PROSPECTS FOR HYBRID-ELECTRIC REGIONAL AIRCRAFT FOR AIR CONNECTIVITY: THE CASE OF GERMANY

"Recharging Regional Aviation – Electric & Hydrogen Opportunities for Europe's Airlines"

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DLR

Background

- Flightpath 2050 / Fly the Green Deal objective: *“90% of travellers within Europe are able to complete their journey in less than four hours”*
- Multiple projects ongoing by start-up companies to develop hybrid-electric or electric regional aircraft
- DLR is highly engaged in the evaluation of concepts in regional aviation:
  - Joint project „CoCoRe“ with Bauhaus Luftfahrt on the development and market prospects of a 19-seat hybrid-electric aircraft
  - Clean Sky 2 Technology Evaluator – DESAT project with Trasporti e Territorio and SEO Amsterdam Aviation Economics
  - Market potential analysis for electric regional aviation at Kassel airport

Source: Bauhaus Luftfahrt / Jasper van Wensveen

What are the potentials of new regional air mobility concepts with regards to travel time savings?

Background

- Regional aviation in Europe has been a challenging business model over the past decades
- Low cost carriers have displaced regional air services on many routes
- Regional aviation remains vital for island services and remote regions, e.g. in France, Greece, Spain, Sweden, Norway

Source: Wikimedia Commons

Methodology & Data

- Comparison of travel time of different modes:
  - Car only
  - Conventional scheduled aviation (with car as access and egress mode)
  - Commuter aircraft (with car as access and egress mode)

- Assumptions on commuter aircraft:
  - 200km full electric range / 160 knots air speed
  - In case of longer distances: 20 minutes added for approach/landing/taxi-in/battery swap/taxi-out/takeoff
  - 15 minutes process times before departure / after arrival

Methodology & Data

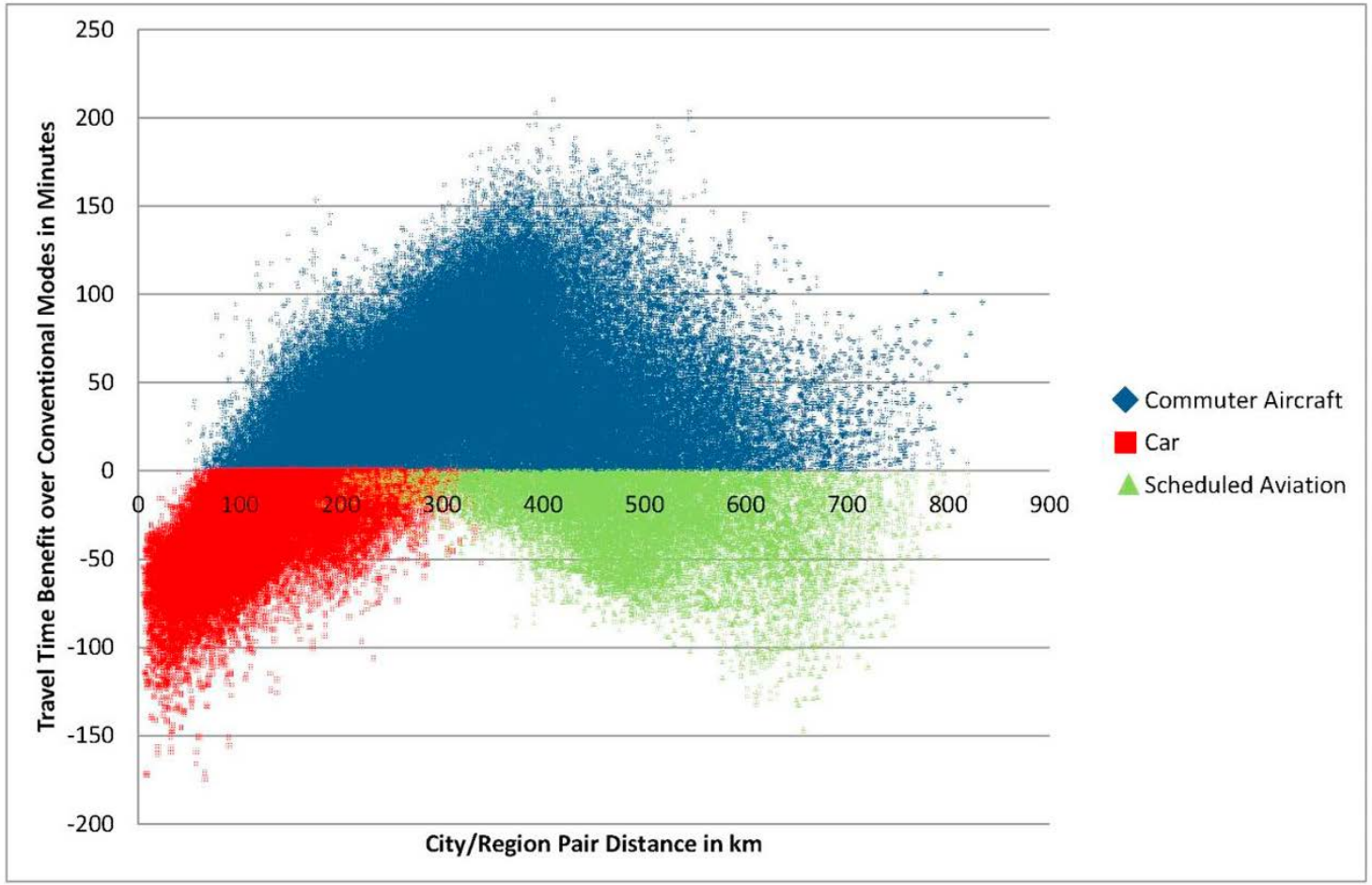
- EUROSTAT database with all centroids (coordinates of geographical centers) of the largest city of each German NUTS 3 region (402 independent cities and districts)
- Shortest car driving times between all NUTS 3 regions (161,202 combinations) as derived from the online service Google Distance Matrix API / HERE Routing API
- Shortest travel times between all NUTS 3 regions by air using Innovata Flight Schedules and Google Distance Matrix API / HERE Routing API driving times for airport access and egress
- A database including all airports/airfields in Germany, as provided by ourairports.com. All airports with a runway length of at least 800 m are considered (240 airports/airfields compared to ~30 with scheduled services today)
- Demand data: dataset developed for the Federal Transport Masterplan 2030 (Bundesverkehrswegeplan 2030, Intraplan, 2014) was used, which provides a forecast of travel demand in Germany between NUTS 3 regions for the year 2030.

Source: https://pixabay.com/de/photos/daten-briefe-scrabble-information-2355696/

Results

- The “travel time-benefit banana“ ⇨ on 110,592 out of 161,202 domestic NUTS3 region pairs small air transport offers a travel time benefit
- Particularly off the main corridors, benefits could be achieved compared to cars and trains
- On long distances (>500km), benefits of commuter aircraft are diminished compared to scheduled jet aviation, due to travel speed and range

Travel time benefit of commuter aircraft compared to car/scheduled aviation

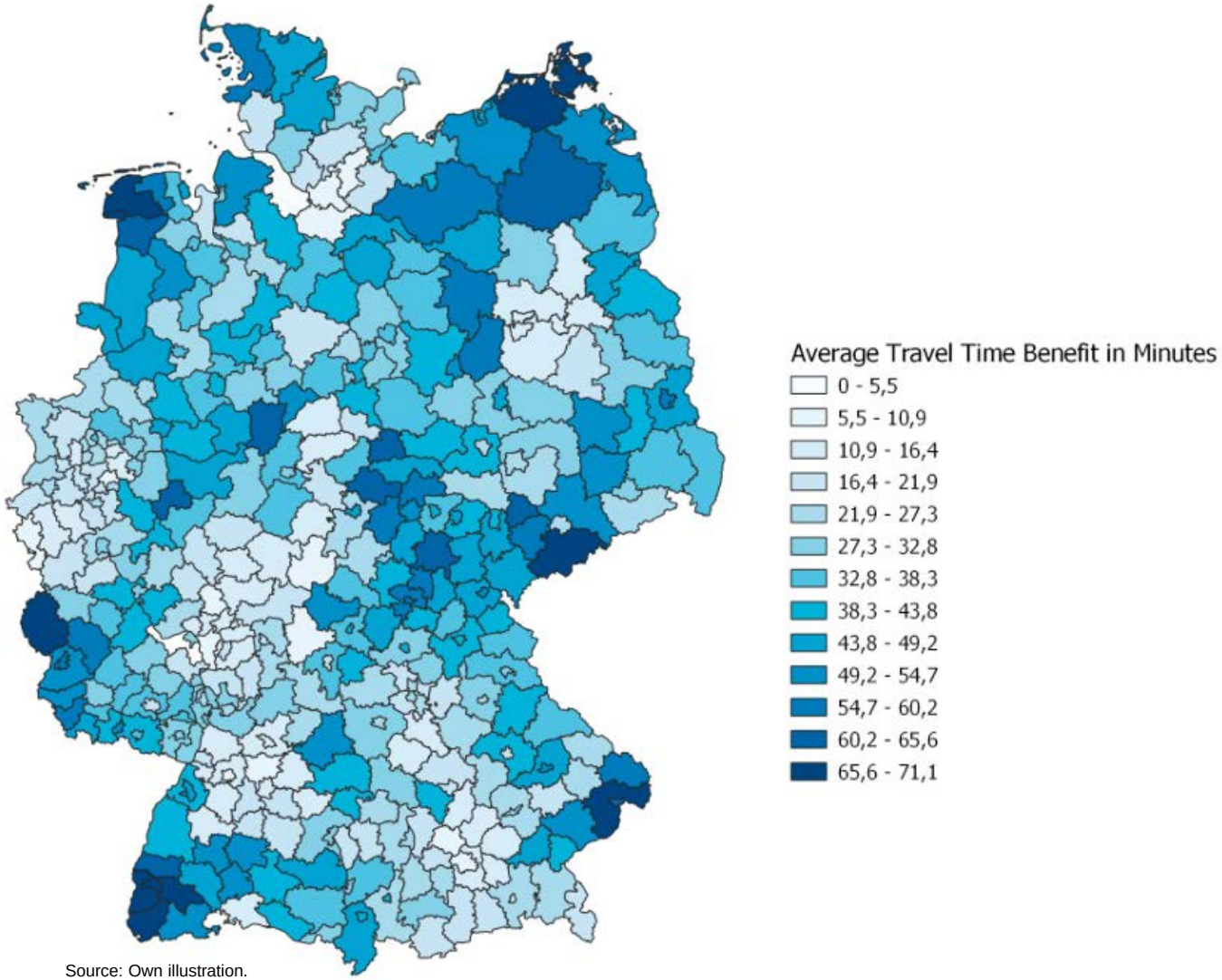


Source: Own illustration.

Results

- Not surprisingly, particularly the peripheral regions would benefit from commuter air services
- But: not only theoretical travel time benefits are relevant for market success, but also potential market demand!

Travel time benefit of commuter aircraft by NUTS3 regions



Source: Own illustration.

Results

NUTS 3 city pairs with highest total travel time benefit of commuter aircraft in Germany (Assumption: 5% modal split share of commuter aircraft)

Origin Region	Destination Region	Forecast Number of Travelers 2030	Potential travelers per day for air taxi (5% modal split share)	Distance (GCD in km)	Shortest Travel Time Conventional Mode (min)	Travel Time Electric Commuter Aircraft (min)	Travel Time Benefit Electric Commuter Aircraft (min)	Total Travel Time Saved (5% Modal Share, hours)
Berlin	Bremen	432,050	59	321	255	178	77	27,597
Ludwigslust-Parchim	Lüneburg	1,638,731	224	96	109	92	17	22,828
Dresden	Hamburg	232,022	32	377	310	204	106	20,521
Ortenaukreis	Rottweil	2,125,688	291	63	97	89	8	14,230
Steinburg	Cuxhaven	425,372	58	55	126	86	40	14,014
Kiel	Berlin	215,022	29	297	247	170	77	13,695
Berlin	Bielefeld	246,815	34	335	243	185	58	11,901
Elbe-Elster	Nordsachsen	1,282,225	176	94	120	109	11	11,629
Rendsburg-Eckernförde	Berlin	174,714	24	319	261	182	79	11,395
Meißen	Berlin	622,434	85	134	141	119	22	11,108

Conclusions & Challenges

- **Travel-time benefits:** Can undoubtedly be realized with small / regional air transport concepts, even in densely populated regions with a relatively good ground transport system
- **Finding a suitable business model / willingness-to-pay**: If there was a market demand for decentral commercial flight operations with regional aircraft, no-one would stop operators from using conventional aircraft (Cessna Caravan, Tecnam) – but this can only be very rarely seen
- **Flight operations:** Reliability is a key issue, as weather below VFR conditions is frequent in most parts of Europe and small airports are insufficiently equipped with ILS and other landing aids
- **Global market**: In 2024, 9 civil regional aircraft with 17-35 seats have been delivered (4 DHC-6-400 and 5 Let 410)
- **Infrastructure provision:** Airports will need to be equipped with electric charging infrastructure, grid access and/or local production of electricity from renewable sources

Literature

- Grimme, W./Maertens, S. (2019): Flightpath 2050 revisited – An analysis of the 4-hour-goal using flight schedules and origin-destination passenger demand data, Transportation Research Procedia 43 (2019) 147–155.
- Grimme, W./Paul, A./Maertens, S./van Wensveen, J. (2020): The prospects of hybrid-electric regional air transport - an assessment of travel time benefits of domestic short-haul flights in Germany with 19-seater aircraft, Transportation Research Procedia 51 (2020) 199–207.
- Fermi, F./Chirico, F./Fiorello, D./Martino, A./Jaksche, R. (2023): The DESAT Model for Estimating Demand for Small Air Transport in Europe, Transportation Research Procedia 75 (2023) 198–208.