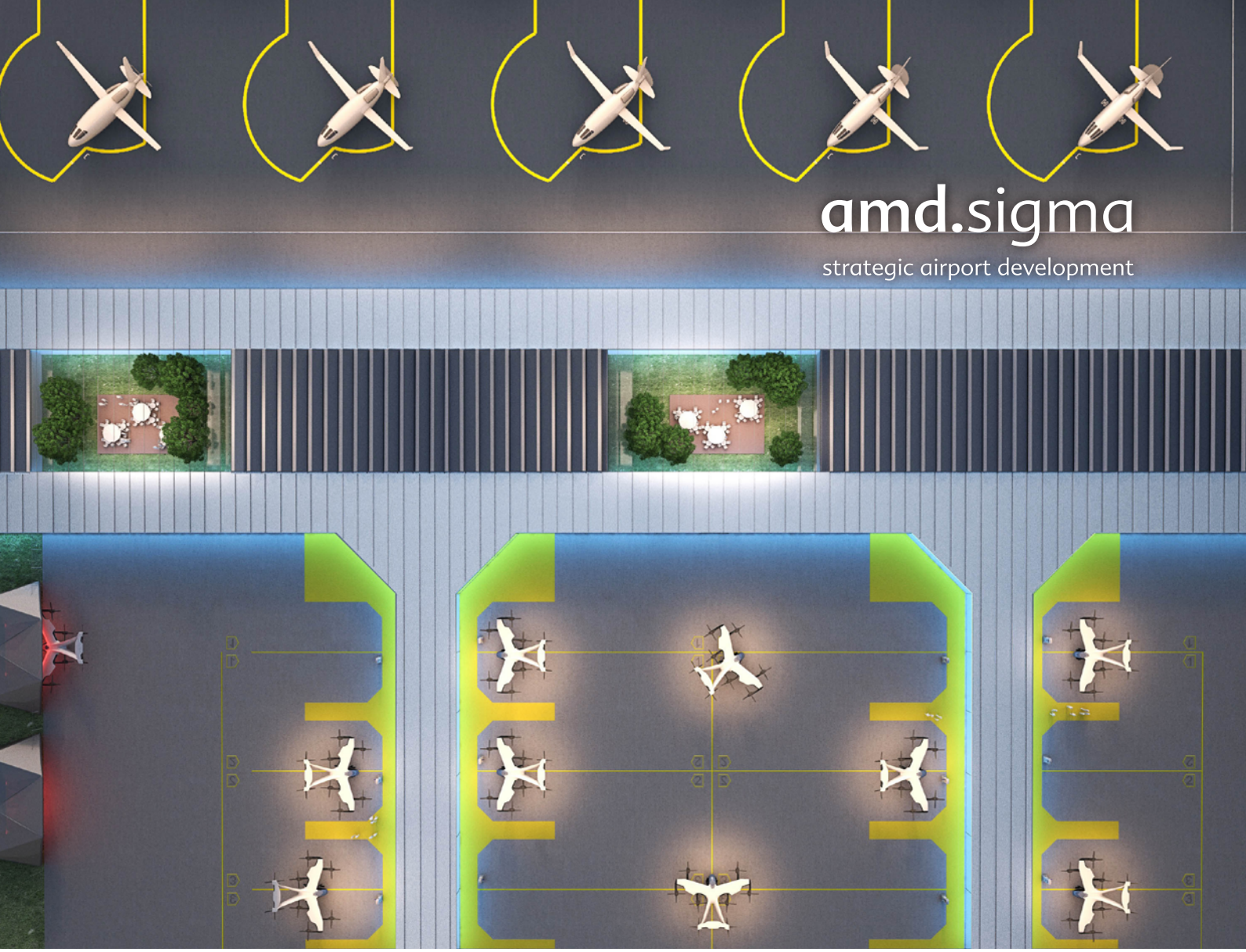

Figure 1: Image Source: © amd.sigma strategic airport development GmbH

Design of an InterRegional eAirport

"Revolutionizing aviation with the world's first battery-electric airport: Introducing the prototype design of an interregional airport by Berlin-based amd.sigma!"

ABSTRACT:

The idea for an interregional eAirport was inspired by a research project in Germany funded by the government, which aims to design and eventually build two prototypical vertiports. The project involves partnerships with Munich Airport International, Airbus, Bauhaus Luftfahrt, and several universities to explore Advanced Air Mobility (AAM).

Following extensive research, the team determined that exploring the potential for using electric vertical takeoff and landing (eVTOL) aircraft to transport individuals from urban areas to nearby regional airports - located within a radius of 100 km from the city - was a promising direction to pursue. These regional airports - many of which are former military airfields - are either currently in operation or abandoned and have the potential to serve as intermodal nodes for eVTOL and small electric short and conventional takeoff and landing (eSTOL/eCTOL) aircraft. The latter type of aircraft has a longer range than an eVTOL, but still requires a runway.

In designing a prototypical terminal concept, the team sought to create a simple, cost-effective, energetically sustainable (with a focus on on-site production) and modular building structure that allows for future expansions. The enhanced passenger experience facilitated by short transit times was also a key consideration.

INTERVIEW

“Interregional eAirport”

Q: Where did the idea of an interregional eAirport originate from?

A: Our team is currently engaged in two major research projects in Germany, in partnership with our parent company Munich Airport International, Airbus, Bauhaus Luftfahrt (a renowned German think-tank for aviation), and several universities. The projects focus on the development of Advanced Air Mobility and are funded by the German government. The goal is to design and ultimately construct two prototypical vertiports – one of them being located at Munich Airport. During the course of our work it became apparent that research had been primarily centered on infrastructure for eVTOL on the one hand, and eSTOL/eCTOL on the other. This led us to the conclusion that a more integrated, holistic approach was necessary in order to examine potential synergies between these two modes of transport. As such, we decided to consider their combination in a single, integrated system.

Q: What have been the key takeaways from this process so far?

A: The integration of AAM at an international airport poses a challenge but is not impossible. The new transportation technology could be more profitable for connecting regional airports, as transportation services can be provided at attractive prices. It could be very useful to offer a fast connection between urban, inner-city areas and more remote regions. Inner-city areas would be relieved, rural regions would be strengthened, and regional airports would gain new significance. This would create a triple-win situation. At regional airports, entirely new traffic patterns could emerge if eVTOL, ESTOL and ECTOL (electric conventional takeoff and landing) traffic are combined. This represents an opportunity for economic growth.

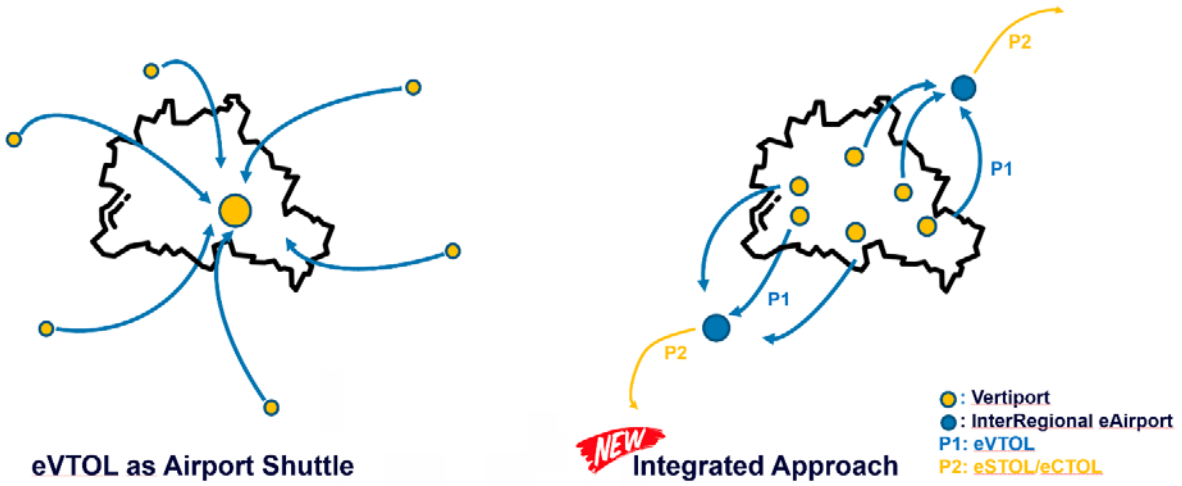

Figure 2: Feeder traffic versus eHub, © amd.sigma strategic airport development GmbH

Q: What would a passenger do in the middle of nowhere outside of a big city?

A: Exactly! We examined sites that were not too far from larger cities, such as sparsely populated areas near Berlin and identified more than 20 regional airports in the region. Some are in operation, some abandoned, but nevertheless could potentially be used for eSTOL aircraft. While we typically focus on either eVTOLs or eSTOLs, combining the two technologies could create synergies and offer significant benefits.

Q: Can you specify on those combined advantages?

A: eVTOLs can transport a limited number of people with zero emissions and without nedding a runway, but they have limited range. They are well-suited for accessing remote regional airports that are typically difficult to reach. Once at a regional airport, passengers could transfer to a small electric plane, or eSTOL/eCTOL, which has a greater range but requires a runway. With typically no more than 1,000 meters these runways can be significantly shorter than those required by traditional regional jets. Furthermore, since all vehicles are emission-free and potentially low-noise, an eAirport could co-exist better with inhabited areas.

Q: Where does the "e" as in electric come into place?

A: As part of our efforts to build for the future, it is essential to prioritize emission-free technology. Together with my colleague Birger Strüfing and Dr. Kay Ploetner from Bauhaus Luftfahrt (BHL), we have identified key specifications for a sustainable approach:

- all-electric battery power, with hydrogen potentially introduced as an option at a later stage
- energy production on site to the greatest extent possible
- very short transit times and paths
- a sustainable building structure for the terminal
- cost-effectiveness, with a focus on low-tech solutions that have a high impact

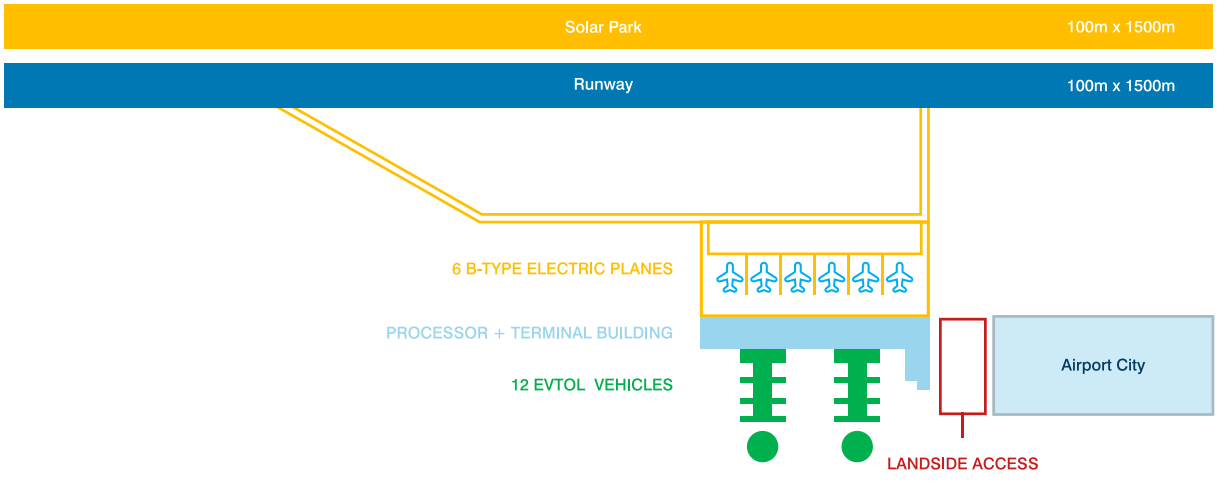

Figure 3: Schematic Layout of eAirport, © amd.sigma strategic airport development GmbH

Q: Where would the energy come from?

A: One potential design element for this airport is the inclusion of a solar field adjacent to the runway, which could be approximately the same size as the runway surface. There are already several examples of small, abandoned airports being converted into solar parks, and this approach could be replicated at an eAirport. The benefit of this design is that the solar field can generate revenue by selling clean energy to the grid while the airport is not yet operational. After a few years, the solar field could pay for itself, allowing the airport to utilize the energy for its own purposes and potentially reduce operational costs. This could create new possibilities for regional aviation operations by providing a clean, efficient and secure energy source.

Q: Can you explain how such an airport could look in the future?

A: The designed terminal integrates gateways for small electric planes and a vertiport under one single roof to facilitate easy passenger transit. It also allows for the possibility of luggage and security checks, if necessary.

This prototype airport can easily be expanded to meet increasing demand for additional vertiport positions, lounge and waiting areas as well as aircraft stands, as each function can be extended independently.

Q: What makes your airport cheap and still sustainable?

A: The implementation of battery-electric airports presents an opportunity to revolutionize the aviation industry while also promoting sustainability. By utilizing existing airport infrastructure, construction is minimized, and the environmental impact is reduced.

The new terminal facility and infrastructure are designed with cost-effectiveness and simplicity in mind, while also considering the environmental impact. This is achieved through the use of a single floor concept and the elimination of complex features such as elevators or escalators, which not only simplifies the design but also reduces energy consumption.

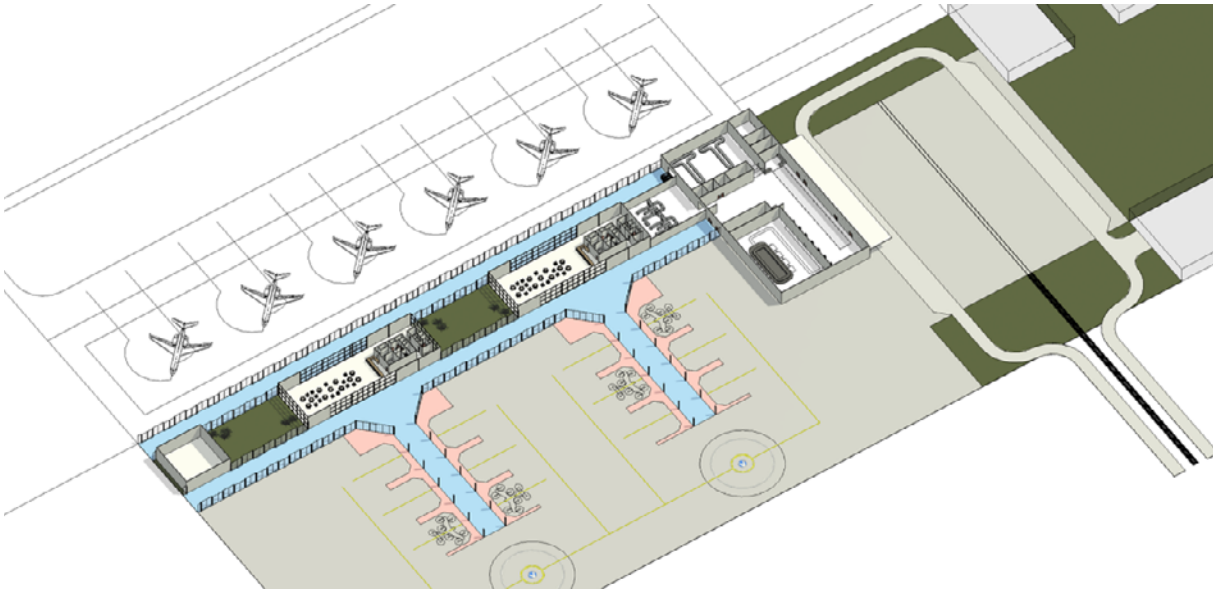

Figure 4: functional design sktech, with green interior spaces and circulation areas in blue, Image Source: © amd.sigma strategic airport development GmbH

The operational concept utilizes efficient procedures such as roll-in/roll-out for aircraft operations, rather than traditional push-back operations. This allows for walk-boarding for both electric planes and eVTOLs (electric vertical takeoff and landing) aircraft, further simplifying the airport operations, reducing costs, and minimizing emissions. Additionally, the use of electric aircraft and eVTOLs significantly reduces emissions and noise pollution, making it a more sustainable mode of transportation.

The terminal incorporates green open spaces and circulation areas that act as climate buffer zones and is constructed using a modular and easily adaptable building structure. Local materials such as wood can be incorporated into the design, and local construction companies can be utilized, which is particularly beneficial for emerging countries.

Q: Where do you envision this airport being built?

A: Germany has a high concentration of regional airports that are underutilized. Sustainability often involves repurposing existing infrastructure and there is significant potential to do so with these regional airports. Many of these airports have struggled financially in the past, but our concept aims to change that by revitalizing them and making them profitable. Not to forget, a successful airport, even a small one, creates a lot of real-estate value in the immediate neighborhood.

Our concept is not centered on a single airport, but on the creation of a network of small airports. Germany has many small airports that could potentially be part of this network. We do not intend to compete with rail transportation, but rather want to identify and serve traffic patterns that would be most suitable for our network of small airports.

The advent of electric vertical takeoff and landing vehicles and electric short takeoff and landing/conventional takeoff and landing aircraft with extended ranges has the potential to revolutionize transportation. These vehicles, with ranges of up to 200 km for eVTOLs and several hundred to 1,000 km for eSTOL/eCTOL, would allow for seamless travel between major destinations such as London, Zurich, Vienna, and Amsterdam from the Berlin area, as well as providing access to previously less accessible regions in the East.

Q: How could a typical travel-experience look like?

A: As an example, consider a family traveling from a central location in Berlin to Venice. Using our network of small airports, they would start by taking a short flight from a vertiport in a strategic location in their neighborhood to a regional airport South of Berlin. The family of three would use an eVTOL carrying hand-luggage.

The transfer time at this regional eAirport would be less than 30 minutes, after which they could board a small electric plane (such as the Vaeridion, Alice, or Heart) for a flight to Venice. Small electric airplanes will have a capacity of approx. 10-25 passengers.

Upon arriving in Venice, they could even potentially land at the old Lido Airport, avoiding the need for additional transportation such as a bus or vaporetto. While this is just one example, it illustrates the potential for efficient and convenient travel using our network of small airports. Let’s dream a bit….

Q: Will this be a mass transport or will it be a luxury?

A: The pricing and target market for this mode of transportation would depend on a variety of factors, including the cost of developing and operating the airports and planes, the amenities and services offered as well as the overall demand for this type of transportation.

Just like electric cars, electric aircraft such as eVTOL, eSTOL and eCTOL, have the potential to offer significant cost savings when it comes to maintenance. Electric propulsion systems have fewer moving parts and require less frequent maintenance compared to traditional combustion engines, which translates to lower maintenance costs.

Additionally, the use of electric propulsion can also lead to reduced operational costs, as electric power is generally cheaper than traditional fossil fuels. Overall, the move towards electric aircraft is expected to bring a noticeable cost-effective advantage over the existing aircrafts, particularly compared to traditional helicopters.

It is likely that the development and proliferation of electric planes and this network of small airports will lead to competitive ticket prices, especially as concerns about fossil fuel availability and environmental impact continue to grow. With electric planes powered by solar energy, there may not be many other options available, as the use of fossil fuels becomes increasingly restricted.

As the cost of renewable energy generated from sources such as wind and solar is comparatively cheap and continues to decrease, it is increasingly likely that electric transportation will become a prevalent mode of travel. The use of solar energy in particular, as a virtually cost-free source of energy, will play a significant role in making this a reality. As the famous saying goes, “The sun does not send a bill.” This, in combination with the environmental benefits and the increasing need for more sustainable and efficient transportation, will likely drive the widespread adoption of electric aviation in the coming years.

The design of this small airport network aims to minimize capital expenditure (CAPEX) by utilizing existing ground infrastructure at certain locations and keeping costs low. Initial capacity for these airports is estimated to range from a few hundred thousand passengers to nearly one million per year, with the potential for expansion as demand increases.

A network of approximately 10 regional airports in Germany that generate their own energy through solar power could be particularly attractive to businesses, especially as the airline industry moves towards emission trading and zero-emission travel becomes financially incentivized. This shift to sustainability is already being embraced by some larger corporations, further increasing the appeal of emission-free air travel.

Q: What is your assessment of the market potential? Which sectors and locations are of particular interest?

In our market analysis in Germany, we have identified significant opportunities at regional airports.

While competition with existing routes may not necessarily be the primary focus, offering unserved short-haul routes could prove to be a viable strategy. By gradually expanding the range of destinations available under the umbrella of these regional airports, a network could be established.

One key advantage of our concept is its highly flexible scaling capabilities and the potential re-use,

adaptation and integration of existing infrastructure. It is important to consider that the demand for air travel is driven by the number of passengers and the rate of growth in this sector.

Forecasts for the regional and short-haul flight market, even when based on conservative estimates, show promising potential. In addition, we anticipate that regional aviation could complement the current landscape of air travel, particularly as large major airports start to reach their capacity limits.

As concerns about environmental issues continue to rise, many large businesses have implemented sustainability agendas that restrict short distance flights for their workforce. An increasing number of leisure travelers also feel uncomfortable about the carbon footprint of their vacation travels. Our concept addresses these concerns and offers an alternative solution.

However, the market potential in emerging countries may be even greater. Our concept is based on reducing complexity, increasing environmental sustainability, and producing your own energy. Terminal buildings can be constructed on site using simple construction methods.

Electric aviation, similar to electric automobiles, simplifies technology and maintenance. In warmer countries, solar energy is also more economically viable and solar parks are rather easy to build and operate. Especially countries with poorly developed transportation infrastructure or complex topography (islands, water, special terrain) could skip several stages of development and directly transition to electrified aviation.

The benefits of Advanced Air Mobility at regional airports are further enhanced by Germany's leadership in key technologies such as energy -generation and -management, eVTOL/eSTOL/eCTOL development, and sustainable construction systems. The potential for this model of small airports and electric planes is significant, with the sky being the limit for future growth and development!

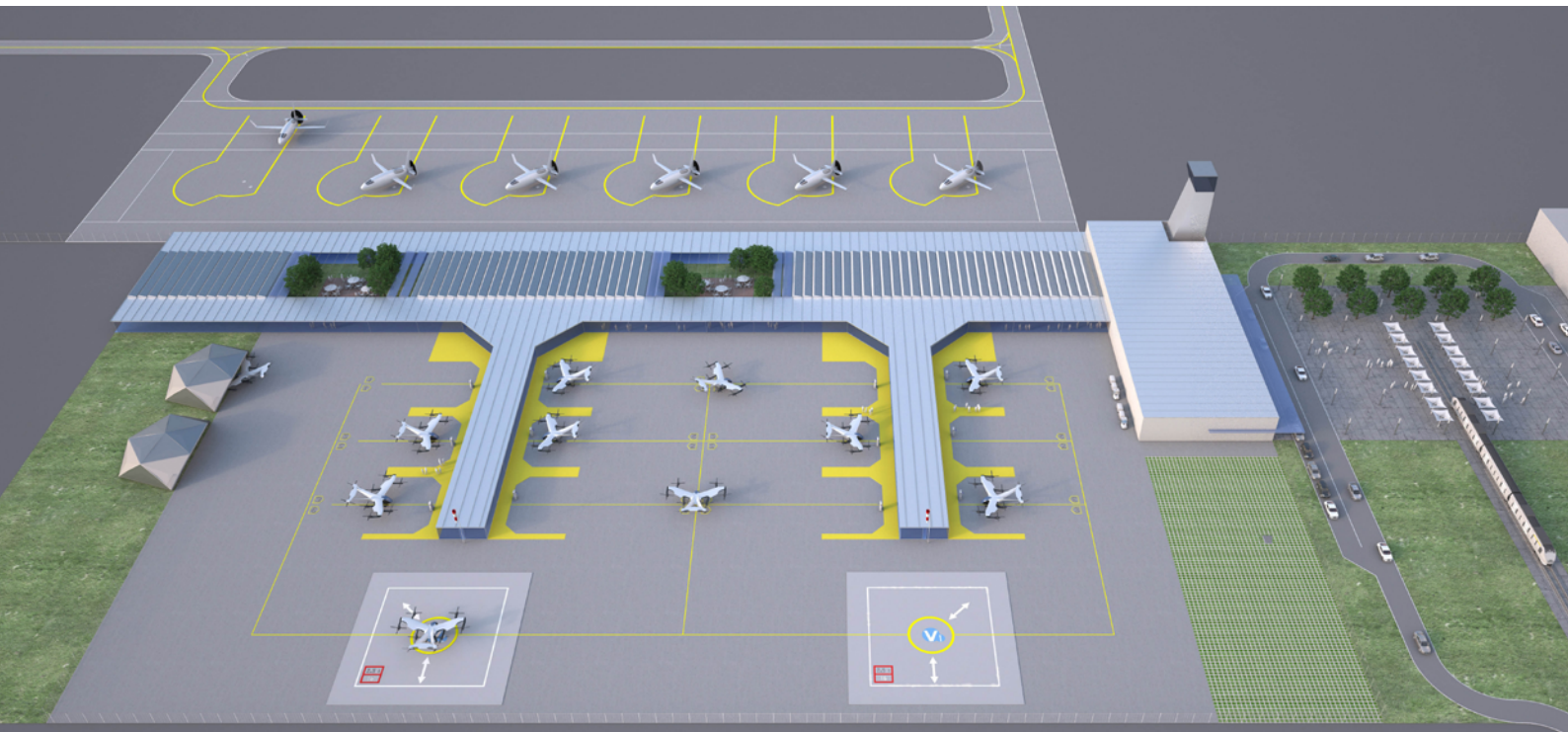

Figure 5: Aerial view of the interregional eAirport with vertiport in the front and apron for B-Size electric planes in the back, © amd.sigma strategic airport development GmbH

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Olaf Bünck is an airport master planner, architect and real estate expert. In addition, he is a specialist in architectural visualization. Olaf Bünck leads all studies on Urban Air Mobility, Airport City, and real estate at amd.sigma.

In 1994, he founded his own company, which was the first address for high-resolution architectural simulations and visualizations for large scale projects, including airports. After more than 20 years in architectural design and marketing, Olaf Bünck turned to the real estate industry.

Since summer 2016, he has been a valued member of the amd.sigma team. He has worked on several masterplan and airport city projects and also provided real estate analysis and concepts for airport and real estate clients.

In 2022, funding was approved for two major research projects, AMI ‘AirShuttle’ and AMI ‘FlyIn2Air’, in the Advanced Mobility Initiative (AMI). Both projects focus on Advanced Air Mobility and have partnerships with Munich Airport International, Airbus, Bauhaus Luftfahrt, and several universities. Results will include the planning and eventual construction of two prototypical vertiports at Munich Airport (MUC) and the city of Ingolstadt.