Green-GEAR

Project Overview – Green operations with GEometric altitude, Advanced separation and Route charging solutions

Final Dissemination Workshop – 12th Feb 2026

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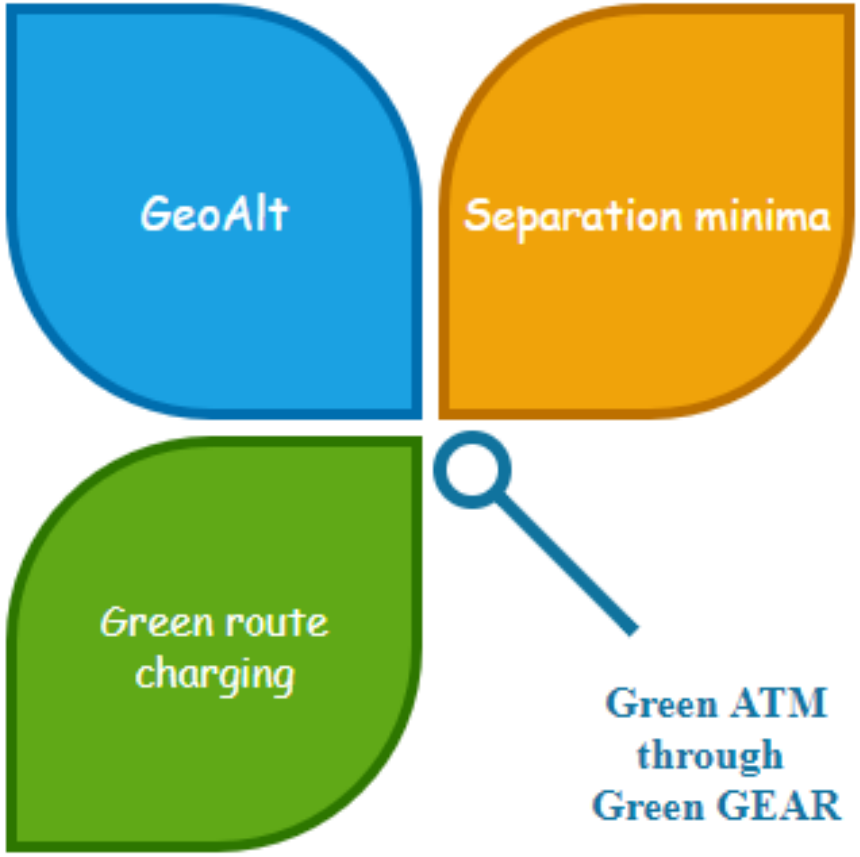
Overview

- Project Facts

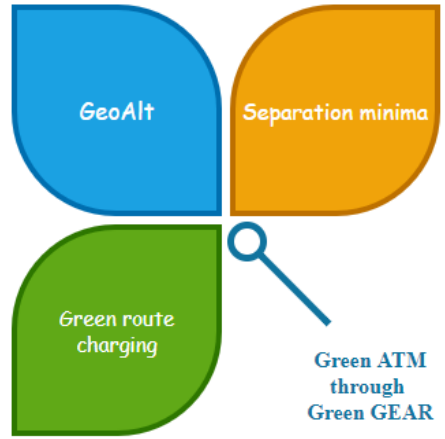
- Motivation for the three Solutions
  - Geometric Altimetry
  - Separation Minima
  - Green Route Charging

- Aim of the Workshop



Green operations with Geometric altitude, Advanced separation and Route charging solutions – Project Facts

- Call/Topic: HORIZON-SESAR-2022-DES-ER-01-WA2-7
- Type: **Exploratory Research** / Application-oriented (targeting TRL 2)
- Duration: 01/09/2023 – 28/02/2026 (30 months), of which
  01/09/2023 – 31/08/2025 (**24 months**) technical phase
  01/09/2025 – 28/02/2026 (6 months) dissemination phase
- budget: € 2,364,387.50 total / € 1,245,006.25 max. EU contribution
- partners: DLR *(coordinator)*
  Airbus & Airbus Operations
  EUROCONTROL
  NATS (En Route) *(associated)*
  NLR
  Università degli Studi di Trieste
  University of Westminster *(associated)*



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Solution 0406

Geometric Altimetry

Vertical Guidance using Geometric Altimetry (“GeoAlt”)

- status quo: altitude determination (outside of final approach) via air pressure (barometric formula, $p = p(h)$)
- weather-dependent difference between actual altitude and indicated altitude [fig. 1]
  - near to the ground, the actual altitude is vital
    → “offset” correction from standard (STD) ground pressure reference to local (QNH) value when below the *transition layer* [fig. 2]

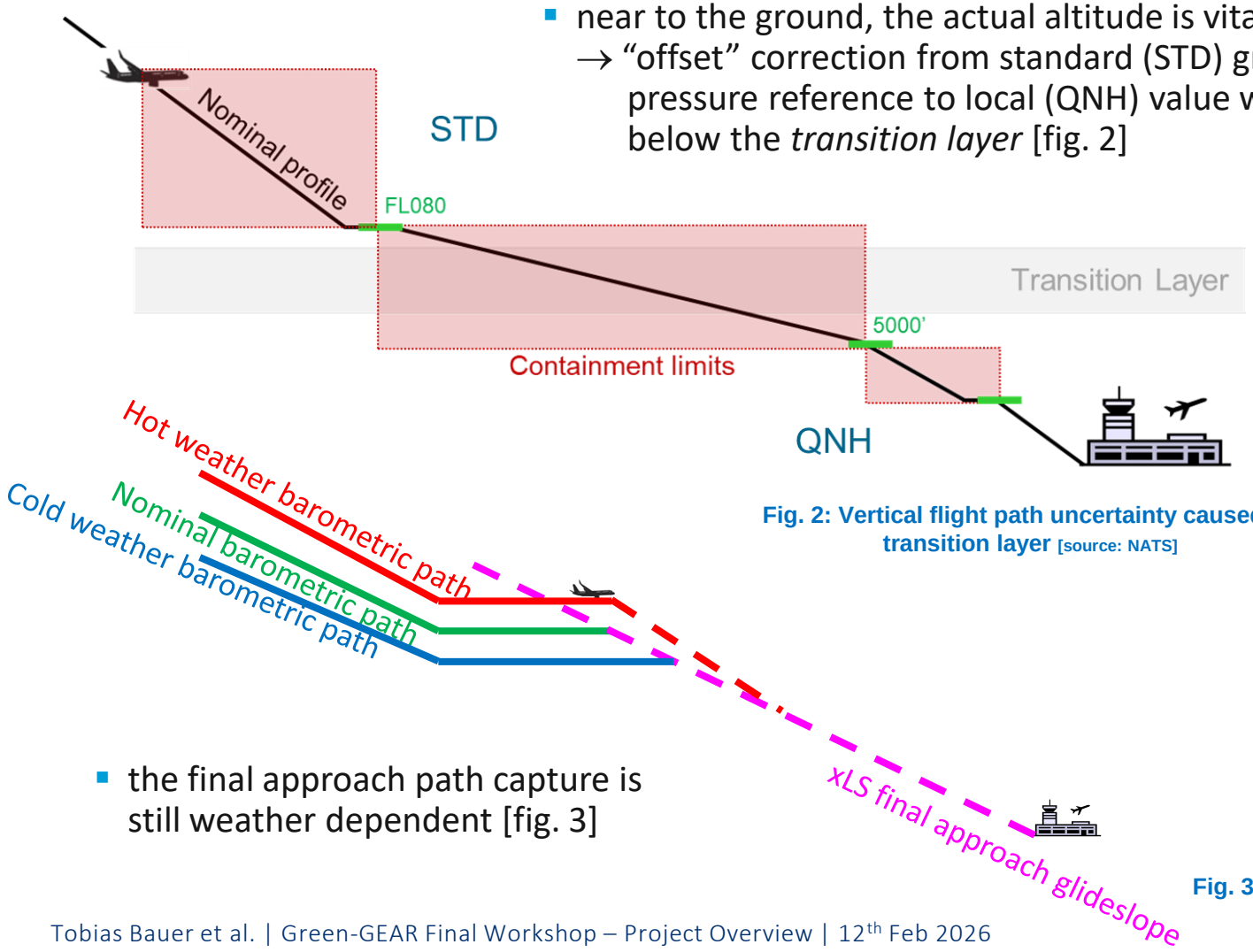


Fig. 2: Vertical flight path uncertainty caused by transition layer [source: NATS]

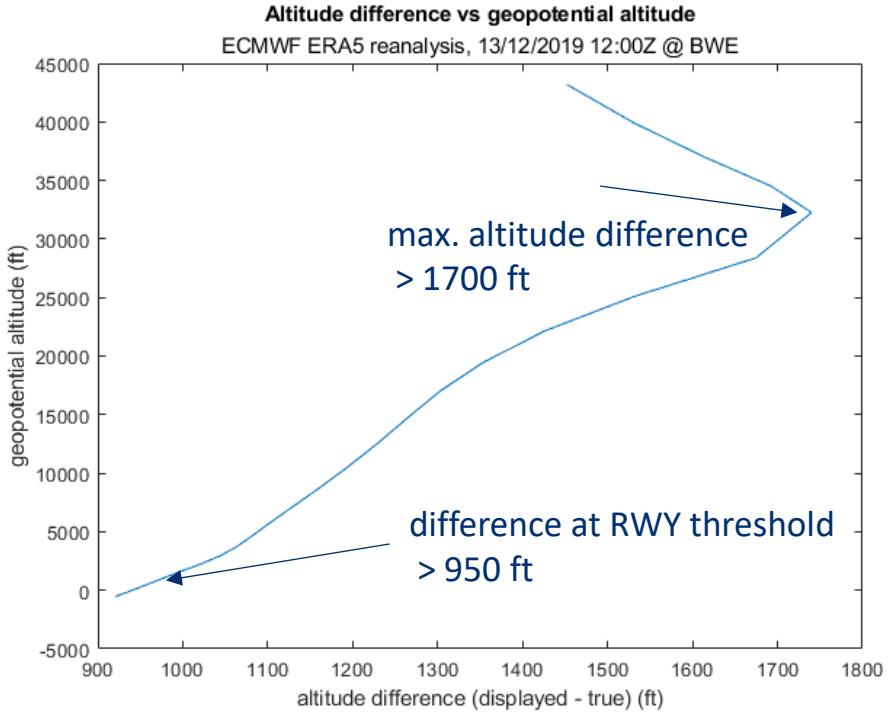
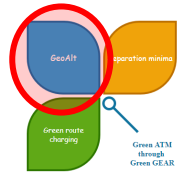


Fig. 1: Sample of difference between ‘actual’ geopotential and ‘indicated’ barometric altitude [source: DLR]

- the final approach path capture is still weather dependent [fig. 3]

Fig. 3 Efficiency and safety benefits during glideslope capture [source: Airbus]

GeoAlt – Research Questions



analysis of the potential of replacing barometric with geometric (GNSS) altitude reference

- scope of the Solution: Terminal Manoeuvring Area (TMA):
  - Can we design a more efficient route network and increase capacity through reduction of containment limits?
  - Can we improve safety by removing the necessity for the QNH correction, without introducing new HF or safety issues?
  - Can redesign and higher predictability of the vertical profile enable less fuel consumption in arrivals and departures?
  - Is the expected simplification of cockpit procedures and improved vertical guidance to intersection with landing systems compatible with existing aircraft system architectures?
- additionally: en-route phase
  - What is the influence on flight performance, which is intrinsically linked to barometric conditions?
  - What is the impact on operations and aircraft systems architecture?

Solution 0407

Separation Minima

Separation Minima

- status quo: the comparatively low accuracy of barometric altimetry is the major contributor to 1000 ft vertical separation requirement between FL290 and FL410, and 2000 ft above
- measurement of static air pressure in a moving aircraft is difficult, with unsurmountable fundamental issues
- emerging types of airspace users primarily use GNSS altitude

- **RVSM 2** concept: leverage the reduced altimetry system error (ASE) of GNSS [fig. 4] for reduced minimum vertical separation [fig. 5]
- initially no further changes to separation modes

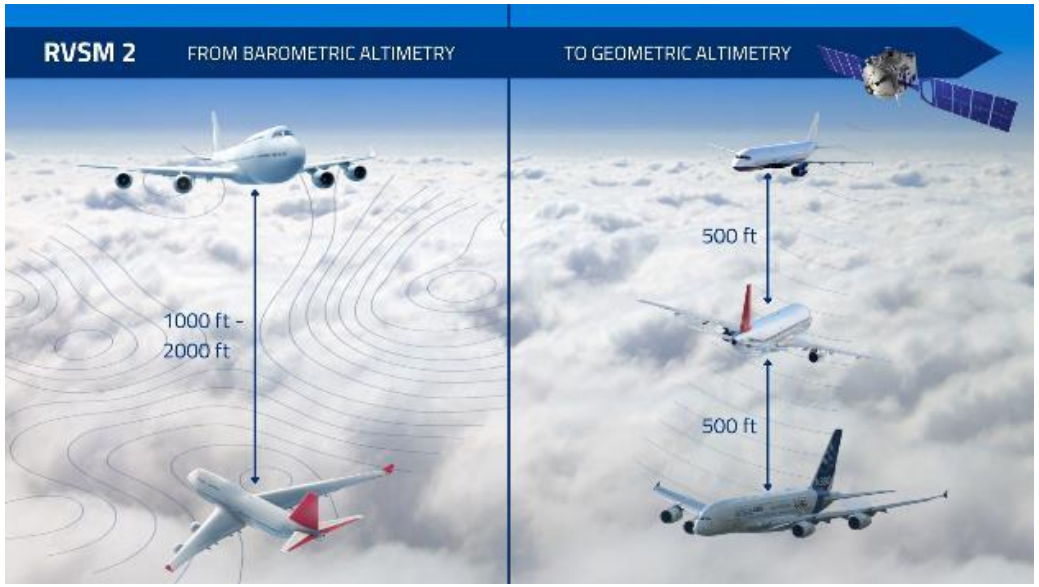


Fig. 5: Artist's depiction of RVSM vs. RVSM 2 operations
[source: DLR]

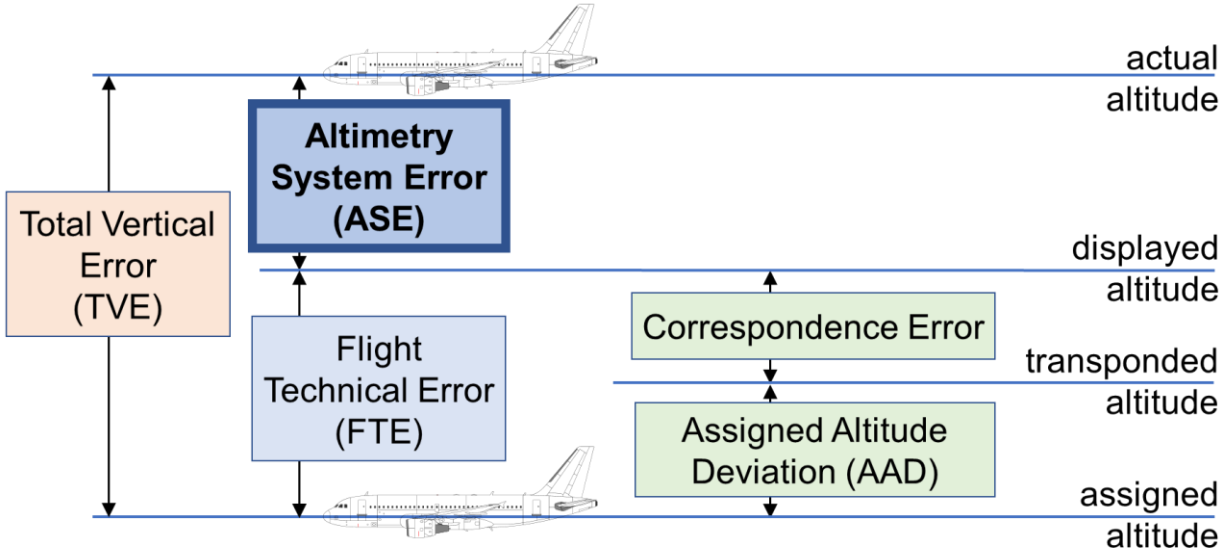
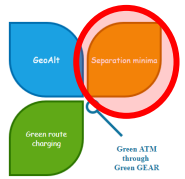


Fig. 4: Vertical errors definition
[after ICAO Doc 9574; source: DLR]

Separation Minima – Research Questions



assessment of the safety of reduced vertical separation using geometric (GNSS) altitude

- scope of the Solution: en-route airspace (RVSM 2 airspace)
  - Can we safely reduce the minimum vertical separation between aircraft in upwards extended RVMS airspace to 500 ft
    - regarding the nominal collision risk?
    - regarding the operational collision risk?
    - regarding the wake vortex encounter risk?
  - What are the safety requirements to do so?
- while not sufficient, safety is the most prominent potential showstopper and has been the focus; additional points have been addressed cursorily:
  - Are there limitations to the capacity increase from the technical safety point of view?
  - What could be the flight efficiency benefit?

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Solution 0408

Green Route Charging

Green Route Charging („Green RC“, GRC)

- in practice, flight plans are observed that cannot be explained with weather, congestion, strikes ... alone but are understandable when considering unit rate differences [fig. 6]
- propose business and operational **incentivisation** of climate-optimised flight planning through route charging
- also capacity taken into account
- **AUs free to choose trajectory** depending on company policy
  - typical weather
  - expected delays
  - urgency (connections, pax compensation, curfews)
  - ...

  but ceteris paribus the most environmentally friendly one should have the least direct costs
- achieve environmental benefits *at network level* and **revenue neutrality per service unit for ANSPs**
- initial Solution: CO_2 / fuel only
- full Solution: also non-CO_2 effects

Fig. 6: Tracks of flights avoiding (comparatively expensive) UK airspace
[source: NATS]

Green RC – Research Questions

assessment of the viability of reducing environmental impact through *modulation* of en-route charges

- scope of the Solution: en-route airspace
  - Can we increase (horizontal) **routing efficiency at network level** through appropriate modulation of charges while
    - respecting capacity constraints
    - keeping economic impacts stable (no cost increase for AUs *on average*, stable revenue *per service unit* for ANSPs)?
  - In view of the facts that
    - aviation's non-CO_2 climate effects contribute more to global warming than CO_2 effects,
    - flight through *climate hotspots* produces much more environmental damage,

    can we find a scheme to **avoid** ever-changing and difficult-to-predict **climate hotspots**?

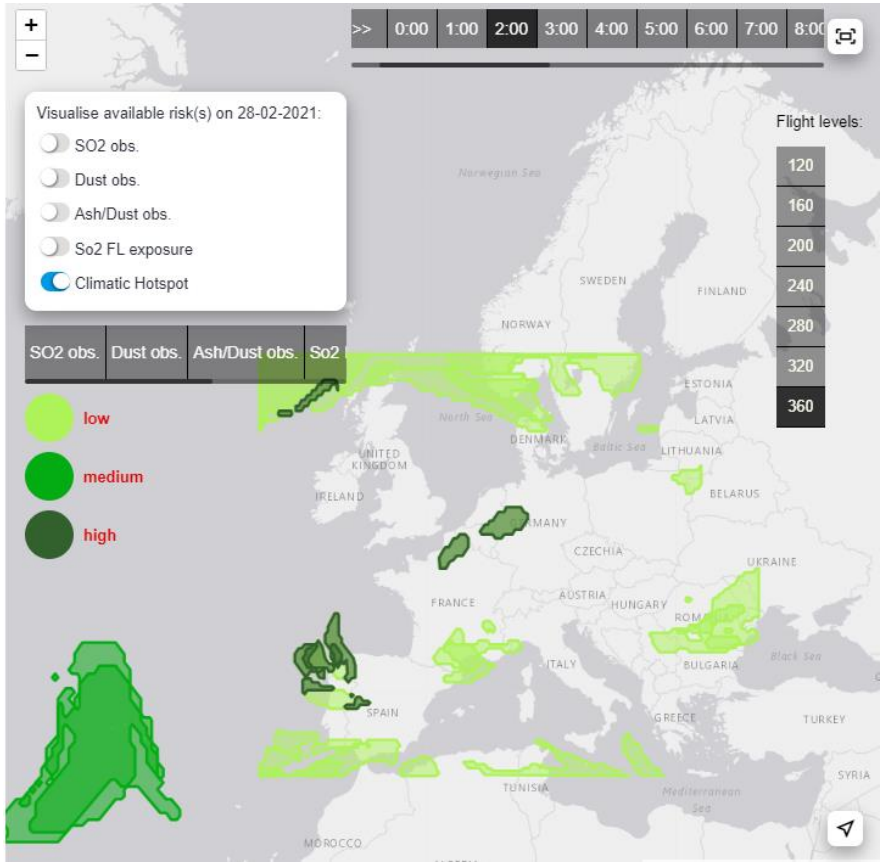
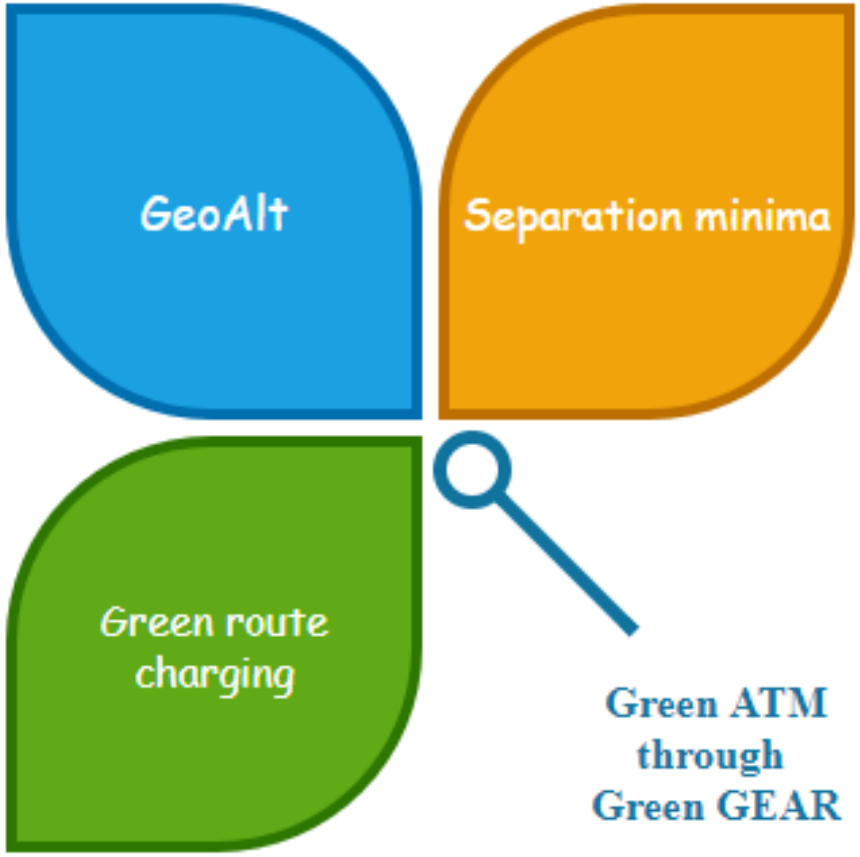


Fig. 7: Sample map of climate hotspots [source: ALARM project[1]]

1: ALARM demo website at https://alarm-project.eu/integrated-platform-for-the-nowcasting-and-forecasting-of-multiple-meteorological-hazards-including-climatic-impact/

Aim of the workshop

- learn about the project results
- give feedback on viability of the concepts
- discuss way forward



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