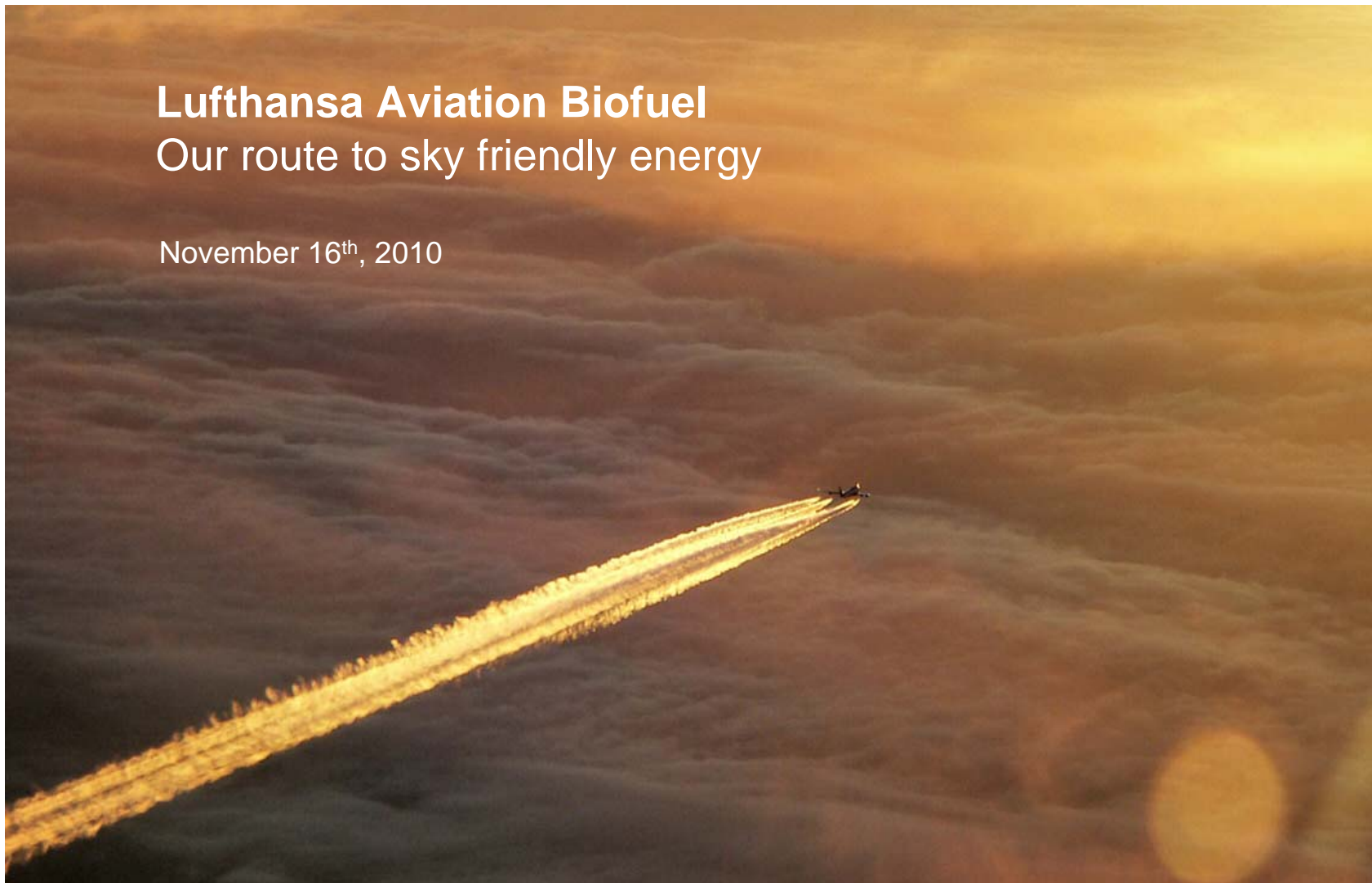


Lufthansa Aviation Biofuel

Our route to sky friendly energy

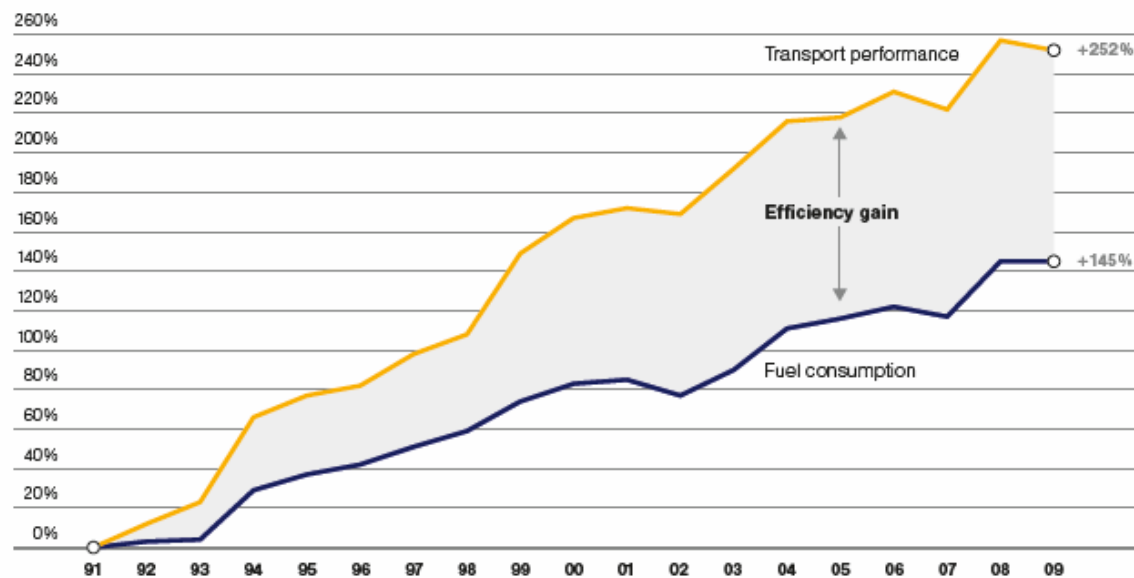
November 16th, 2010



Lufthansa has decoupled transport capacity from fuel consumption by a factor of two

Decoupling of transport performance and fuel consumption

Change compared to 1991 in percent, values for the fleet of the Lufthansa Group



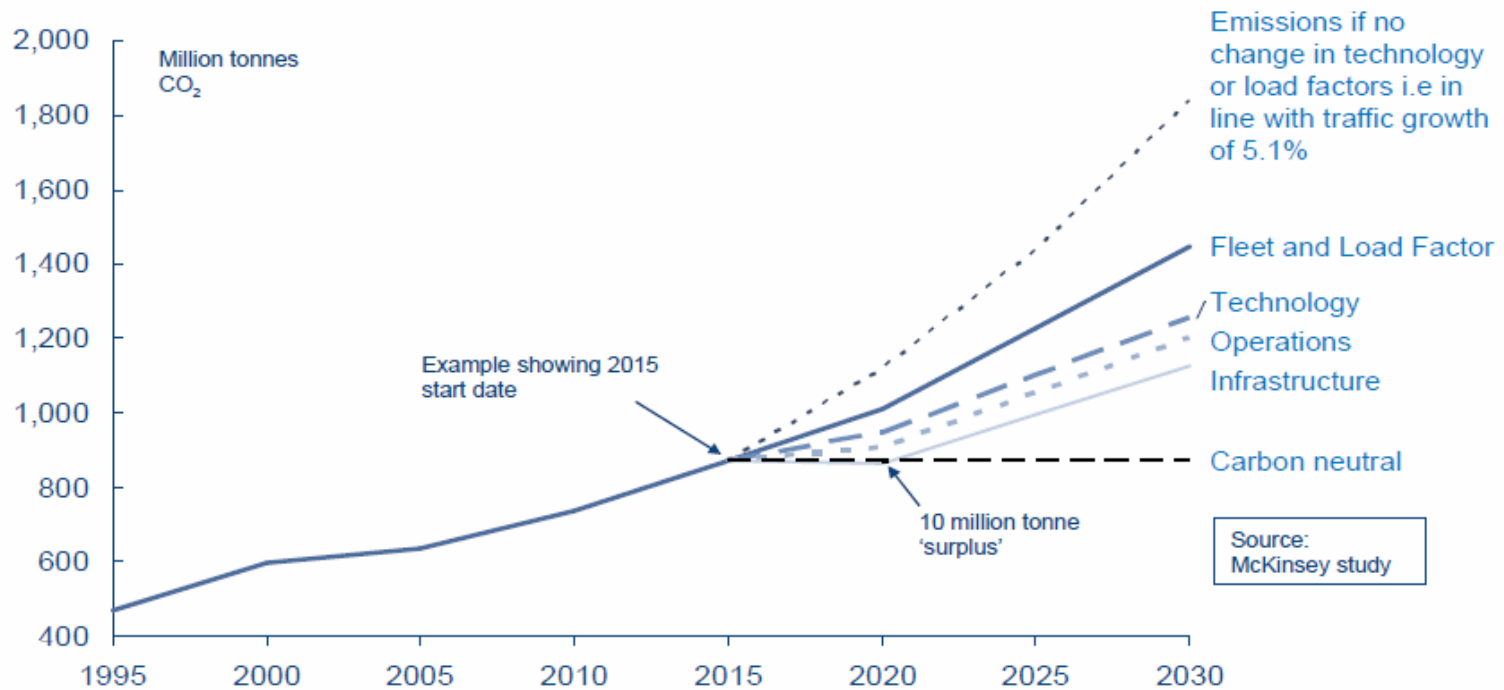
Carried through operational improvements and fleet modernization almost half of the growth since 1991 was CO₂ neutral

Transport service in TKT
Source: Balance 2010

Even a tight use of all technologies can't stop raising CO₂- emissions



Something beyond technology improvement has to happen to curtail future CO₂ emission growth



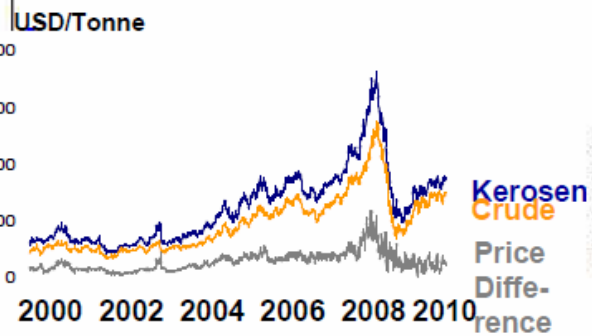
Drivers for alternative fuels

crude oil is limited

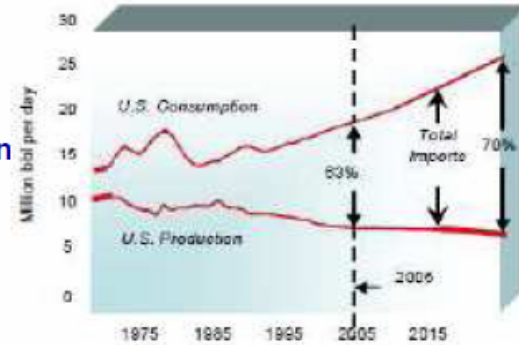


Price is increasing and volatile

Price of oil



Dependency from import



Environmental issues brought additional boost and is the current priority topic



Industry Concept of Carbon Neutral Growth

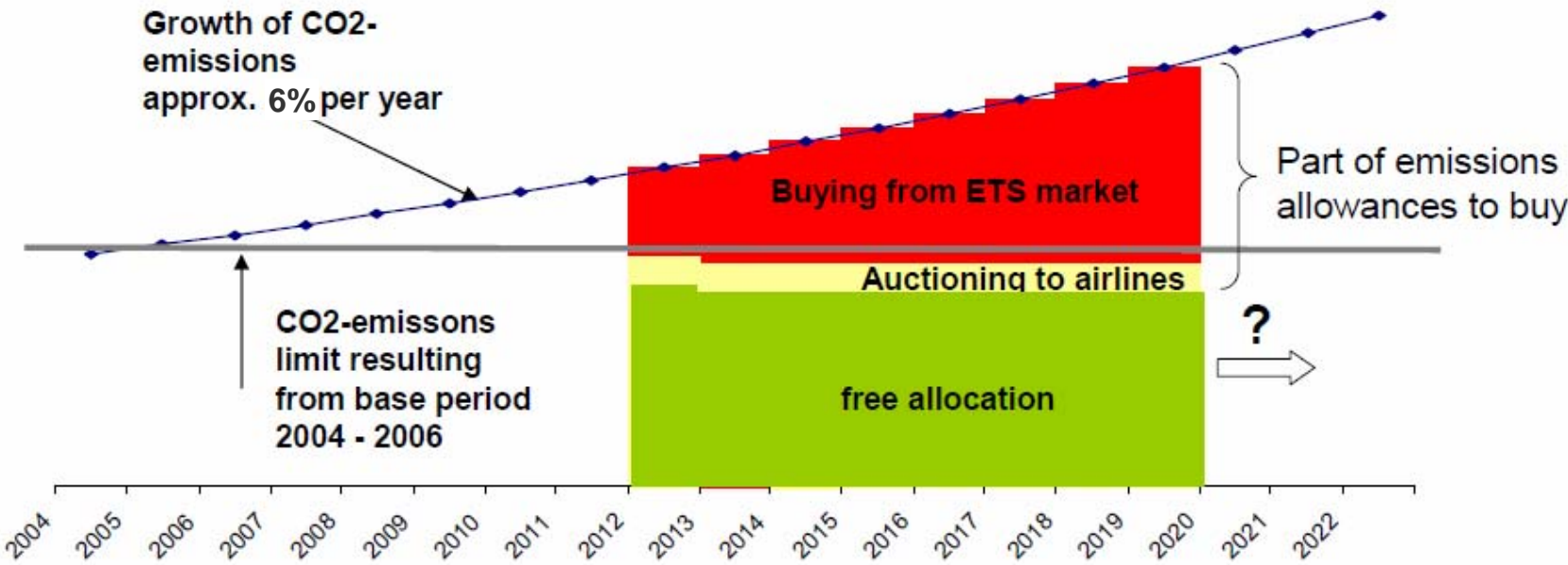
The industry approach to mitigate climate change



Industry targets



Emissions trading involves risks: price per ton CO₂ and unclarified number of acquired certificates



Statistics about jetfuel consumption within the Lufthansa Group

2009 in m³ *

Austrian**	834.380
bmi**	539.785
Germanwings	273.386
Lufthansa Cargo	751.714
Lufthansa Passage	7.035.186
Swiss	1.526.520

Total **Σ 10.960.971**

=====

* January 1st to December 31st, 2009

** 1m³ = 1.000 Liter

Statistics about jetfuel consumption

Daily jetfuel consumption in 2009 (average): 30.030 m³

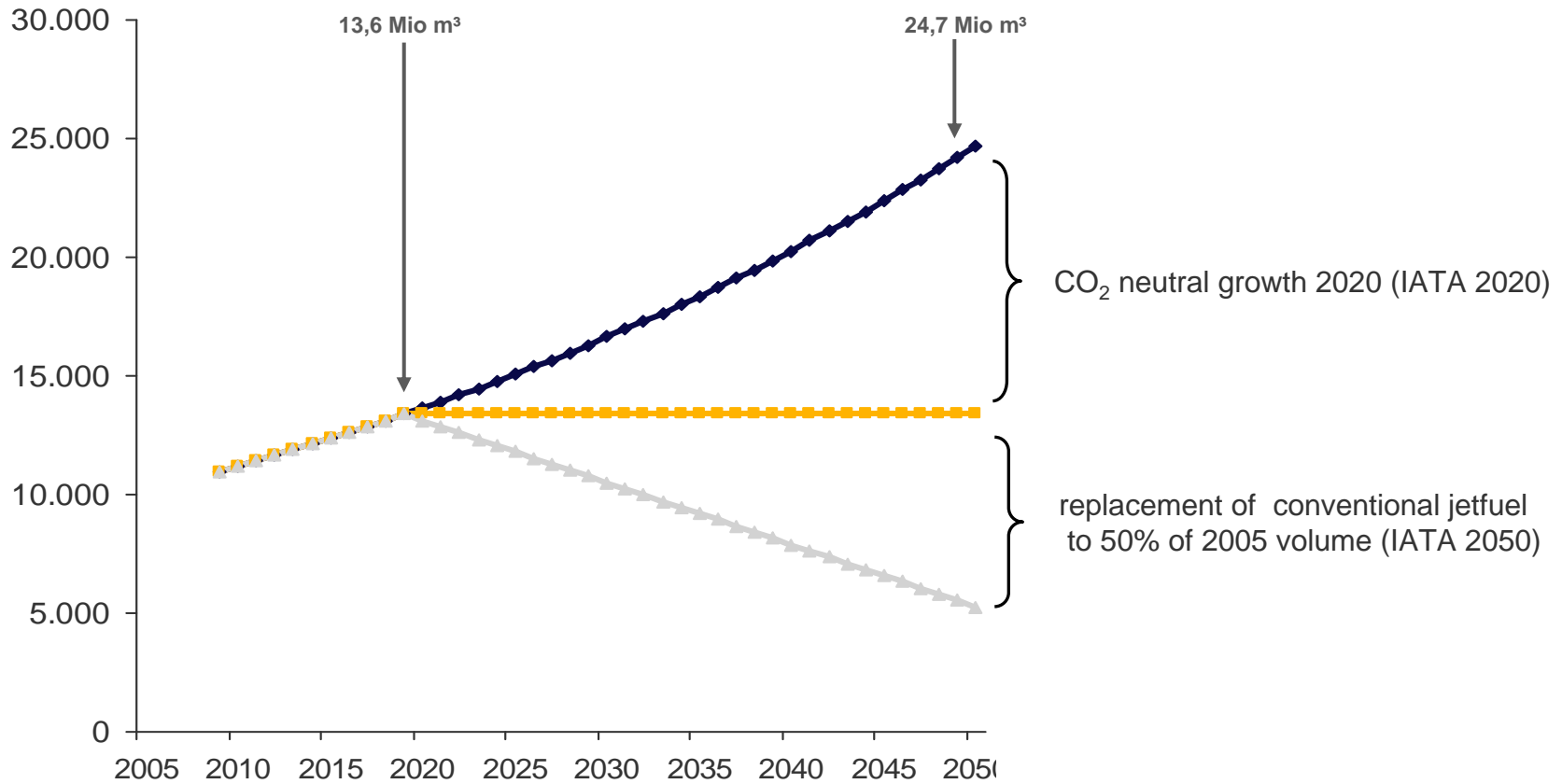
= 1.000 road tanker trucks

= annual jetfuel supply of Dresden Airport

= heating oil for 2.700.000 households (à 4.000 l)

Total demand and Biofuel volumes* for the Lufthansa Group 2010-2050

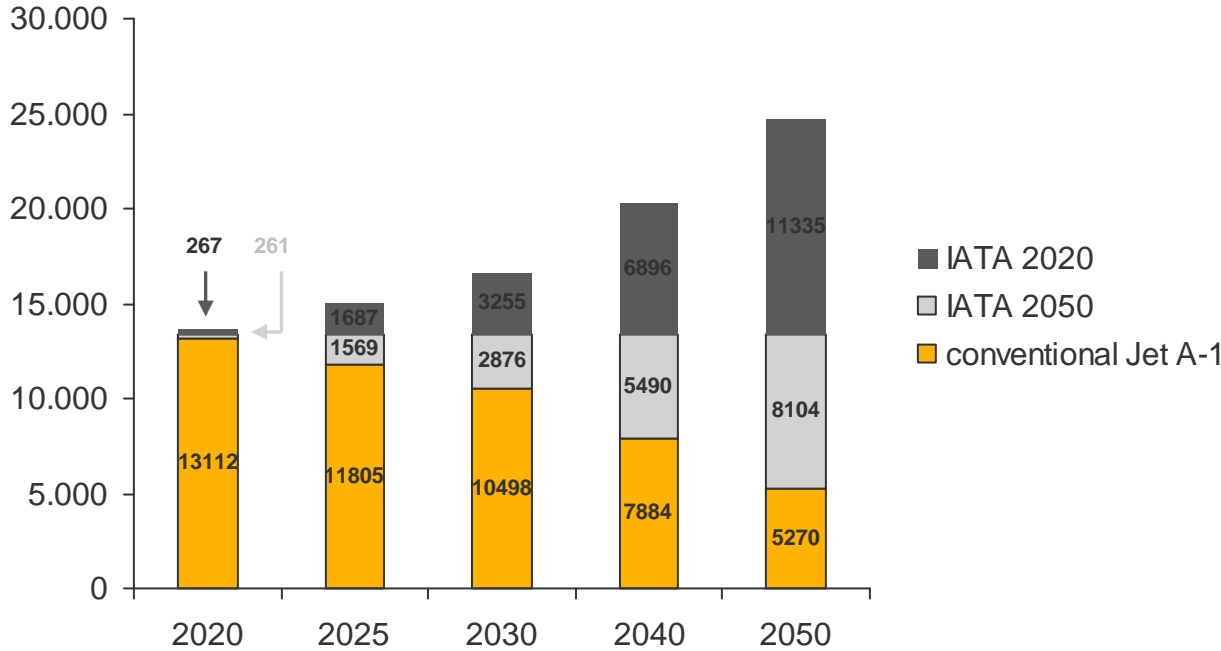
2% net volume growth per annum



* in 1.000 m³

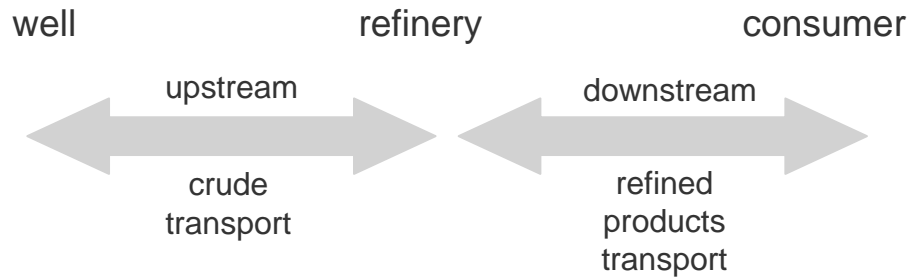
LH's Biofuel Demand 2020-2050 acc. to IATA

2% annual growth

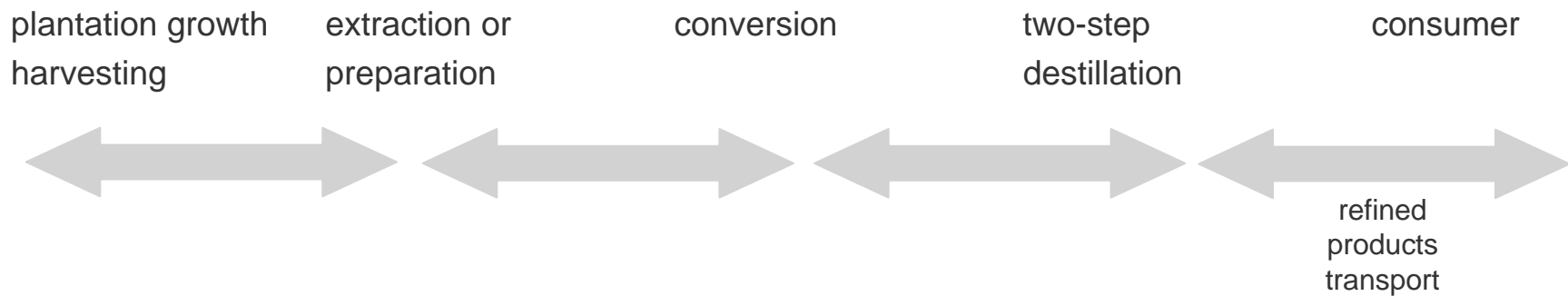


Comparison fossile fuels vs. Biofuels

- Fossile



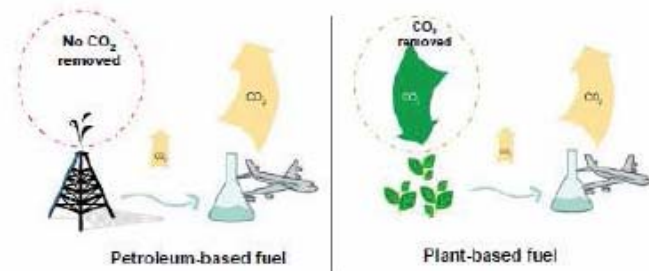
- Biofuel



- more complex
- more steps from plantation to consumer
- more „bottlenecks“
- more seasonality



Plant based feedstock reduces CO₂-content of the atmosphere in a natural way



Lower CO₂ lifecycle



Does not compete with food or promote deforestation



Promotes local and regional solutions and economies

COPYRIGHT © 2008 THE BOEING COMPANY



Three feedstock-processing combinations for Biofuels in Aviation

Feedstock	Processing	Product
1. Sugarcane (Glucose)	Fermentation	Bioethanol* 2 nd Generation
2. Wood, organic Waste (Ligno-Cellulose)	Pyrolyse (Fischer-Tropsch- Synthesis)	FT-Biodiesel* 2 nd Generation
3. Vegetable Oils (Palm oil, Jatropha, Camelina, Algae)	Hydrotreatment („cracking“)	HVO-Biodiesel* 2 nd Generation (HRJ) (Bio-SPK)

* final processing acc. to jetfuel spec. possible



Biomass feedstock for LH – Demand 2025

1 ha = 10.000 m²

3.256.000 m³

Bio-Jetfuel (40% of destillation)

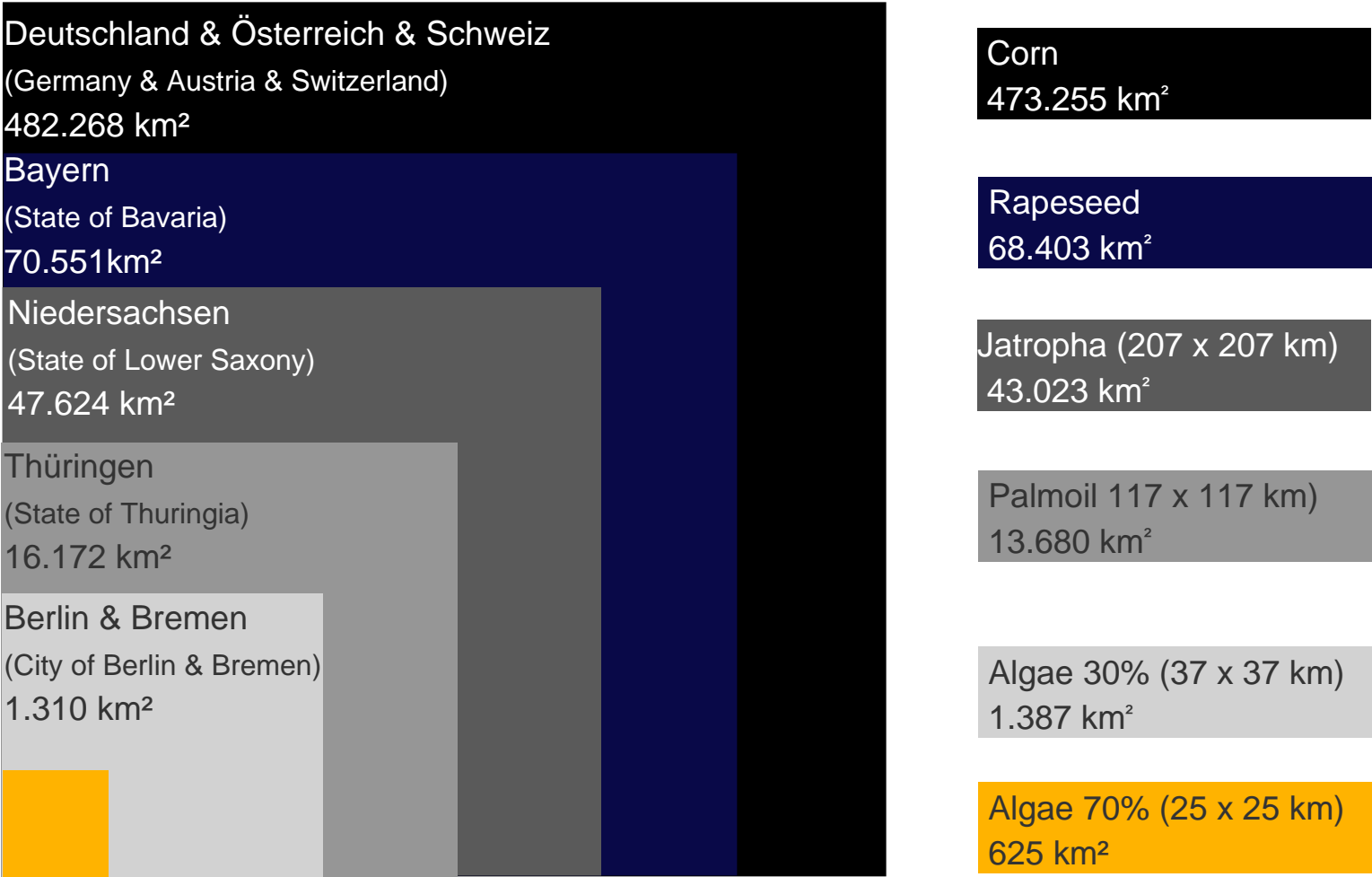
100ha = 1 km²

8.140.000 m³

vegetable oils

Feedstock	Oil per Hektar (l ha/a)	arable land required	Remarks
Corn (Mais)	172 l	473.255 km ²	not suitable for jetfuel
Rapeseed (Raps)	1.190 l	68.403 km ²	not suitable for jetfuel
Camelina (Leinöl)	1.200 l	67.833 km ²	field rotation crop!
Jatropha (Purgiernuss)	1.892 l	48.023 km ²	Potential on degraded land!
Palmoil (Palmöl)	5.950 l	13.680 km ²	Clean and cheap, but food vs. fuel problem
Microalgae (30% drymass oil)	58.700 l	1.387 km ²	not available in 2025
Microalgae (70% drymass oil)	136.900 l	595 km ²	not available in 2025

Cultivated area to meet LH's feedstock demand in 2025



Investments in Land acquisitions for LH-demand 2020-2025

Landuse change from pasture, deforrested or degraded land
 Biomass feedstock: Jatropha with 3 years from clearance to harvest

Year	2020	2021	2022	2023	2024	2025
LH-demand in Biojet	529.000 m ³	1.063.000 m ³	1.603.000 m ³	2.148.000 m ³	2.699.000 m ³	3.256.000 m ³
Cultivated land for Jatropha in ha	699.000	2.657.00	4.007.500	5.370.000	6.747.500	8.140.000
Cumulative investment in Mio. US\$ (pricebase 2010)	560	2.126	3.206	4.296	5.400	6.512

Investments in Biorefineries for LH-demand 2020-2025

HVO-Biorefinery 800.000 t/a → 800 Mio. Euro
 FT-Biorefinery 800.000 t/a → 3.500 Mio Euro

} with 35% Biojetfuel output

Year	2020	2021	2022	2023	2024	2025
no of sites	1	2	4	5	6	8
Σ Investments in HVO-Biofuel refineries in Mio US\$	800	1.600	3.000	4.000	5.600	6.400
Σ Investments in FT-Biofuel refineries in Mio US\$	3.500	7.000	14.000	17.500	21.000	28.000

Industry is grouping to drive realization and commercialisation

SAFUG

Sustainable Aviation Fuel Users Group
Our Commitment to Sustainable Options

Objective - Accelerate Development and Commercialization of Sustainable Aviation Fuels

„Therefore, we, the undersigned air carriers and other aviation industry organizations **declare our commitment to advance the development, certification, and commercial use of drop-in sustainable aviation fuels.**“

Members:



The beginning is already half the way to success.
(korean wisdom)

