

CONSAVE 2050 - Aviation Scenario Storylines

Abbreviations:

IN	Influence on air transport development, adjusted to fit the AERO model input variables (e.g. environmental pressure)
AV	Quantification parameter - AERO model input variable (e.g. population, economic growth)
EO	Expected output used as yardstick for the calculations with the AERO model (e.g. demand)
OP	Other influence parameters on air transport development, but no direct input variable

1. High Growth

1.1. Unlimited Skies (ULS)

Main challenges, bottlenecks, constraints

Very high challenges, to keep airport capacity in line with the requirements of the huge demand, especially in Europe and the States. The high challenges to fit demand are addressed and overcome by reacting in time, applying market forces.

Background Development (external to aviation)

- Strong market orientation OP
- Moderate population growth with 7.6 billion people in 2020 and 8.7 billion in 2050 AV
- 2.9% economic growth per annum AV
- World GDP: 57 trillion \$ (1990 US\$, mer) in 2020 and 180 trillion (1990 US\$, mer) in 2050 AV
- Income gaps between regions close up IN
- Increasing convergence of social values and lifestyle along the “Western” hedonistic model OP
- “Soft” policy concept OP
- Active “management” of natural and environmental amenities and services OP
- High growth in energy use with 700 ZJ in 2020 and 1350 ZJ in 2050 IN
- High energy availability and low growth in energy prices IN
- Dynamism of technological innovation is broad-based OP
- Communication and transportation technologies highly homogenous and highly developed OP

Mobility Patterns and Transport Development

- High requirements for physical and virtual mobility IN
- High increase in average trip distance IN
- High increase in transport demand overall IN
- High enhancement of intermodal transport IN

Air Transport Supply and Demand

- Very high increase in air transport demand due to the high economic growth and the convergence of social values and lifestyles along the western hedonistic model EO
- High increase in air trips per capita EO
- High increase in air transport supply, both hub & spoke flights and point to point flights EO
- High comfort standards IN
- Increase in all trip purposes (vacation, leisure and business), highest growth in leisure trips, higher growth in vacation trips than in business trips EO
- Demand peaks caused by mega events like Olympic Games, World Exhibitions and World Championships OP

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- High increase in air cargo demand and supply EO
- Decrease of military movements in relation to the total number of flights EO

Aircraft Technology

- Aircraft size increase, new very large aircraft available AV
- High dynamism in the development of propulsion technology IN
- Lower specific fuel consumption and decrease in aircraft noise AV
- Major introduction of Cryoplane from 2060 (start in 2045) AV
- Very fast innovation cycles in new technologies AV

Airport and Air Traffic Management Capacity

- Many new airports, most notably in Asia IN
- New Airports financed without public capital IN
- High constraints in the availability of airport capacity, in particular in conurbations like New York, London and Tokyo IN
- New technologies in Air Traffic Management, enhancement of productivity IN
- In spite of high increase of aircraft movements, no serious problems with delays IN
- Mega Airports with very high capacity IN

Safety & Security

- High safety and security standards, paid from fares IN
- Low specific accident rate IN
- Low security problems IN

Air Transport Market Development

- Deregulation OP
- Strong competition IN
- Building of alliances as a transitional stage toward global fusions OP
- No more differentiation between Network Carriers and Low Fare Carriers because of the low level of air transport fares in general IN
- Number of global players decreases, however many regional airlines IN
- Specific profits decrease AV

Aviation Costs

- Higher personnel costs in general, but lower specific costs because of higher productivity AV
- Lower specific costs for maintenance because of higher productivity AV
- Higher costs for new aircraft AV
- Higher costs for airport usage because of high demand for airport capacity AV
- Lower specific costs for ATM services AV
- Costs for aircraft fuel increasing AV
- Decrease of fares in air transport because of high competition AV

Environmental Impacts of Air Transport

- Decrease of specific emissions (gaseous and noise) because of technological development EO
- High increase of emissions (gaseous and noise) overall because of high increase in numbers of flights, but noise problems for sleepers decreased EO
- No major problems with the increase in emission because impacts of emissions are shown to be less dangerous than originally thought and therefore the environmental consciousness is reduced. Noise molestations are compensated. IN

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1.2 Regulatory Push & Pull (RPP)

Main challenges, bottlenecks, constraints

Nuisances of noise (especially during the first decades of the century) and emissions (near airports, climate change) are predominantly addressed by frame-setting policy measures, which require high costs and adaptation phases for aviation stakeholders.

Background Development (external to aviation)

- Increasing environmental problems (local and global) IN
- Regulatory approach in environmental issues IN
- Moderate population growth with 7.6 billion people in 2020 and 8.7 billion in 2050 AV
- 2.9% economic growth per annum AV
- World GDP: 57 trillion \$ (1990 US\$, mer) in 2020 and 180 trillion (1990 US\$, mer) in 2050 AV
- Income gaps between regions close up IN
- Increasing convergence of social values and lifestyle along the “Western” hedonistic model OP
- High growth in energy use with 610 ZJ in 2020 and 1100 ZJ in 2050 IN
- Energy availability is a challenge to regulation. Medium growth in energy prices IN
- Dynamism of technological innovation is broad-based OP
- Communication and transportation technologies highly homogenous and highly developed OP

Mobility Patterns and Transport Development

- High significance of physical mobility IN
- High importance of virtual mobility IN
- Increase in average trip distance IN
- Increase in transport demand in general, not so strong as in “Unlimited Skies” IN
- High enhancement of intermodal transport caused by regulation IN
- Higher regulation of leisure trips than of business trips IN

Air Transport Supply and Demand

- High increase in air transport demand depending on the high economic growth and the conditional convergence EO
- High increase in air transport supply, both hub & spoke flights and point to point flights EO
- Increase in air trips per capita EO
- Business trips with high importance and high growth rates, but vacation and leisure trips with higher growth rates EO
- Demand peaks caused by mega events like Olympic Games, World Exhibitions and World Championships OP
- High increase in air cargo demand and supply, but not so strong as in US EO
- Decrease of the share of military movements on the total number of flights EO

Aircraft Technology

- Aircraft size increase, new very large aircraft available AV
- High dynamism in the development of propulsion technology IN
- Lower specific fuel consumption and decrease of aircraft noise, pushed by governmental regulations AV
- Introduction of Cryoplane starts 2035 [check final decision] AV
- Innovation cycles for aviation technology driven by regulation AV

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Airport and Air Traffic Management Capacity

- Some new airports, most notable in Asia IN
- Airport capacity regulated by government IN
- New airports financed by government, but managed by private sector IN
- Constraints in the availability of airport capacity IN
- New technologies in Air Traffic Management, enhancement of productivity, regulation of ATM services IN

Safety & Security

- High safety standards defined by government and paid from fares IN
- Low specific accident rate IN
- High security standards ensured by government IN
- Low security problems IN

Air Transport Market Development

- Liberalisation in transport markets in general, but many detailed regulations OP
- Many airlines, but medium competition IN
- High profits protected by regulation AV
- High importance for airline alliances. No fusion possibilities because of high regulation OP
- Low Fare Carriers are complementary to Network Carriers, limited proportion of Low Fare Carriers because of high regulation IN

Aviation Costs

- Higher personnel costs in general, but lower specific costs because of higher productivity AV
- Higher specific costs for maintenance in comparison to “Unlimited Skies” because of higher regulation standards AV
- Lower specific costs for new aircraft than in “Unlimited Skies” AV
- Low costs for airport usage because of regulation AV
- Lower specific costs for ATM services AV
- High costs for aircraft fuel AV
- Decrease of fares in air transport, but not so strong as in “Unlimited Skies” AV

Environmental Impacts of Air Transport

- Decrease in specific gaseous emissions because of regulation EO
- Increase in gaseous emissions overall because of increase in numbers of flights EO
- Decrease in specific noise emissions because of regulation EO
- Increase in noise emissions overall because of high increase in numbers of flights EO
- As response of the emission increase regulations are tightened. IN

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2. Fractured World (FW)

Main challenges, bottlenecks, constraints

Due to two political, religious and social divergences, the world is divided into blocks with high tensions, occasional confrontations, terrorism, causing high security and standardisation problems/costs.

Background Development (external to aviation)

- Large international disparities, less cooperation, more conflicts, autarky orientation IN
- Political structures diversify, regional governments strengthened IN
- Global block building with dividing lines: “North Atlantic” (between North and Central America, and Eurasia [i.e. Europe and Russia]), the “Pacific” (between America and Asia), the “Mediterranean” (between Eurasia and the Islamic world), and the “Himalayan divide” (between the Indian subcontinent and China, Japan and the rest of Asia) IN
- Heterogeneous economic growth between regions AV
- 2.3% growth per annum for world GDP AV
- World GDP: 40 trillion \$ (1990 US\$, mer) in 2020 and 82 trillion (1990 US\$, mer) in 2050 AV
- High population growth with 8.2 billion people in 2020 and 11.3 billion in 2050 AV
- Social trends highly heterogeneous OP
- Environmental protection is not uniform between the regions, global environmental concerns are weak IN
- Disparities in energy availability, high energy prices in general, heterogeneous growth in energy use between regions, global use: 600 ZJ in 2020 and 970 ZJ in 2050 IN
- Technology development dependant upon regional resources OP
- Fast development in communication technologies, but persistent incompatibilities between regions OP

Mobility Patterns and Transport Development

- The importance of physical mobility differs between world regions IN
- High importance of virtual mobility in a few world regions, like NA, Europe, Asia IN
- Long-distance travel only to friendly regions IN
- Development in transport demand inhomogeneous among world regions IN
- Enhancement of intermodal transport in a few world regions, like NA, Europe, Asia IN

Air Transport Supply and Demand

- Different development of the air transport supply and demand in different world regions EO
- High growth in domestic air transport demand in North America, Europe and Asia EO
- Low growth in interregional air transport demand with large fluctuations due to occasional improvements in the relationships between blocks or on account of economic and military conflicts EO
- Different comfort standards in aviation between the world regions IN
- Different development in trip purposes: very high growth of vacation and leisure trips and high growth of business trips in western regions, only growth of business trips in poor regions EO
- Different development of air freight growth, low growth in long distance air cargo demand EO
- Comparably high level of military movements EO

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Aircraft Technology

- Different standards in different world regions IN
- High technology development in North America, Europe and Asia with new fuels (synfuel, hydrogen), new propulsion technologies IN
- Lower specific fuel consumption and decrease of aircraft noise in North America, Eurasia and Far East AV
- High specific fuel consumption in Middle East because of high oil availability AV
- Introduction of Cryoplane only in Eurasia AV
- Different diffusion of new aviation technologies: high introduction of innovation in the western regions AV

Airport and Air Traffic Management Capacity

- Airport capacity availability is inhomogeneous IN
- Significant infrastructure constraints in Europe and North America IN
- Private financing of airports in western regions (NA, Europe, Far East), public finance of airports in other regions IN
- Low efficiency of the ATM-System overall because of many different technical solutions IN
- Efficiency problems in interregional flights because of different standards in ATC IN

Safety & Security

- Different standards in safety between the world regions IN
- High safety standards in North America, Europe and Southwest Pacific IN
- Safety problems in a few world regions like Africa and South America IN
- High effort to ensure security all over the world, with high costs IN
- Different guarantees for security between the world regions IN
- During conflicts, occasionally high security problems, especially affecting the interregional air traffic between hostile regions. IN
- Phases with terrorism IN

Air Transport Market Development

- Liberalisation in a few world regions, but still dominance by national carriers OP
- Different competition in the different world regions IN
- High profit for airlines in world regions with high air transport demand AV
- Airline alliances only in the individual regions, high importance for alliances in regions of high air transport growth OP
- High relevance of Low Fare Carriers in regions with high air transport growth IN

Aviation Costs

- Heterogeneous personnel costs in different world regions AV
- Higher specific costs for maintenance because of different regulation standards AV
- High specific costs for new aircraft because of small volume of aircraft ordering AV
- Varying costs for airport usage AV
- High specific costs for ATM services because of low efficiency AV
- Varying costs for aircraft fuel, high costs in North America and Europe AV
- Increase in fares for air transport AV

Environmental Impacts of Air Transport

- Heterogeneous development of specific gaseous and noise emissions in the world regions EO
- Heterogeneous development of gaseous and noise emissions overall in the world regions EO
- Heterogeneous environmental regulations for aviation in the world regions IN

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3. Down to Earth (DtE)

Main challenges, bottlenecks, constraints

The problem to achieve sustainability is addressed by uncompromising changes in lifestyles. Air transport, especially long distance trips regarded very critically for the mainstream, the demand is low. In addition customers require high security, safety and comfort levels.

Background Development (external to aviation)

- Significant lifestyle change: Social and environmental values are “mainstream”. OP
- High environmental consciousness and environmental concerns IN
- Moderate population growth with 7.6 billion people in 2020 and 8.7 billion in 2050 AV
- 2.5% economic growth per annum AV
- World GDP: 53 trillion \$ (1990 US\$, mer) in 2020 and 136 trillion (1990 US\$, mer) in 2050 AV
- Fast-changing and convergent world IN
- Successful governance concepts OP
- Low growth in energy use with 580 ZJ in 2020 and 810 ZJ in 2050 IN
- Post-fossil technologies and rapid diffusion of cleaner technologies IN
- Medium growth in energy prices IN
- Global spread of information technologies OP

Mobility Patterns and Transport Development

- Low importance of physical mobility IN
- High importance of virtual mobility IN
- Decrease in average trip distance IN
- Sparse long-distance travel, in particular for vacation trips IN
- Low increase in transport demand overall IN
- High importance of intermodal transport in conurbations IN

Air Transport Supply and Demand

- Decrease in demand for air transport because of ecological awareness EO
- Decrease in air transport supply, mainly point to point flights EO
- Low growth of vacation and leisure trips, medium growth of business trips, business most important reason for air transport demand EO
- Low air freight demand growth EO

Aircraft Technology

- Introduction of Cryoplane starts in 2030 AV
- In 2040 95% of all aircraft are powered by hydrogen. AV
- Lower specific fuel consumption and decrease of aircraft noise because of high environmental standards AV
- Innovation in aircraft technologies driven by environmental regulations IN

Airport and Air Traffic Management Capacity

- Few new airports necessary within the first three decades, afterwards decrease in demand and no new airports needed IN
- Airports managed by the government because of low profitability IN
- No constraints in airport and ATM capacity IN

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Safety & Security

- High safety and security standards IN
- No safety or security problems IN

Air Transport Market Development

- High regulation in transport markets IN
- Decrease in the number of airlines and low competition between airlines IN
- High importance of airline alliances but also of fusions to enhance declining profitability of airlines OP
- No relevance for Low Fare Carriers because of high environmental costs and low demand IN
- Strong decrease in military movements EO

Aviation Costs

- Higher personnel costs, in general and specifically AV
- Higher specific costs for maintenance because of high regulatory standards AV
- High specific costs for new aircraft because of small volume of aircraft orders AV
- High costs for airport usage because of high cost of environmental taxes AV
- High specific costs for ATM services because of lower flight demand AV
- High costs for aircraft fuel because of high cost of environmental taxes AV
- High increase in fares for air transport AV

Environmental Impacts of Air Transport

- Decrease of specific gaseous emissions because of regulation EO
- Decrease of gaseous emissions overall because of decrease in numbers of flights EO
- Decrease of specific noise emissions because of regulation EO
- Decrease of noise emissions overall because of decrease in numbers of flights EO
- In spite of decrease in noise and the emissions, most people think that aviation is a burden because of high environmental consciousness. IN