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The Aviation Think Tank

BHL TREND REPORT 2022

Towards Sustainable Air Travel: Exploring the Passenger

Taufkirchen, Germany

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ABOUT THE TREND MONITOR

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Bauhaus Luftfahrt Trend Monitor at a Glance

The air transport environment constantly changes, facing challenges and uncertainties.

Within the scope of the Trend Monitor, manifold social, technology-driven, economic, environmental, and political developments are captured, analysed, and evaluated.

Enabling an early and comprehensive detection mechanism and the consecutive assessment provides insights for the aviation community and beyond regarding emerging developments, including the future of travel, business applications, partnerships, or strategic consequences.

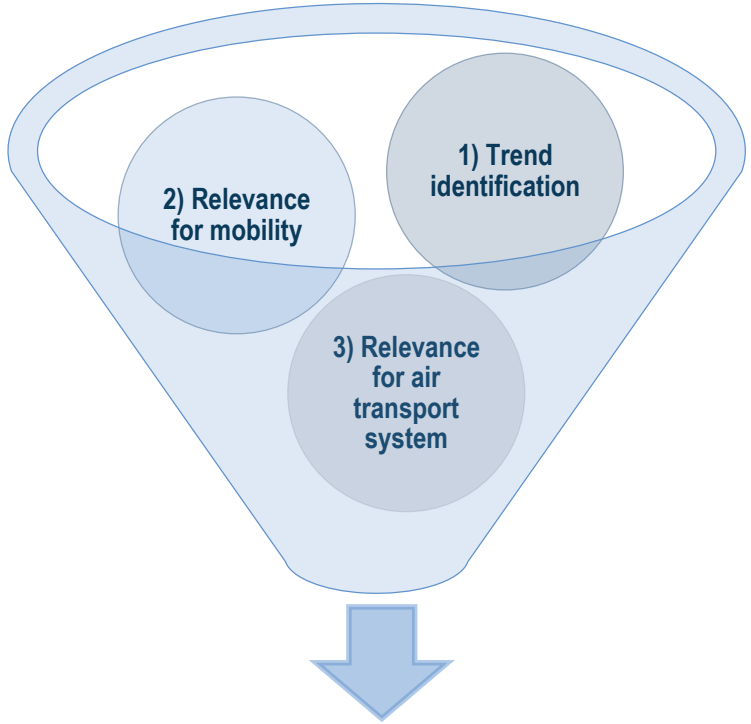
Benefits of the Trend Monitor

What makes us unique

- **Scientific-based** trend research with **established methods** and use of **various data** sources
- **Interdisciplinary** approach with a **systematic view**
- **Aviation** and **long-term focused**
- Practical research with a radar for all trends with the further derivation of managerial **implications** for aviation stakeholders
- Making loose trends more tangible and understanding them from an **aviation think tank perspective**

Uncertainty higher

What are the trends next to the obvious?



Uncertainty lower

Use cases & derivation of implications

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Our Toolbox: Transforming Uncertainty into Understanding

	Qualitative / Trend Identification			Mixed-Method / Trend Understanding		Quantitative / Trend Confirmation		
Method \ **Outcome**	**Detection of novel trends**	**Understanding trends in more depth**	**Hypotheses development**	**Ranking of trends & cross-impact analysis**	**Scenario development & use cases**	**Data analytics** (e.g., hidden pattern in data, new information from text)	**Detection of statistical significance**	**Accept or reject hypotheses**
Systematic literature review	++	++	+		+			
Expert interviews	+++	++	+++		+			
Workshops	++		+	++	+++			
Delphi technique	+	+	++	++	+++		+	+
Surveys		++		+	++		+	
Statistics							+++	+++
Machine learning (ML), supervised and unsupervised	+					+++	+	

\+ = possible

++ = solid method

+++ = very suitable method

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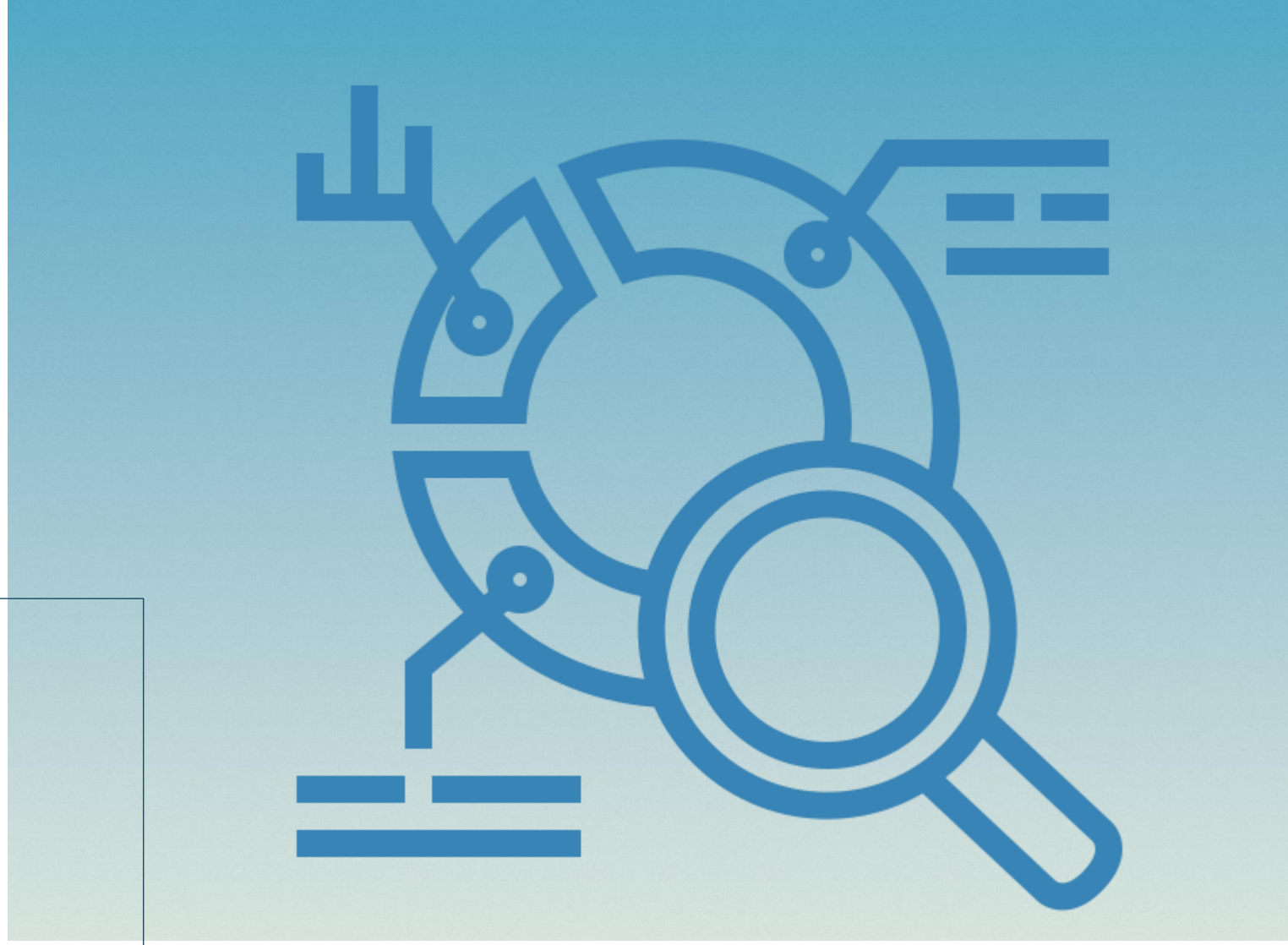

TREND DATABASE 2022+

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Overview of Our Trend Database 2022+

SOCIAL

1. **Analogue society** – offline and low-tech living
2. **Emerging middle class** – emerging middle class in some parts of the world
3. **Fake news** – distribution of misleading and/or wrong news, often spread online
4. **Attention to inclusion** – growing importance of inclusion
5. **Hyper-connectivity** – always online on social media and other networks
6. **New work** – work and lifestyle change, e.g. working remotely

TECHNOLOGY DRIVEN

7. **Metaverse** – digital parallel existing world
8. **Data is the new oil** – increasing the value of (personal) data and digital footprint
9. **Internet of Things (IoT)** – connection of systems and exchange of data between them

ECONOMIC

10. **Aviation Non-Fungible Token (NFT)** – digital asset on the blockchain
11. **Circular economy** – sharing and reusing products and materials
12. **Industry 5.0** – finding the balance between human and technology
13. **New forms of tourism** – space, virtual, solo travel, etc.
14. **Stagflation** – increasing recession with a high inflation rate

ENVIRONMENTAL

15. **Green hydrogen** – becoming a driver and central element of the energy system in aviation, mobility, and other sectors
16. **Neo-ecology** – sustainable mind-set shift and change of behaviour
17. **Sustainable Aviation Fuels (SAF)** – alternatives to fossil kerosene, e.g. advanced biofuels and power-to-liquid
18. **Bio-diversity** – appreciation and preservation of ecosystem diversity
19. **Climate change mitigation** – measurement to reduce emissions such as offsetting, direct air capture, or slow-flying

POLITICAL

20. **Changing power dynamics of world countries** – a shift of global superpowers and coalitions, new block formation or the revival of the iron curtain
21. **Environmental justice** – a debate about who is allowed to fly and generate emissions
22. **Slobalisation** – slowing down of globalisation

Maturity Assessment of Trends

- The maturity of a trend depicts if a trend is already **observable** today, **emerging** by showing first indications or a **weak signal** far ahead in the future
- The assessment is based on expert interviews, a trend workshop and an assessment survey in spring 2022

1. Analogue society
2. Emerging middle class
3. Fake news
4. Attention to inclusion
5. Hyper-connectivity
6. New work

7. Metaverse
8. Data is the new oil
9. Internet of Things (IoT)

10. Aviation Non-Fungible Token (NFT)
11. Circular economy
12. Industry 5.0
13. New forms of tourism
14. Stagflation

15. Green hydrogen
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20. Changing power dynamics of world countries
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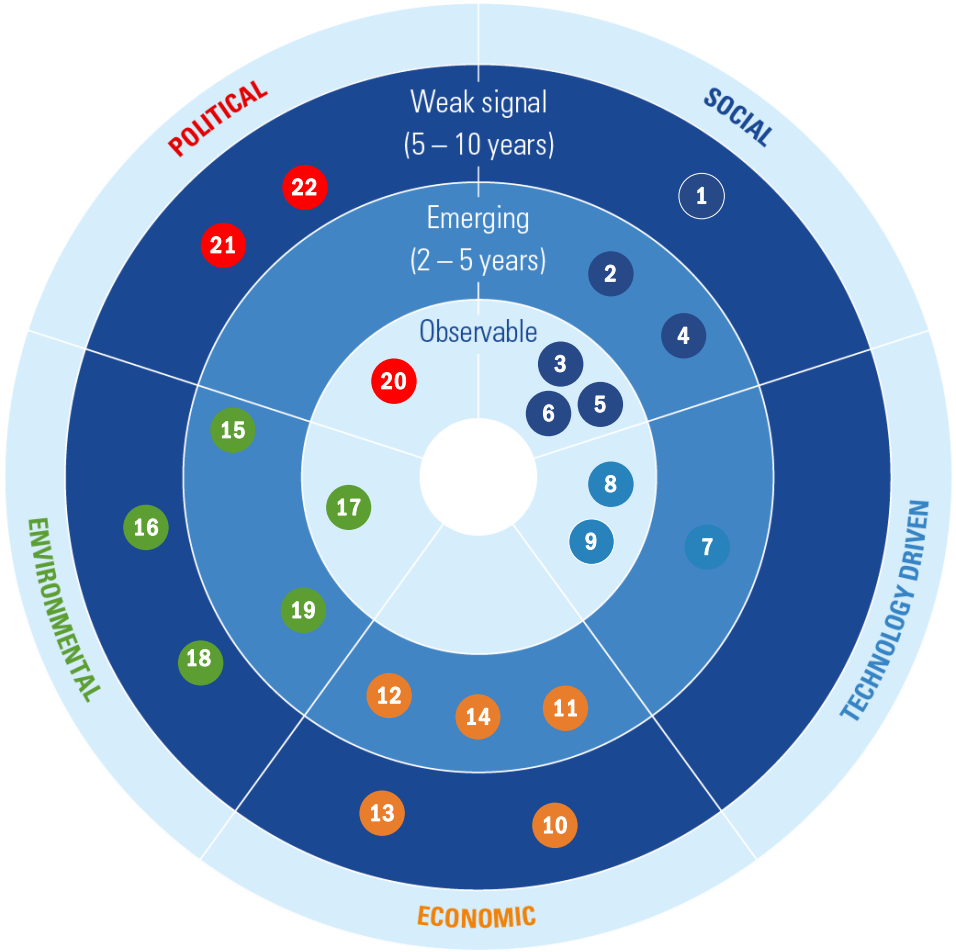
22. Slobalisation



Experts assessment N = 25

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SELECTED USE CASES

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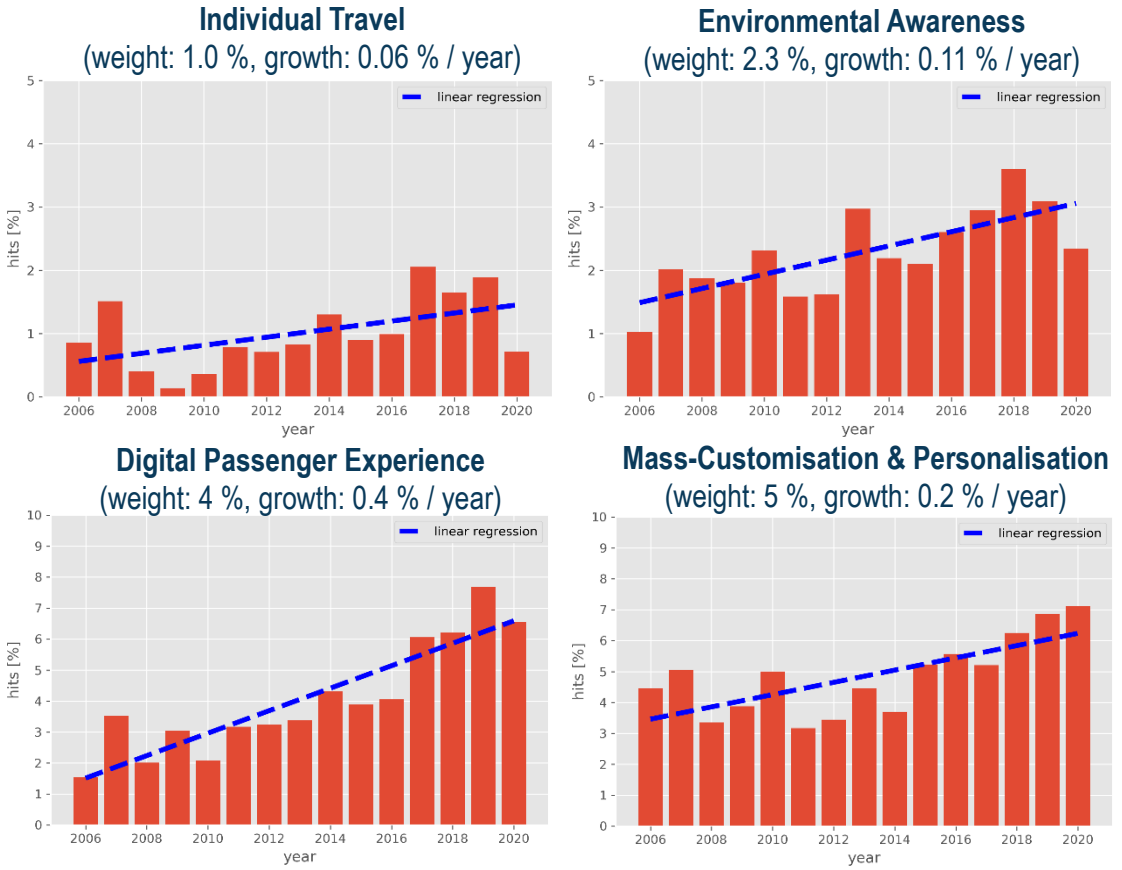
Passenger Research Gains Momentum

Key insights

- A **text-mining analysis** of 15 top transport journals uncovered topics with higher research interest
- **Passenger-related trends** are increasingly covered
- Passengers are **key in tackling climate change** regarding their willingness to pay, preference to offset, acceptance of new technology solutions, etc.
- The COVID-19 crisis showed strong **dependency** of aviation stakeholders **on propensity to fly**
- **Increasing investments** made into travel and mobility platforms, micro-mobility, ride and car share operators, and other end-user-facing start-ups

These aspects motivate a closer look at passenger-related trends within the following use cases



Analysis of journals shows clear trends toward increasing publications on passenger-related topics

Source: Schmalz et al. (2021)

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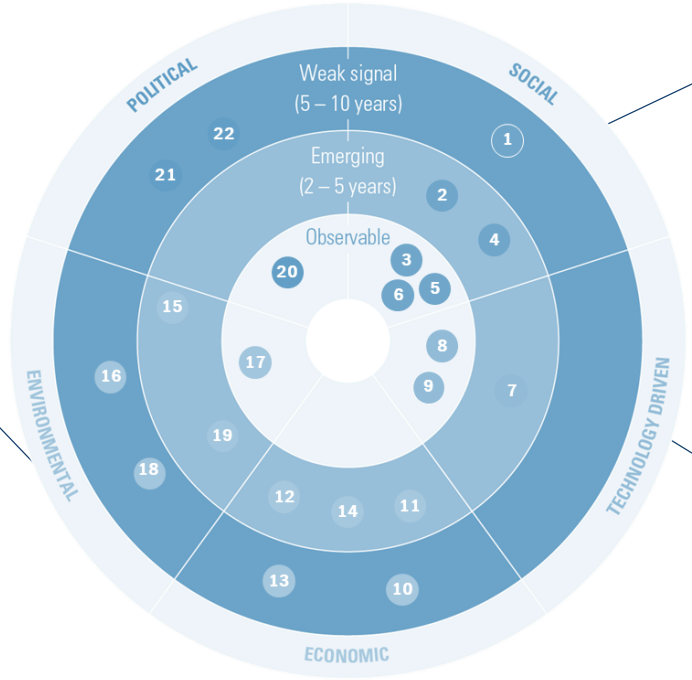
Passenger Trends of Recovery & Transition to Greener Flying

- Getting detailed insights into trends is part of the **Trend Monitor** approach
- Three selected use cases are presented in this report:

1. Passenger Environmental Awareness

Exploring the factors that influence passenger environmental awareness and strategies to close the awareness-behaviour gap



3. Air Travel in the New Normal

Exploring passenger requirements in the New Normal, taking the long-haul flight as a use case

2. Passenger Acceptance of New Technology

Exploring the factors that might have an impact on passenger acceptance of hybrid-electric airplanes

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3.1

SELECTED USE CASES

1. Passenger Environmental Awareness

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Factors Influencing Environmental Awareness

ENVIRONMENTAL AWARENESS

Starting position & motivation

- **Tackling the climate change** is a key priority and main challenge for the entire aviation system
- The environmental awareness among the public has been growing for years
- **Passengers do not walk the talk –** they play a key role in this endeavour as they decide to travel and choose a mode in the booking process, for instance
- Given the **awareness-behaviour gap** (e.g., see Dickinson et al. (2013) or Tölkes (2020)), the question arises how passengers might behave and be shaped for translating higher awareness into a true behaviour change
- As a Trend Monitor use case, a **systematic literature review** was conducted to **uncover the main factors influencing environmental awareness** and respective **mobility behaviour** among passengers

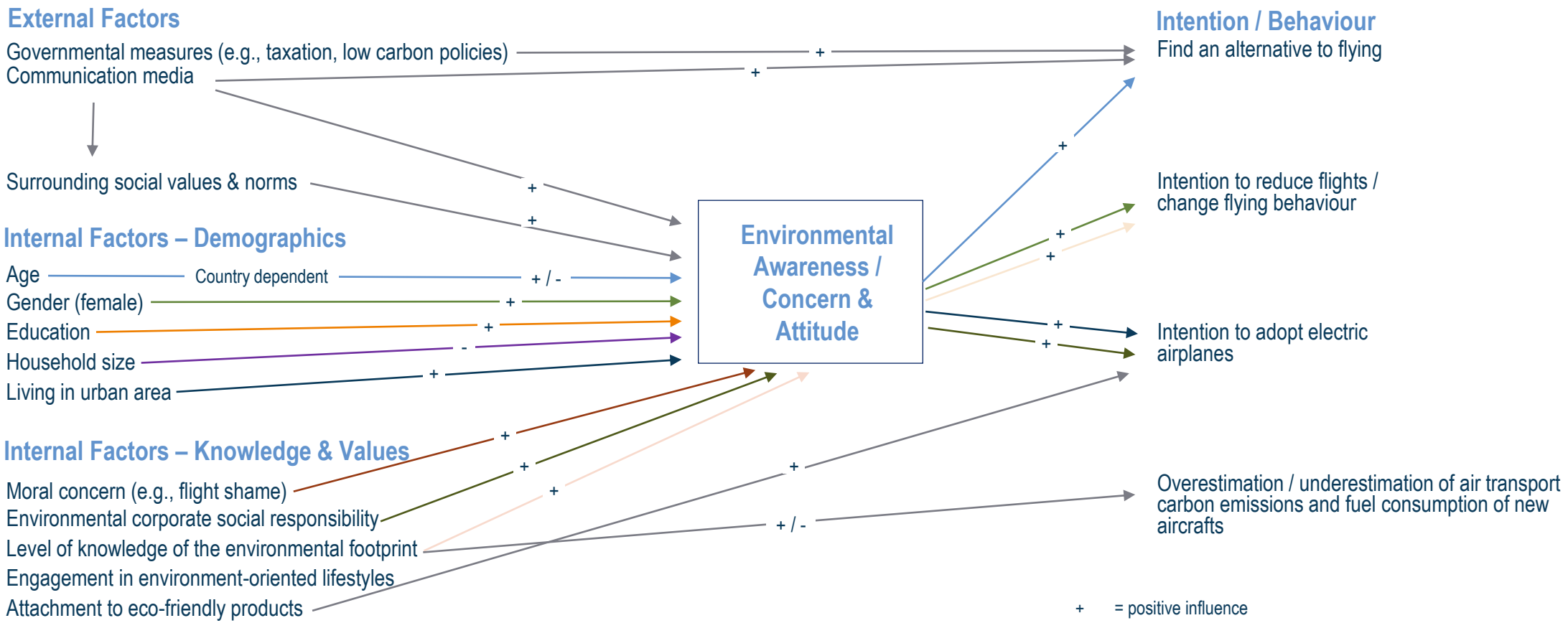
Applied method: Systematic literature review (Grant & Booth, 2009)

- **Systematic literature review (SLR)** of scientific publications, using a structured and keyword-based approach
- Following a mixed-method approach, factors are further confirmed in **semi-structured interviews** with experts from the aviation and sustainability community

Source: Fu et al. (2022b)

Factors Influencing Environmental Awareness

- **Overview of all factors** based on review of 74 studies: environmental awareness is driven by many factors
- Factors also influence each other (interconnectivity)



Source: Fu et al. (2022b)

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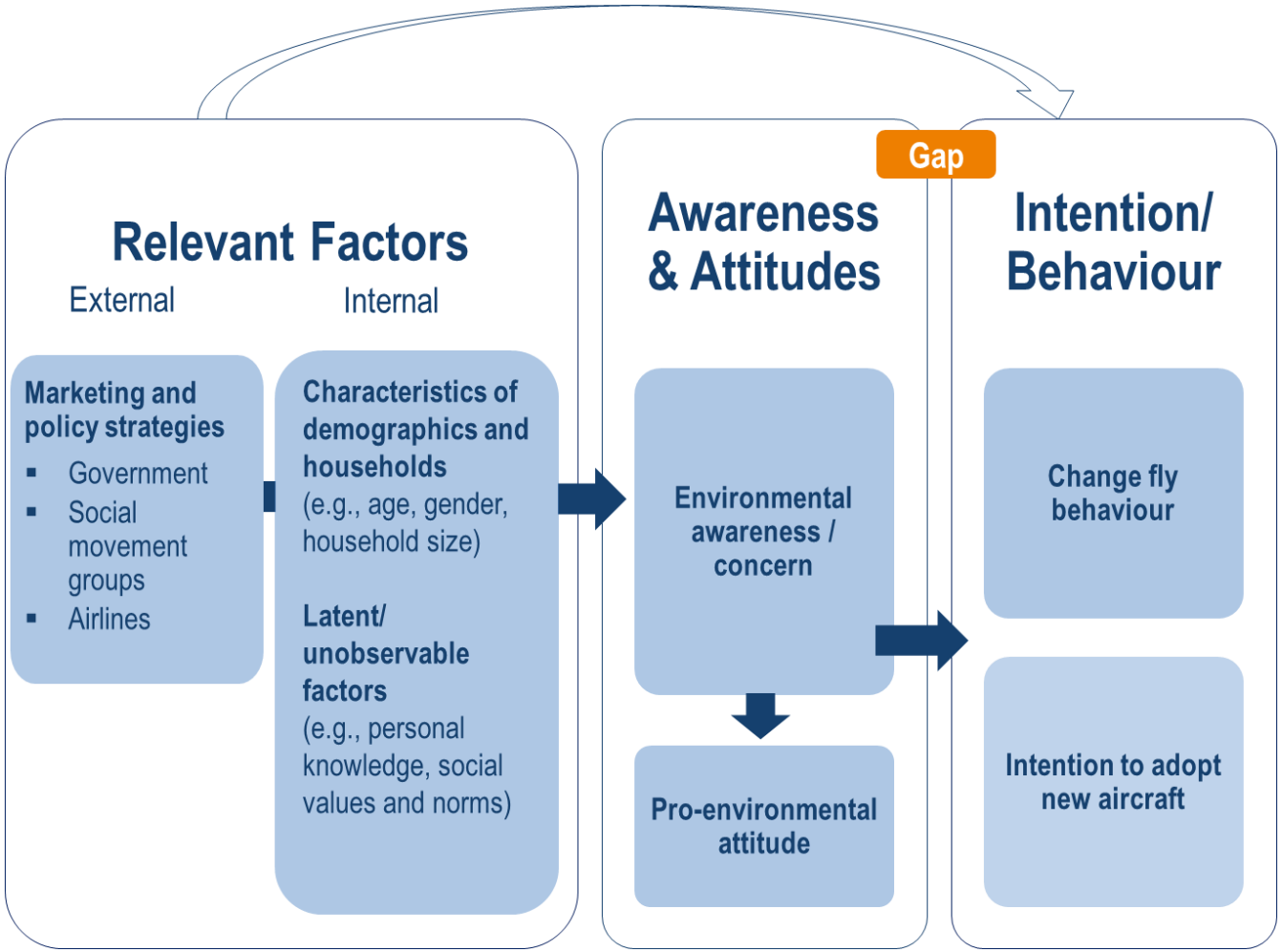
Factors Influencing Environmental Awareness

- **Summary model** of factors influencing environmental-friendly air travel, based on reviewed studies



Source: Fu et al. (2022b)

Factors Influencing Environmental Awareness

ENVIRONMENTAL AWARENESS

Key insights

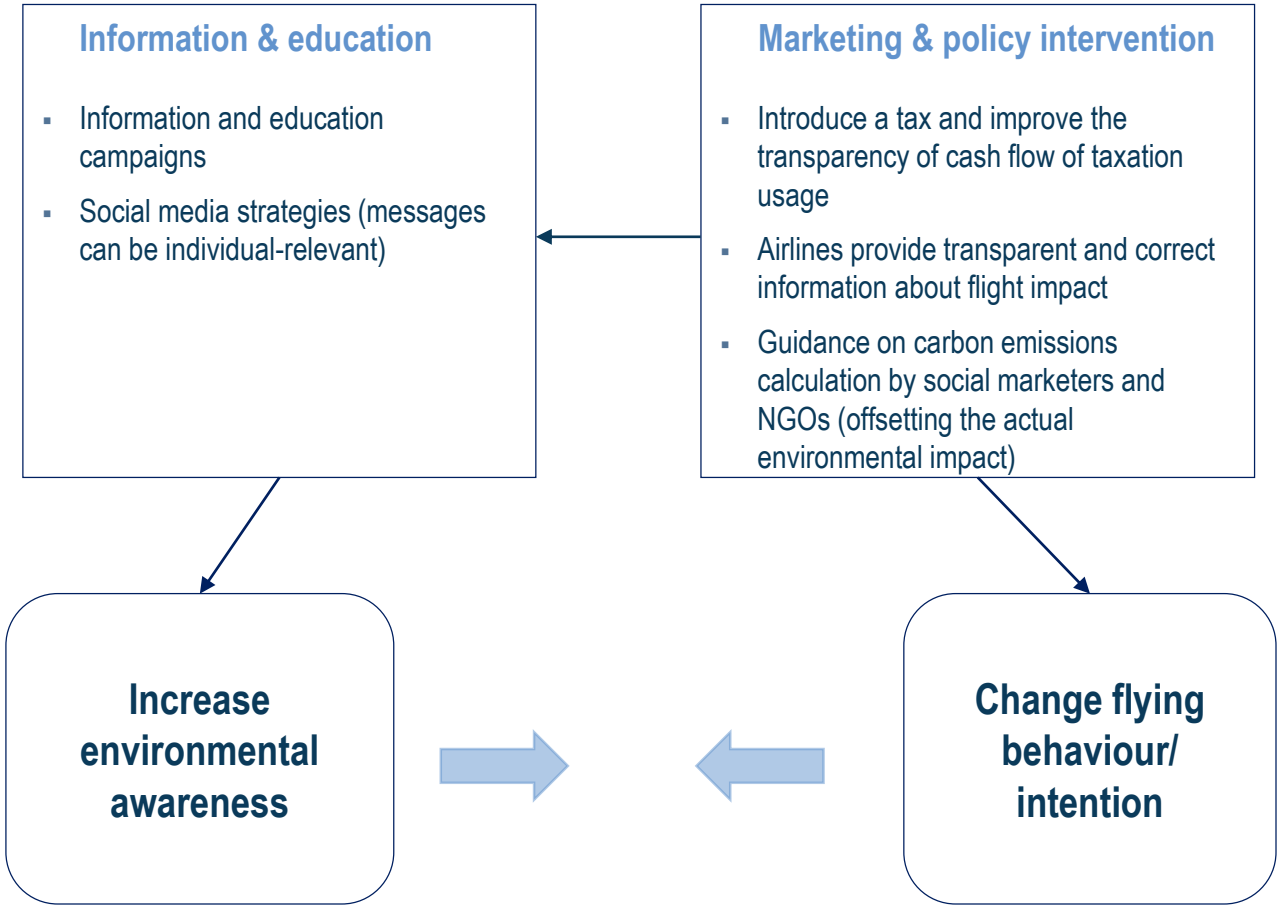
- **Social media** and **social norms** have a **positive impact** on environmental awareness
- **Females,** individuals with **higher education** levels, and **urban residents** have a **stronger environmental awareness**
- The stronger moral concern, social responsibility, and greener lifestyle affect environmental awareness and behaviour positively
- The stronger environmental awareness, concern, and attitude lead to more environmentally friendly mobility behaviour
- **Not all policy interventions can directly change behaviour**, but they can affect knowledge and values, which indirectly impact behaviour changes

Implications for the air transport system

- Identification of levers to **nudge passengers towards more sustainable air travel,** such as:
  - Increasing transparency in the booking process
  - Social media campaign
- Aviation stakeholders are called upon to **translate increased awareness into actions and products to close the gap**

Source: Fu et al. (2022b)

Strategies to Reduce the Attitude-Behaviour Gap



What causes the gap between green attitude and behaviour

- Economic rationales (e.g., price, time)
- Chance to “repair“ by other green behaviours

A two-stage strategy

- Education aimed at changing attitudes
- Marketing and policy intervention aimed at lasting behaviour change (McDonald et al., 2015)

Communication and **education** could be carried out by targeting **specific demographic groups**

All aviation stakeholders should collaborate to **address transparent information** to the public and endorse behaviour/intention change

Source: Fu et al. (2022b)

3.2

SELECTED USE CASES

2. Passenger Acceptance of New Technology

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ACCEPTANCE OF NEW TECHNOLOGY

Hybrid-Electric Airplanes on the German Market

Starting position & motivation

- **User acceptance** is the key **success factor** of **novel technologies**
- This use case explores the factors that might impact **passenger acceptance of hybrid-electric airplanes for short-haul regional transport** (as part of the GNOSIS project)
- A **passenger survey** collected a representative sample of more than 3,000 German residents who have travelled actively within Europe before the start of the COVID-19 pandemic
- Study area was Europe and a scenario of **hybrid-electric airplanes entering the market** in **2025** is tested for

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

Applied method: Statistical analysis based on empirical survey data

- Online survey for data collection: **direct passenger survey** using a 5-point Likert scale
- **Statistical analysis**, such as confirmatory factor analysis and structural equation modelling, was conducted to identify relevant factors (Duncan, 1975)

Source: Fu et al. (2022a)

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Hybrid-Electric Airplanes on the German Market

Key insights

- A **majority** of the **respondents** (74 %) agree that they would **consider flying with hybrid-electric airplanes**
- A **large majority** (77 %) who would consider flying with hybrid-electric airplanes envisioned **private travel purposes** for leisure and social activities as main purposes (20 % for business purposes)
- **Potential risks of electric propulsion** is one of the major concerns of **42 %** of the **respondents**
- The regression analysis results show a **reduced acceptance** intention in case of passengers' **stronger concerns about safety and comfort**
- The regression analysis results show an increased **acceptance** intention in case of general trust towards new mobility technology
- The analysis also shows that passengers' acceptance intention is positively affected by the **surrounding social norms**, which are positively associated with passengers' climate concerns

GNOSIS

Gefördert durch: Bundesministerium für Wirtschaft und Klimaschutz aufgrund eines Beschlusses des Deutschen Bundestages

Source: Fu et al. (2022a)

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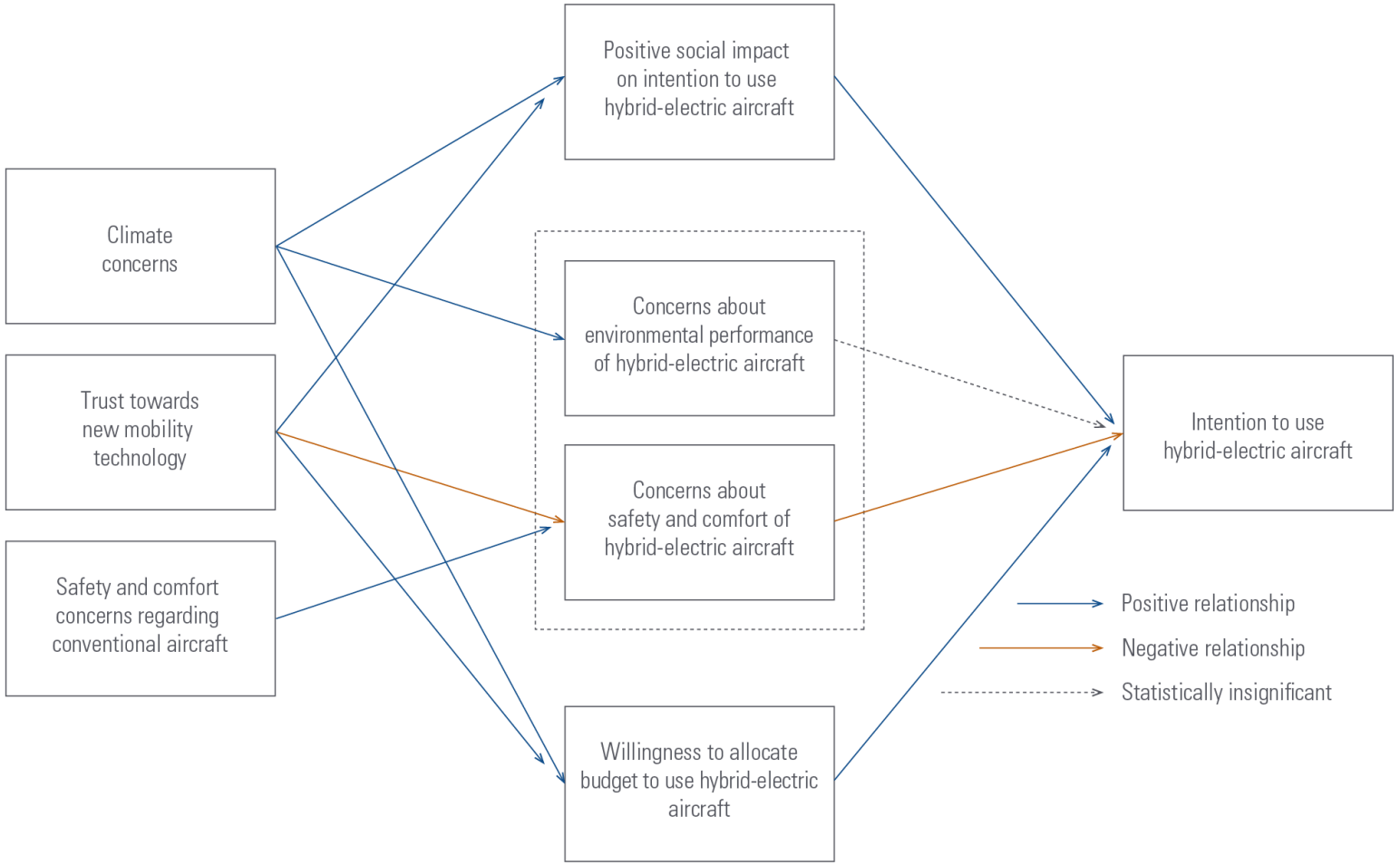
Hybrid-Electric Airplanes on the German Market

- The impacts of **psychological factors on passenger intention** to accept hybrid-electric airplanes:



Source: Fu et al. (2022a)

Hybrid-Electric Airplanes on the German Market

Implications for the air transport system

Social acceptance is an **essential part of technology strategies.** Results help to **support market strategies with:**

- Uncovering **possible concerns** that need to be addressed (for private and business passengers)
- Understanding the **relevant aspects** that might **affect** passengers' intention to **accept the new-technology** driven air transport product

First concept studies already exist: The German Aerospace Centre (DLR) teamed up with Bauhaus Luftfahrt in the *CoCoRe* (Cooperation for Commuter Research) project, which examined the possibilities and potentials for a hybrid-electric 19-seater aircraft (Paul et al., 2019)

Source: Fu et al. (2022a)

3.3

SELECTED USE CASES

3. Air Travel in the New Normal

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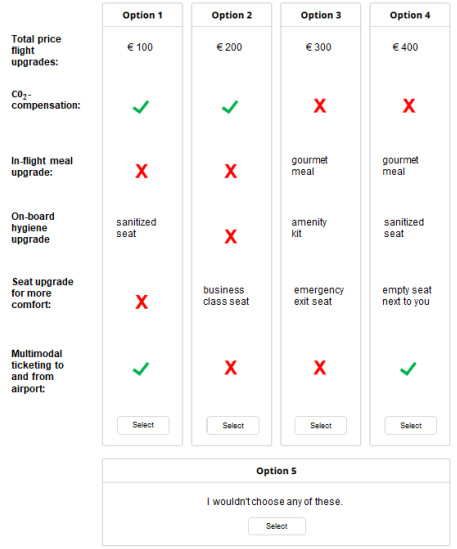
Air Travel in the New Normal: Use Case German Market

NEW NORMAL

Starting position & motivation

- We are currently facing a **transition** into a world of the **New Normal**, shaped by the ongoing COVID-19 pandemic, high uncertainty, and changing market dynamics
- This leads to a disruptive air travel market influenced by various factors, and makes long-term planning challenging
- The conducted study helps to shed some light on **passengers' possible preferences within the New Normal,** testing their choices between and willingness to pay for **six ancillary services** in a one-way, long-haul flight scenario (defined here as >4,000 km)
- Within this case study, **269 German passengers** were surveyed in late summer 2021



Example of online choice experiment

Applied method: Choice based conjoint analysis (CBC) (Orme, 2019)

- Applied in **online choice experiment** asking passengers indirectly within their decision (booking or buying) process (stated preferences)
- Several product profiles are presented simultaneously and passengers are asked to **choose their preferred one**

Source: Schmalz et al. (2022)

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Air Travel in the New Normal: Use Case German Market

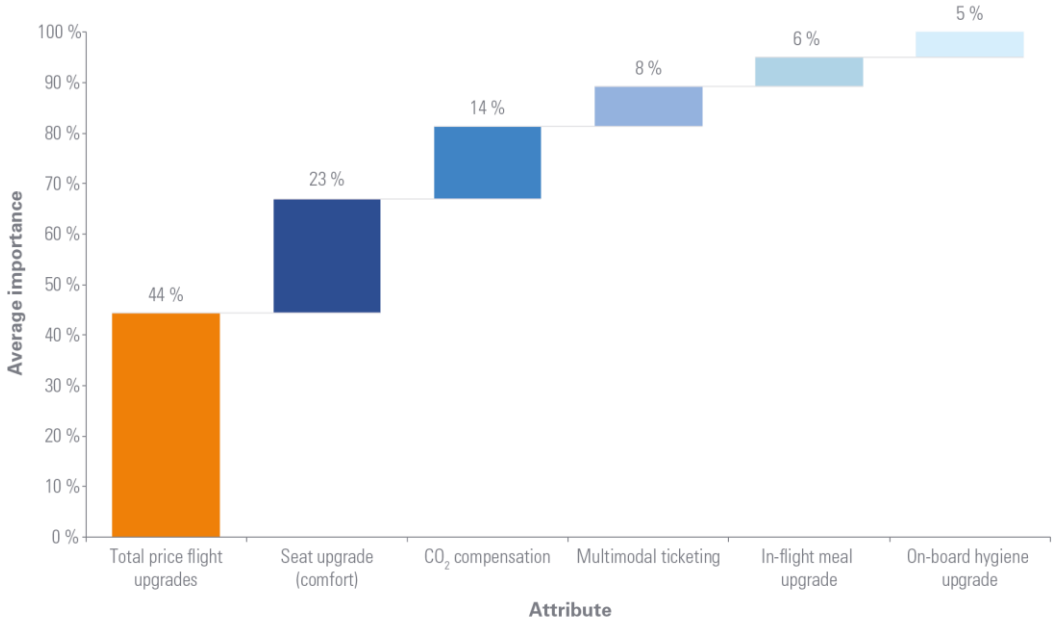
NEW NORMAL

Key insights

- **60 %** of passengers are **ready to upgrade** their tickets with ancillary services on a long-haul flight
- **CO_2 compensation** shows **higher preference** to be chosen by passengers, indicating that **green flying gains momentum in the New Normal**
- **Hygiene-related ancillaries** bring **few utilities**
- Female and senior passengers care more for environmentally friendly ancillaries, indicating a segment of green flyers
- Business passengers and frequent flyers care more for comfort upgrades aboard as already seen pre-COVID

Implications for the air transport system

- Results shed light on uncertain future and passenger preferences
- Support **pricing and product decisions** for operators and increasing yields with targeted segmentation strategies



Relative influence of the total upgrade price and ancillary services on passengers' choice behaviour

Source: Schmalz et al. (2022)

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REFERENCES & CONTACT

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Bauhaus Luftfahrt Trend Monitor

How can you get involved? Become part of our trend network!

- Learn more about upcoming challenges and opportunities in a complex aviation system
- Explore other sectors, novel data sources, and the integration of different disciplines
- Identify weak signals and emerging trends with us
- Derive first implications for your business

Contact

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