# Demand Analysis of Regional Air Mobility Using an Agent-Based Demand Model

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Short-haul services with electric aircraft and Regional Air Mobility (RAM) have the potential to offer improved regional airport access and reduced emissions. This study investigates RAM demand in Germany and neighboring countries, focusing on 19-passenger hybrid-electric aircraft (HEA) with a range of up to 950 km. Unlike previous studies that focused on potential time savings and emissions or relied on secondary data (e.g., Grimme et al., 2020; Baumeister et al., 2020; Paproth et al., 2020; Justin et al., 2021), we incorporate survey-based passenger behavior findings into an agent-based demand model. Our adoption-aware framework, integrating a calibrated mode-choice model, simulates individual travel decisions, estimates potential market demand, and assesses the impacts of RAM.

The study area covers Germany and neighboring countries with 11,875 zones (11,717 in Germany and 158 in surrounding regions). A synthetic population of ~80 million individuals in 53 million households was generated (Pukhova et al., 2021), and a representative 5% sample was used for the initial analysis.

A multimodal network was developed, including door-to-door travel times and distances for car, rail, long-distance bus, conventional air, and HEA, which can operate from 54 IFR-capable airports or airfields in Germany and 341 in neighboring countries. Car and public transport were considered as the feeder modes. The HEA was projected to offer up to 82% $CO_2$-eq emission reduction compared to conventional aircraft configuration by 2050 and ticket prices between €0.45–€0.60 per revenue passenger kilometer, comparable to first-class train in Germany (Strathoff et al., 2022; Fu et al., 2025).

Travel demand was modeled with trip generation, destination choice, and mode choice components. (Pukhova et al., 2021) The mode choice model incorporated the stated-preference survey results analyzed by Fu et al. (2025). We assessed RAM's impact by quantifying demand-weighted changes in door-to-door travel time, door-to-door $CO_2$-eq emissions, and accessibility gains. The adoption-weighted benefits were estimated relative to current mode choices. Promising routes were identified considering both demand and benefit levels. Accessibility gains were monetized using logsum-based metrics and survey-derived value of time. Due to limited real market data of RAM, we defined both optimistic and conservative adoption scenarios. The former based on our

model estimates, and the latter calibrated to a 5% market share based on prior studies (Spangenberg et al., 2020; Paproth et al., 2020).

On an average weekday, over 212,000 long-distance trips were generated by a 5% sample of the German population, with 90% occurring within Germany and 10% crossing borders. The majority (63%) were private or leisure trips, while 37% were business-related. In the optimistic scenario, the estimated RAM mode share reached 19% for non-business and 29% for business trips. Persisted under both optimistic and conservative scenarios, business travelers consistently showed higher adoption of RAM than non-business travelers. Adoption of RAM declined with lower income levels and was highest on routes connecting large cities, while rural connections had less uptake.

RAM offered time savings of 1.1 hours per trip on average compared to the fastest available mode on about half of all routes, and 1.3 hours compared to currently chosen modes on over 60% of routes. Routes with car-based feeder modes yielded greater time savings than those using public transport.

While RAM did not reduce the $CO_2$-eq emissions per trip compared to the currently chosen modes overall, it could potentially reduce $CO_2$-eq emissions by up to 16% on 59% of car routes and by up to 67% on 86% of routes currently served by conventional air.

Accessibility gains from RAM were positive across scenarios. In the conservative case, average generalized travel time per trip decreased by 2% (~€4). In the optimistic case, average generalized travel time savings per trip reached 15% (~€23) with car feeders and 13% (~€19) with public transport feeders. These benefits were higher for high-income and business travelers, and for routes connecting urban areas, with total accessibility improvements in the optimistic scenario roughly five times greater than in the conservative case.

The initial results suggest that RAM offers general benefits in travel time savings, emission reductions, and overall accessibility improvement. However, targeted policy support is needed to enhance access for lower-income groups and less-connected regions. Next steps include sensitivity analyses on time and cost parameters, as well as scaling the model to represent the full population for a comprehensive national assessment. Future work will also incorporate 2030 projections, accounting for anticipated socio-demographic developments.

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# Biography
## Mengying Fu

Mengying Fu is a Research Associate at Bauhaus Luftfahrt e.V. and a PhD candidate at the Technical University of Munich. Since 2019, her research has focused on travel behavior and the market development of emerging sustainable air transport, with a particular emphasis on urban and regional air mobility as a key application area.