be considered as a trusted, neutral source of information for Texas regulators and lawmakers.

Association of Uncrewed Systems International

Commercial Drone Alliance

Consumer Technology Association

Small UAV Coalition

July 14, 2022

Attachment

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REPORT AND RECOMMENDATIONS OF THE

Urban Air Mobility Advisory Committee

PREPARED FOR THE
Texas Transportation Commission and the Texas Legislature

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https://www.txdot.gov/inside-txdot/division/planning/urban-air-mobility-advisory-committee.html

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