MONITOR

Monitoring System of the development of Global Aviation
EU-funded coordination and support action

The Updating of the CONSAVE 2050 Scenarios: Framework and Air Transport related Assumptions

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Needs for the updating of the CONSAVE scenarios

- The updating of the CONSAVE scenarios within MONITOR will be an example for a quantitative analysis in a monitoring system
- New global development scenarios with modified data came up in the field of climate change research
- AERO-MS as the quantification tool of the CONSAVE scenarios was updated in the SAVE project
- There is a need to consider new priorities in the field of aviation research, like bio fuels instead of H_2

General aspects of the scenario update

- The updated AERO will be used for quantification.
- The basic taxonomy of the CONSAVE scenarios will be retained
- Most of the CONSAVE assumptions will be retained. Only a few assumptions should be adapted.
- Modified data on framework will be used to quantify the scenarios.
- If there are additional data requirements for the scenario updating, the used data sources should be considered in the Network of Sources.

Modifications to be considered

- Population: modified IPCC data were used
- GDP: modified IPCC data were used
- Energy prices: CONSAVE assumptions were checked and could be retained
- CO2 mitigation targets: only in DtE reached
- Bio fuels (instead of H2 as fuel)
- Adapted technology goal: higher efficiency increase in ULS

Adjustments of CONSAVE Scenario characteristics

CONSAVE assumptions	Unlimited Skies (ULS)	Regulatory Push & Pull (RPP)	Fractured World (FW)	Down to Earth (DtE)
Main assumptions	Very High growth of demand: Ability to fit demand, new technologies	High growth of demand + Environmental problems + Introduction of Cryoplane	Global conflicts, regionalisation, and fractured markets	Changing values, regional lifestyles and environmental conscious
Main character of challenges/ constraints	Need for large enhancement of aviation infrastructure and energy availability, landing charges	Regulations and increasing costs	Security problems, low demand, high costs (strong focus on regional resources, low standardisation)	Low demand, very high sensitivity to environmental impacts
IPCC/SRES related scenarios	SRES A1	SRES A1 -3%*	SRES A2	SRES B1

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Main character of challenges/ constraints	Need for large enhancement of aviation infrastructure and energy availability, landing charges	Regulations and increasing costs	Security problems, low demand, high costs (strong focus on regional resources, low standardisation)	Low demand (but higher than CONSAVE), high sensitivity to environmental impacts
IPCC/SRES related scenarios	No current IPCC scenario available, use of old ones?	No current IPCC scenario available, use of old ones?	SRES A2	SRES B1

Adjustments of the shaping factors

CONSAVE 2050 Assumptions	**Unlimited Skies**	**Regulatory Push & Pull**	**Fractured World**	**Down to Earth**
Population	8,7 Billion	8,7 Billion	11,3 Billion	8,7 Billion
GDP growth (as a multiple from 1990)	7,7	7,4	2,9	5,5
Energy price (1990 = 1)	2	4	8	4

Adjustments of the shaping factors

Modified Scenario Assumptions	**Unlimited Skies**	**Regulatory Push & Pull**	**Fractured World**	**Down to Earth**
Population	8,6 Billion	8,6 Billion	10,2 Billion	8,6 Billion
GDP growth (as multiple from 1990)	8,7	8,7	3,8	5,5
Energy price (1990 = 1)	2	4	8	4
	in CONSAVE project used assumptions	in CONSAVE project used assumptions	Updated IPCC assumptions	Updated IPCC assumptions

Adjustments of key air transport assumptions

CONSAVE assumptions	Unlimited Skies	Regulatory Push & Pull	Fractured World	Down to Earth
Aircraft technology	new very large aircraft available	introduction of hydrogen powered ac	different standards	NOx optimized aircraft
Safety & Security	high standards	high standards	high effort for security	high standards
Market Development	deregulation, strong competition	controlled liberalisation, medium competition	dominance of national carriers	decrease in the number of airlines
Air transport supply & demand	Very high increase	High increase	Low growth in interregional flights	Decrease
Airport & ATM Capacity	Constraints	Capacity regulated	Depending to regions	No constraints
Aviation Costs	Lower specific costs	Lower specific costs	Higher costs (security & standards)	Higher specific costs

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Adjustments of key air transport assumptions

Assumption modifications	Unlimited Skies	Regulatory Push & Pull	Fractured World	Down to Earth
Aircraft technology	new very large aircraft available, higher efficiency growth	introduction of bio fuel	different standards	NOx optimized aircraft
Safety & Security	high standards	high standards	high effort for security	high standards
Market Development	deregulation, strong competition	controlled liberalisation, medium competition	dominance of national carriers	decrease in the number of airlines
Air transport supply & demand	Very high increase	High increase	Low growth in interregional flights	Slight increase
Airport & ATM Capacity	Constraints	Capacity regulated	Depending to regions	No constraints
Aviation Costs	Low specific costs, but higher than CONSAVE	Low specific costs, but higher than CONSAVE	Higher costs (security & standards)	Higher specific costs

Assumptions of the CONSAVE 2050 Scenarios also used for the updating

	fuel price levels (conventional and alternative fuels)	fuel efficiency increase	NOx reduction
ULS	2020: 1.5 as multiple of 1990, 2050: 2 as multiple of 1990	0.9% per year until 2020, 1.3% per year between 2020 and 2050	-2.25% per year until 2020, -1.3% per year between 2020 and 2050
RPP	2020: 2 as multiple of 1990, 2050: 4 as multiple of 1990	0.75% per year until 2020, 1.5% per year between 2020 and 2050	-2.75% per year until 2020, -0.74% per year between 2020 and 2050
FW	2020: 4 as multiple of 1990, 2050: 8 as multiple of 1990	regional differences (see additional spreadsheet)	regional differences (see additional spreadsheet)
DtE	2020: 2 as multiple of 1990, 2050: 4 as multiple of 1990	0.75% per year until 2020, between 2020 and 2050: 1.87% in North America, 0.76% in Eurasia and Far East, 1.43% in all other regions	-3.25% per year until 2020, -1.4% per year between 2020 and 2050

Additional assumptions for the updating of the CONSAVE 2050 Scenarios

	ETS	bio fuels introduction	
ULS	only in EU until 2020, after 2020 no ETS	on global scale: 10% in 2020, 20% in 2030, 30% in 2040 and 40% in 2050	reasoning: medium pressure for replacing conventional energy resources, bio fuels are one of several enery sources for aviation
RPP	in EU after the planned introduction, in the rest of the world after 2020	on global scale: 10% in 2020, 30% in 2030, 50% in 2040 and 70% in 2050	reasoning: high pressure for replacing conventional energy resources, bio fuels are the main future enery sources for aviation
FW	in EU after the planned introduction, in some other regions after 2020	regional differences (see additional spreadsheet)	regional differences (see additional spreadsheet)
DtE	in EU after the planned introduction, in the rest of the world after 2020	on global scale: 10% in 2020, 20% in 2030, 30% in 2040 and 40% in 2050	reasoning: medium pressure for replacing convetional energy resources, bio fuels are one of several enery sources for aviation, discussion on competetion to other uses of agricultural areas

Remarks:
- in EU bio fuels are excluded from ETS until
- after 2020 bio fuels should be regarded to 50% in ETS (MONITOR assumption)
- With the exception of FW a common global energy market can be assumed. In consequence will there be a common price level for conventional and alternative fuels.

Sources:
CONSAVE 2050 Final Report
Report of the European Expert Group of Future Transport Fuels, January 2011

Assumptions of the several regions in the FW scenario (I)

Region	ETS	Resource Availability	Aircraft fuels	bio fuels introduction	fuel price levels conventional and alternative fuels)*
North + Central America	no ETS	low quality fossil fuels	manufactured kerosene from low quality fossil fuels, e.g. tarsands etc	10% in 2020, 20% in 2030, 30% in 2040 and 40% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local
Eurasia	ETS before and after 2020	renewables and Russian gas	kerosene alternatives such as bio fuels, Russian gas	10% in 2020, 30% in 2030, 50% in 2040 and 70% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local
Middle East	no ETS	abundant oil reserves	Kerosene	0% in 2020, 5% in 2030, 10% in 2040 and 15% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local
Sub-Himalayas	no ETS	Coal	manufactured kerosene from coal	10% in 2020, 20% in 2030, 30% in 2040 and 40% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local
Far East North	ETS until 2020	Nuclear	manufactured kerosene and kerosene alternatives such as bio fuels	10% in 2020, 25% in 2030, 40% in 2040 and 55% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local
Other (Southern Africa, Oceania, Latin America)	no ETS	coal and biomass	manufactured kerosene from coal and biomass	10% in 2020, 20% in 2030, 30% in 2040 and 40% in 2050	**Until 2020:** Uniform oil price: **In 2030:** 70% world, 30% local; **In 2040:** 50% world, 50% local; **In 2050 and after:** 30% world, 70% local

* taken from page 78 of the CONSAVE 2050 Final Technical Report

Assumptions of the several regions in the FW scenario (II)

Region	fuel efficiency increase[a]	NOx reduction[b]
North + Central America	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** -1.87% p.a. after 2020; **2100:** -1.02% p.a. after 2020	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** gradual increase to 2x2000 levels (+11.5% p.a.); **until 2100:** no further change
Eurasia	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** -0.76% p.a.; **2100:** -0.886% p.a.	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** maintain 2020 tech levels; **until 2100:** no further change
Middle East	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** 2010-2020 aircraft mean levels; **2100:** -1% p.a.	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** 2010-2020 aircraft mean levels; **until 2100:** no further change
Sub-Himalayas	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** post-2000 aircraft mean levels; **2100:** -1% p.a.	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** post-2000 aircraft mean levels; **until 2100:** no further change
Far East North	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** -0.76% p.a.; **2100:** -0.886% p.a.	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** maintain 2020 tech levels; **until 2100:** no further change
Other (Southern Africa, Oceania, Latin America)	**2020:** -10 to -20% below 2000 level (-0.75 p.a.); **2050:** post-2000 aircraft mean levels; **2100:** -1% p.a.	**2020:** -50 to -60 % below 2000 level (-2.75% p.a.); **2050:** post-2000 aircraft mean levels; **until 2100:** no further change

[a] Note: reductions are cumulative year-on year. Reductions compared to year 2000 data.

[b] Note: reductions are constant percentage point reductions per year (not cumulative year-on-year)

Additional adjustments, which should be considered in a qualitative way

- The number of necessary supersonic business jets in ULS and RPP should be lower (150 to 300 instead of 500 to 1000).
- The aim of noise reduction in ULS, RPP and DtE of 10dB until 2020 seems to be very ambitious. This number should be discussed with additional experts.
- High security standards in all scenarios