Clean Sky

- Teknikutveckling för framtidens civilflyg

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November 25, 2009

Flygtekniska Föreningen, Göteborg

Innehåll

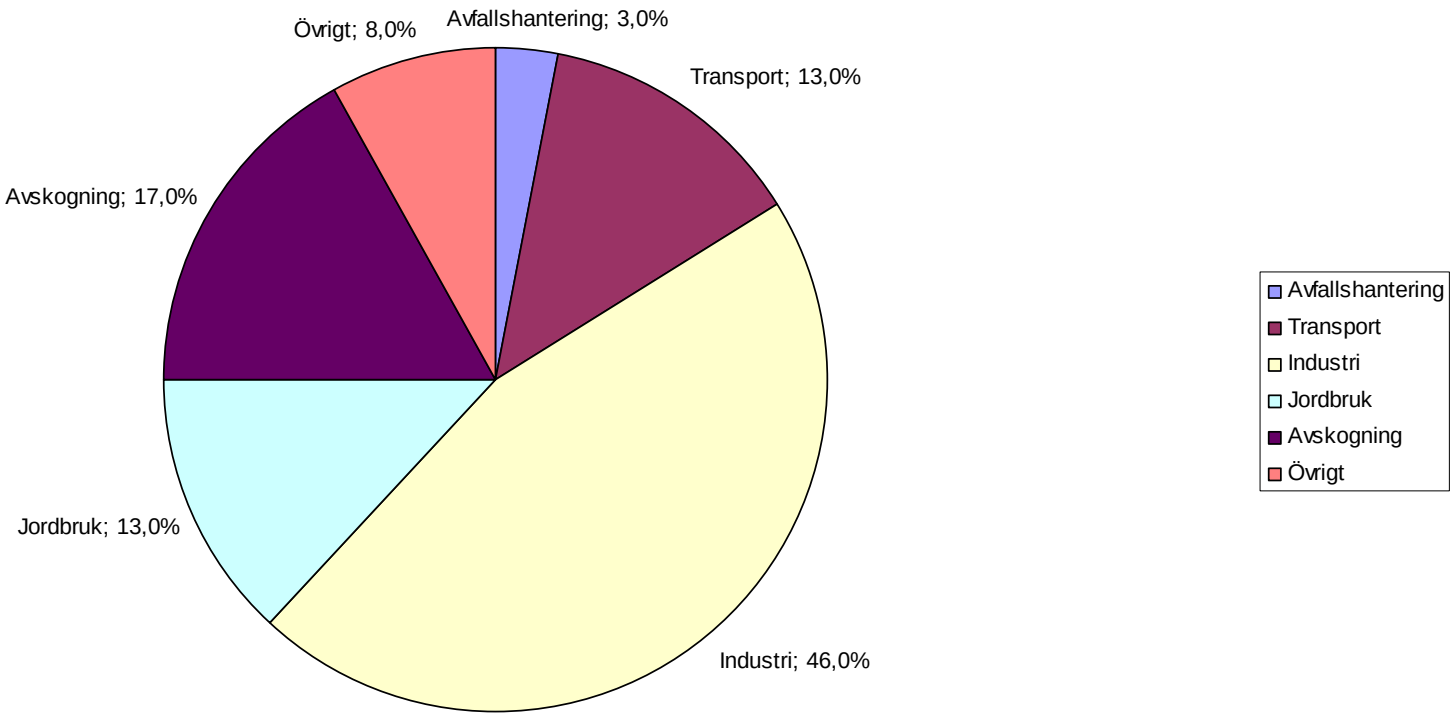
- Flygets miljöutmaningar
- Saab – vår historia som en leverantör av högteknologiska produkter
- SESAR - viktigt projekt med koppling till Clean Sky
- Clean Sky
  - Vad är Clean Sky
  - Vilka delar finns, SGO och SFWA
  - Vad gör Saab
  - Vad blir resultatet

CHALLENGES FACING AIR TRANSPORT

- Environment
  - Global warming is a world-wide recognised issue
  - Europe has fixed clear targets to reduce negative impact
  - Global demand for oil will continue to rise leading to extremely volatile prices
  - Carbon trading allowance or tax is likely to increase

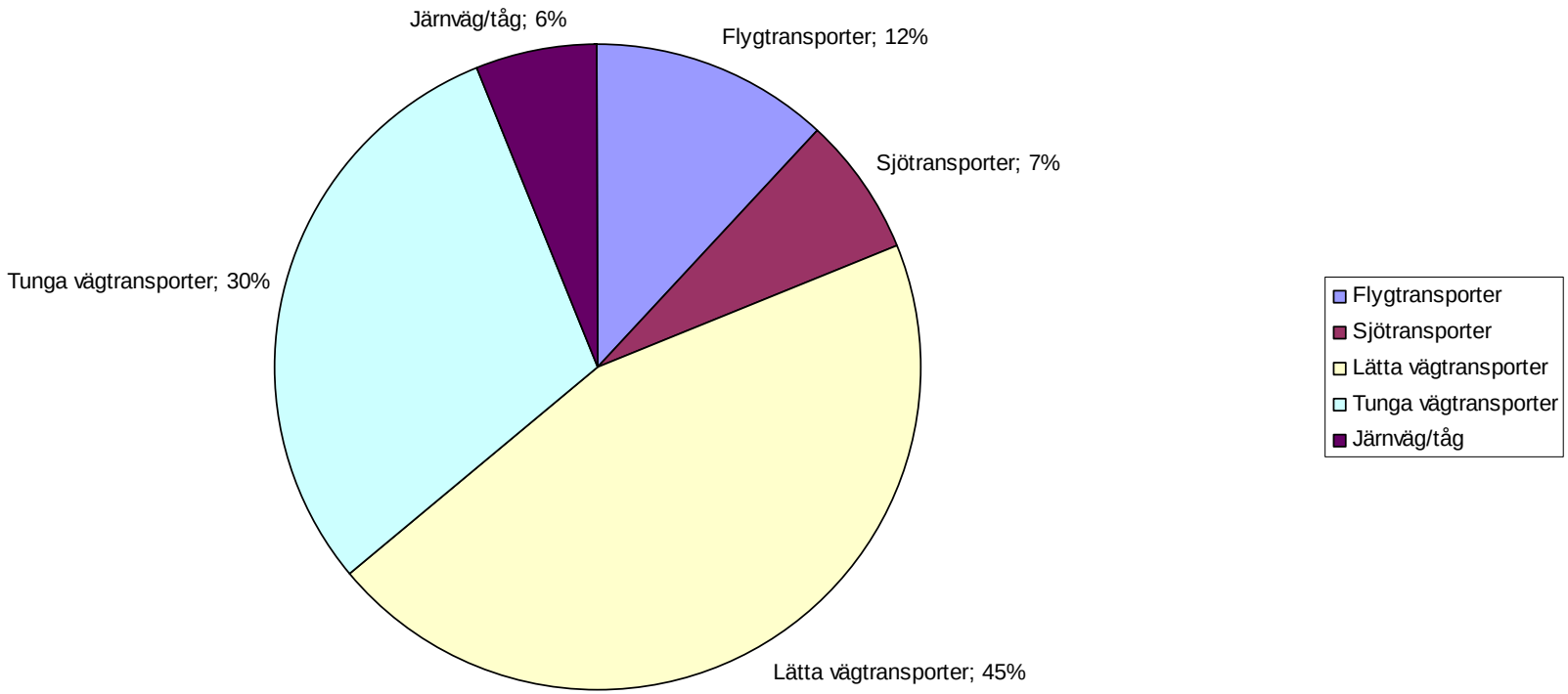
- Economy
  - Air Traffic is of significant importance for the enlarged European economy, global competitiveness, our way of living
  - Aeronautics is crucial to shape a future competitive and sustainable European economic growth

Globalt utsläpp av växthusgaser



Källa: IPCC 2006

Flygets andel av de globala CO_2 utsläppen från transporter

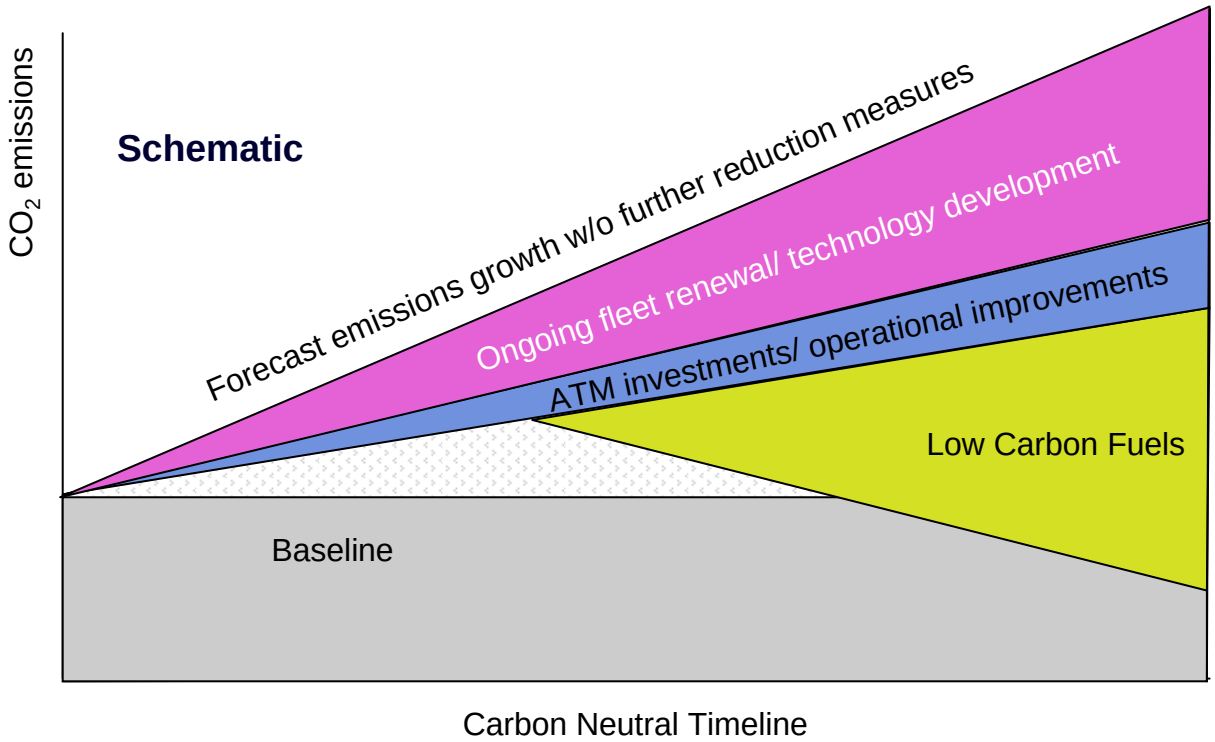


Flyget andel av de totala CO_2 utsläppen

- **Globalt ~2%**
- **Europa ~3%**
- **Sverige ~1% (inrikesflyget)**

Källa: IPCC/IATA 2006
Svenskt flyg 2009

Föreslagna mål för flygets CO_2 utsläpp



IATA förslag till ICAO Maj 2009 (GIACC 4th meeting)

Några aspekter på den industriella utmaningen

- Vi är långt på optimeringskurvan

- A380 och B787 kraftigt försenade
  - En känsla av att pressa för hårt inom ramen för en teknisk och programmässig kontext

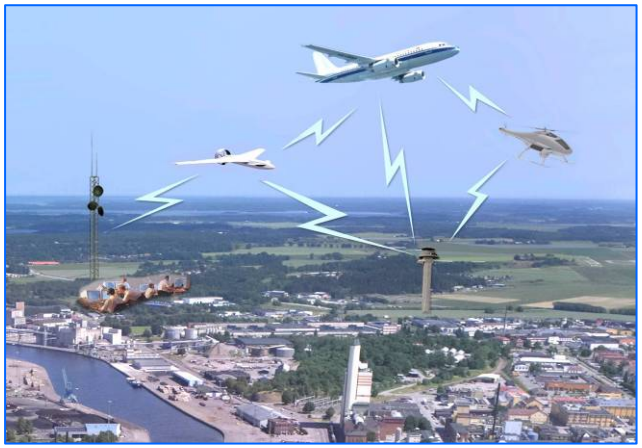
- Är idag svårt att generera satsningsvilja för nästa utmaning
  - Utmaningar och risker på en nivå som är svåra att stödja med dagens modell/situation

SAAB

Major efforts in Europe to shift to new technologies

JTI Clean Sky

SESAR



UAV Traffic Insertion

Saab AB

- vår historia som en leverantör av högteknologiska produkter

A HISTORY OF HIGH TECHNOLOGY

1941

First B17 delivered

1948

Tunnan – first flight

1979

First order for RBS 15

1990

First laser simulator BT46

1993

First Gripen delivered

2002

First contract for NLAW

2005

Contract for Neuron

2006

Saab 2000 ERIEYE™ AEW&C

2008

Gripen Demo – first flight

SAAB

1937 Saab is founded

1990 Saab Automobile independent company

2000 Saab acquires Celsius

2005 Saab acquires Grintek

2006 Saab acquires EMW

1646

Bofors Järnbruk is founded

1894

Alfred Nobel acquire Bofors

1948

First order for Carl Gustaf

1998

StriC in operation

1950–

Development of fighter radar

1970–

Development of GIRAFFE

1980–

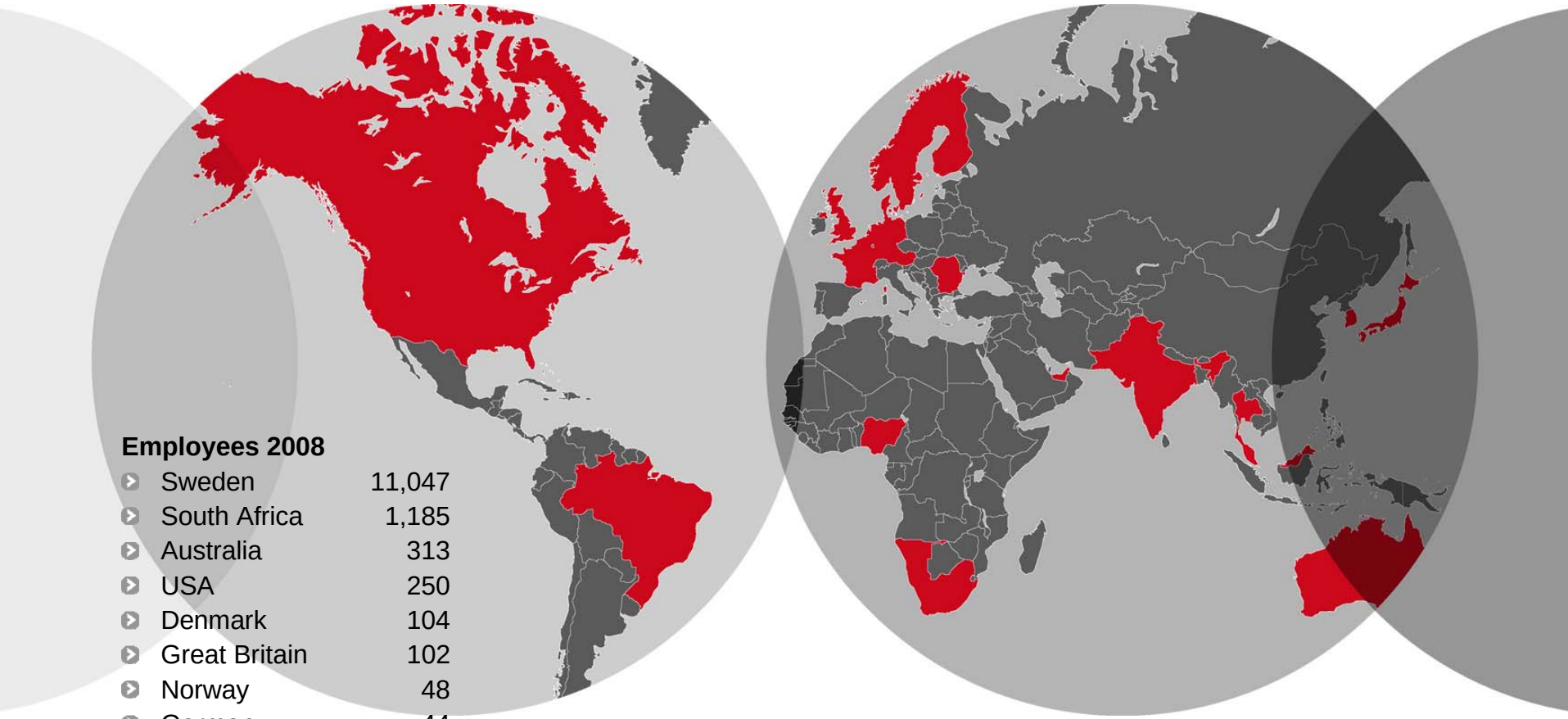
Development of ARTHUR

1990–

Sea Giraffe AMB is launched

SAAB

SAAB WORLDWIDE



Employees 2008

Sweden	11,047
South Africa	1,185
Australia	313
USA	250
Denmark	104
Great Britain	102
Norway	48
Germany	44
Switzerland	34
Other	77

AERONAUTICS

Operations

- Gripen program
- Unmanned aerial vehicles (UAVs)
- Supplier to international aircraft programs
- Leasing of Saab regional aircraft

Key strategic issues

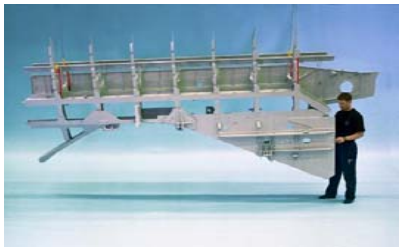
- Export Gripen
- Invest in technology to win new business
- Secure position in next European Air Power System

THE HERITAGE AND EXPERIENCE

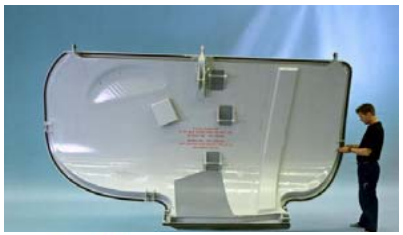
- More than 4000 aircraft manufactured.
- Among them 500 airliners.
- 15 different types of aircraft.

MAIN CONTRACT - AEROSTRUCTURES

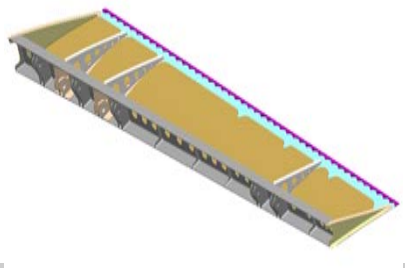
A340 5/600
Pylons, Rear Secondary Structure
- Composites, Machining and Assembly
- First delivery March, -00



Pressurized Lateral Floor
- Machining, Sheet Metal and Assembly
- First delivery August, -99

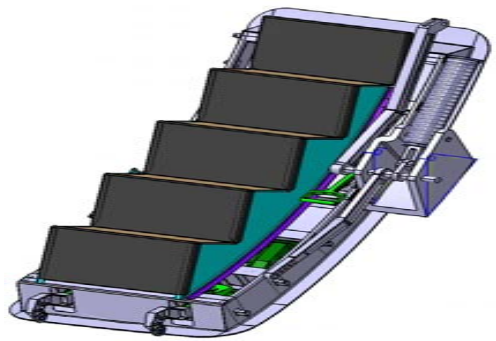


Main Landing Gear Doors
- Composites and Assembly
- First delivery February -00

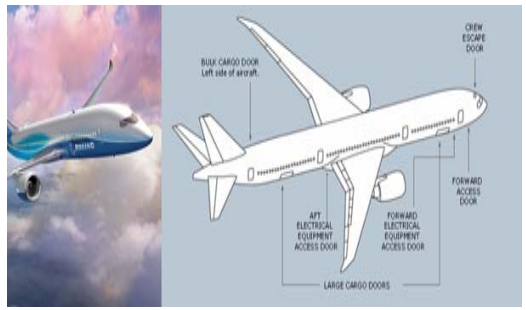


A320 Ailerons
- Composites and Assembly
- First delivery February -00

A380 Mid Outer Leading Edge
- Metallic Assembly Assembly
- First delivery April 2003



A400M Crew Door
- Metallic Assembly
- First delivery February -00

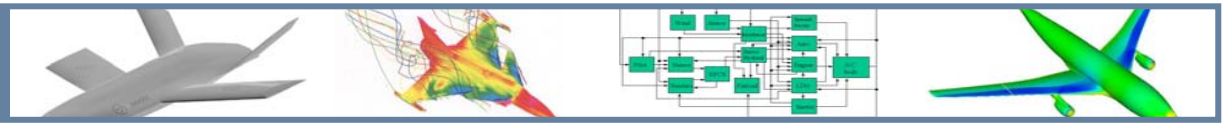


B787
- Bulk Cargo Doors, Access doors
- First delivery June 07

SAAB

SYSTEM PRODUCTS

Aeronautical Engineering



Airborne Computer Systems

General/Vehicle Systems

Tactical Systems

Human Machine Interaction

Weapons Integration & Structural Technology

Support Systems and Simulators

SESAR

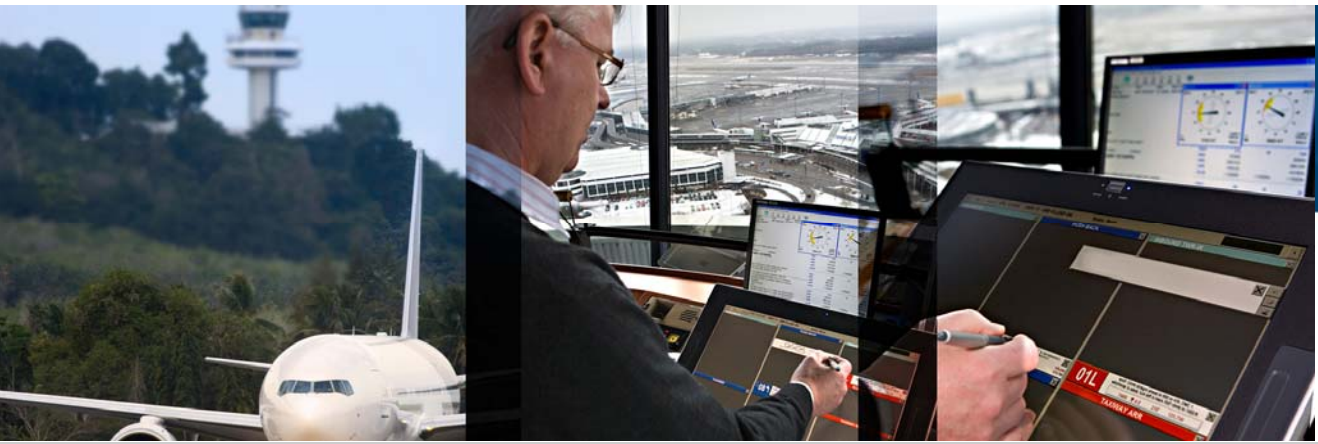
- Ett infrastrukturprojekt som skall utveckla nästa generations ATM system för Europa

SESAR

Single European Sky ATM Research

- Ongoing Initiative to achieve a Single European Sky
- Objectives include
  - Enabling EU skies to handle 3 times more traffic
  - Improving safety by a factor of 10
  - Reducing the environmental impact per flight by 10%
  - Cutting ATM costs by 50%
- Supported by state-of-the-art and innovative technologies

- Ska ge möjlighet till bredare och säkrare kommunikation, beslutsstöd, precisare trafikledning…
- 4D nav, ger ökade möjligheter till effektivare vägar, gröna inflygningar…
- Förenklar integration av UAV'er

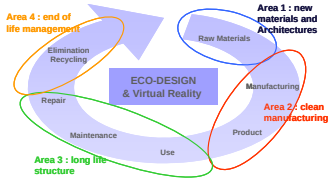


Clean Sky

- Ett PPP där Europas ledande flygindustrier utvecklar ny teknik för att möta de tuffa miljömål som ställs på framtidens flygtransportsystem

Clean Sky

Vehicle ITD



Eco-design
For Airframe and Systems

Leaders: Dassault Aviation & Fraunhofer Institute
116 M€

Smart Fixed-Wing Aircraft

Leaders: Airbus & SAAB
393 M€

Green Regional Aircraft

Leaders: Alenia & EADS CASA
174 M€

Green Rotorcraft

Leaders: Eurocopter & AgustaWestland
159 M€

Sustainable and Green Engines

Leaders: Rolls-Royce & Safran
421 M€

Systems for Green Operations

Leaders: Liebherr & Thales
304 M€

Transverse ITD for all vehicles

Saab involvement

ITD: Integrated Technology Demonstrator

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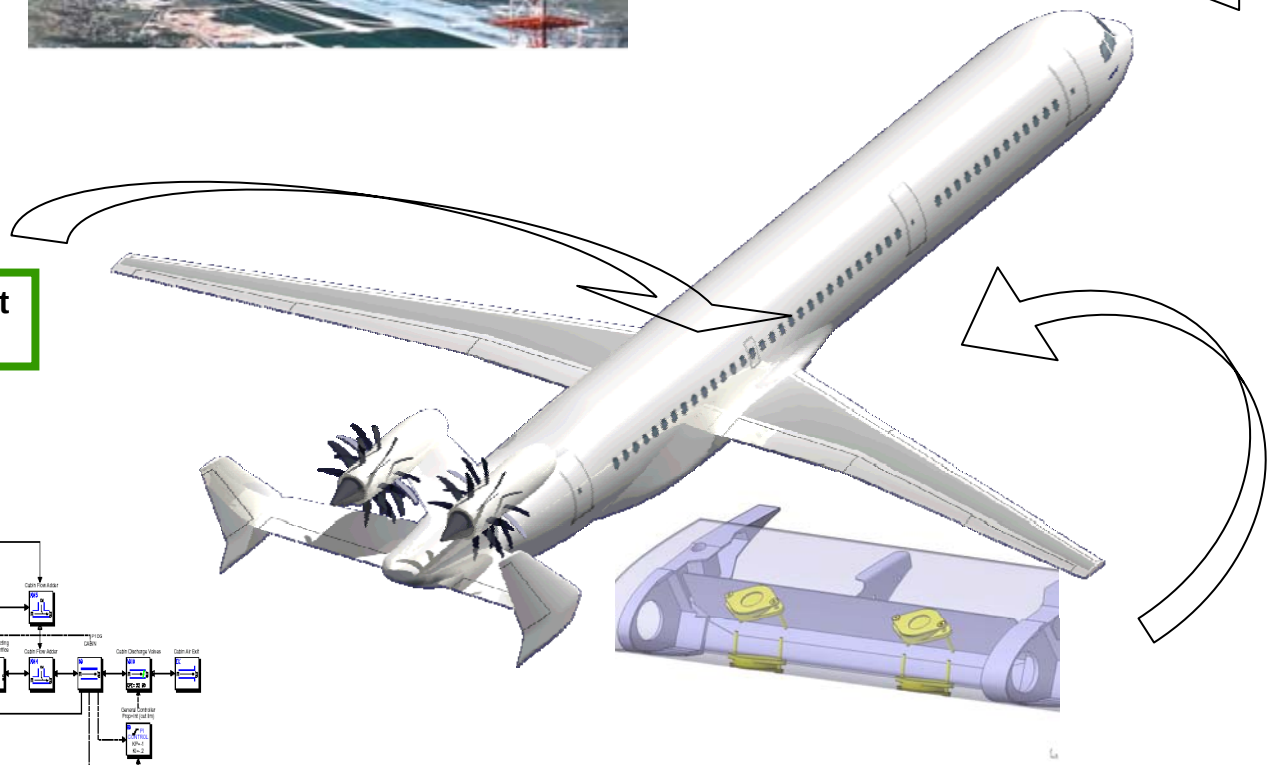
Vad gör Saab i ITD SGO?

Saab involvement…

WP3 – **Mission and Trajectory Management**

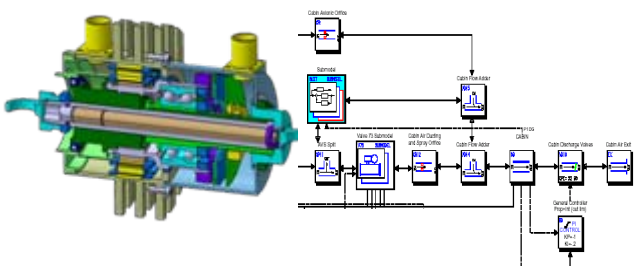
Tech studies and concept validation of new trajectory algorithms

Tech for smart ground operations- electrical engine concept



WP2 – **Management of aircraft energy**

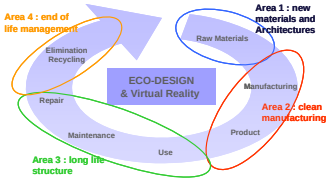
Thermal Management



Wing Ice protection system

Clean Sky

Vehicle ITD



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304 M€

Transverse ITD for all vehicles

ITD: Integrated Technology Demonstrator

SAAB

SFWA- ITD Participants and Global Shares

393M€ Total Budget

„ITD-Leaders“ *Associate Partners*

- **Airbus**
- **SAAB**
- Dassault
- EADS-CASA
- Thales
- Liebherr
- Fraunhofer
- SAFRAN
- Rolls-Royce

50% of Total Budget

- **DLR**
- **ONERA**
- **INCAS**
- **NL-Cluster**
- **QinetiQ**
- **RUAG**
- **Aernnova**

25% of Total Budget

Partners

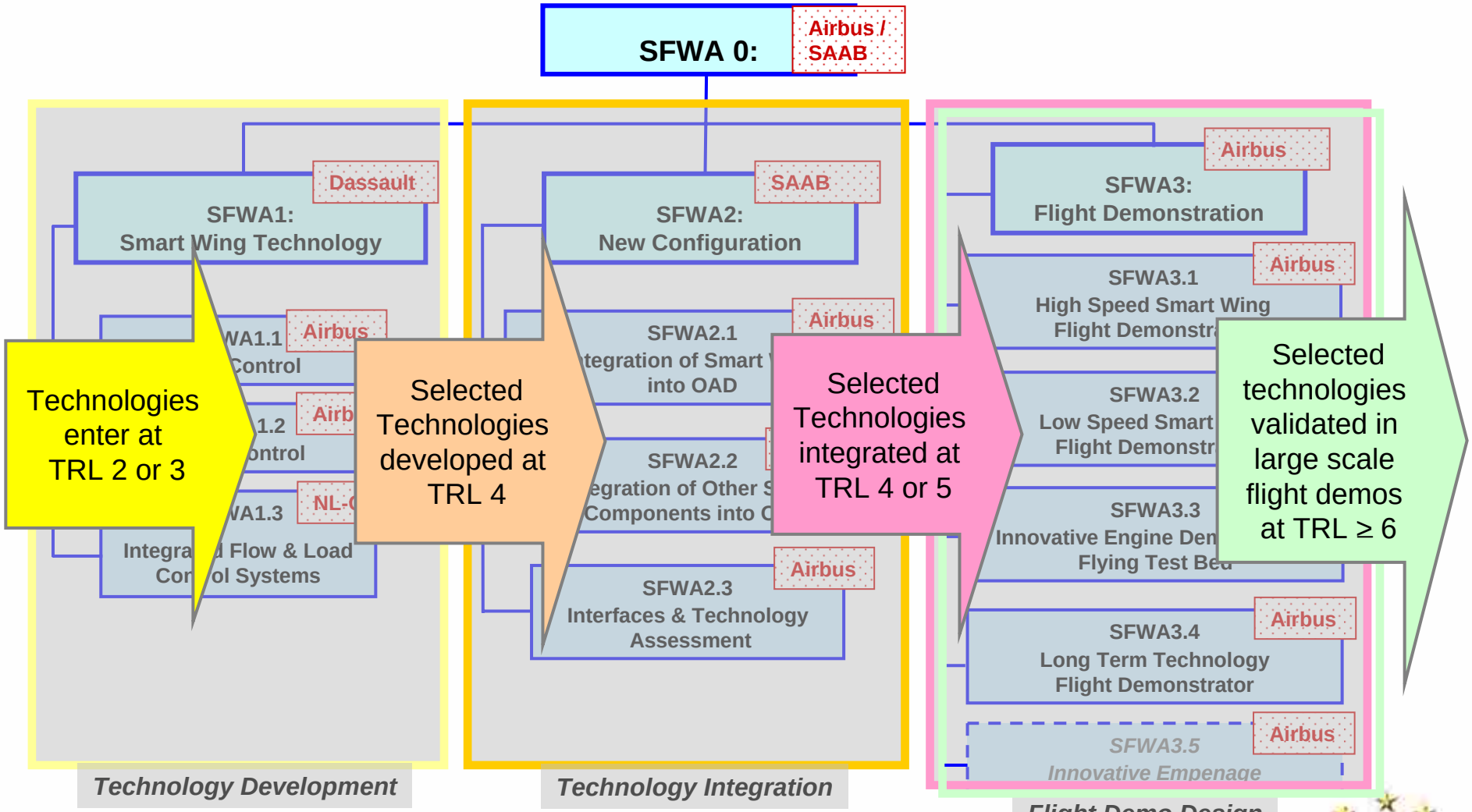
Partner participation based on Call for Proposals

„CfP“

25% of Total Budget

CLEANSKY

SFWA- ITD Technology WBS



SFWA-ITD "Technology Demonstrator Flagships"

Input connecting to:

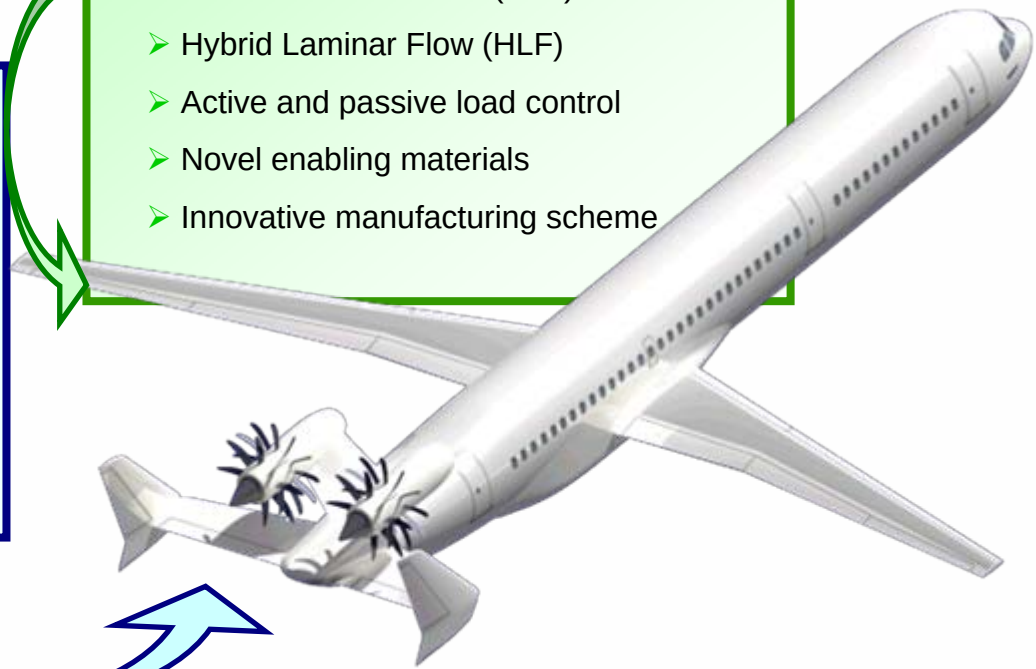
- SAGE ITD – **CROR engine**
- SGO – **Systems for Green Operation**

Smart Wing Technologies

- **Technology Development**
- **Technology Integration**
- **Large Scale Flight Demonstration**
  - Natural Laminar Flow (NLF)
  - Hybrid Laminar Flow (HLF)
  - Active and passive load control
  - Novel enabling materials
  - Innovative manufacturing scheme

Innovative Powerplant Integration

- **Technology Integration**
- **Large Scale Flight Demonstration**
  - Impact of airframe flow field on Propeller design (acoustic, aerodynamic, vibration)
  - Impact of open rotor configuration on airframe (Certification capabilities, structure, vibrations...)
  - Innovative empennage design

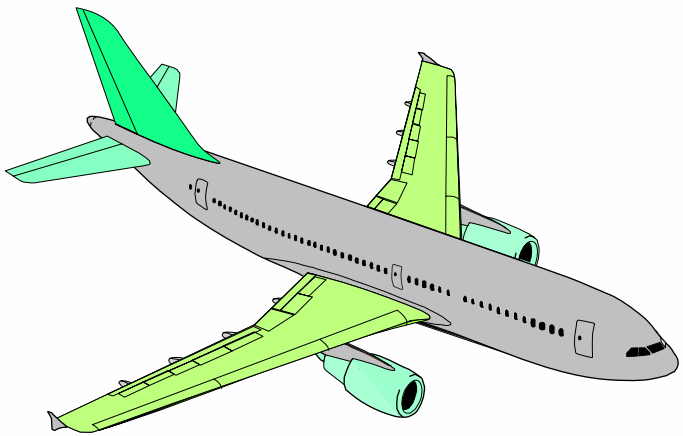


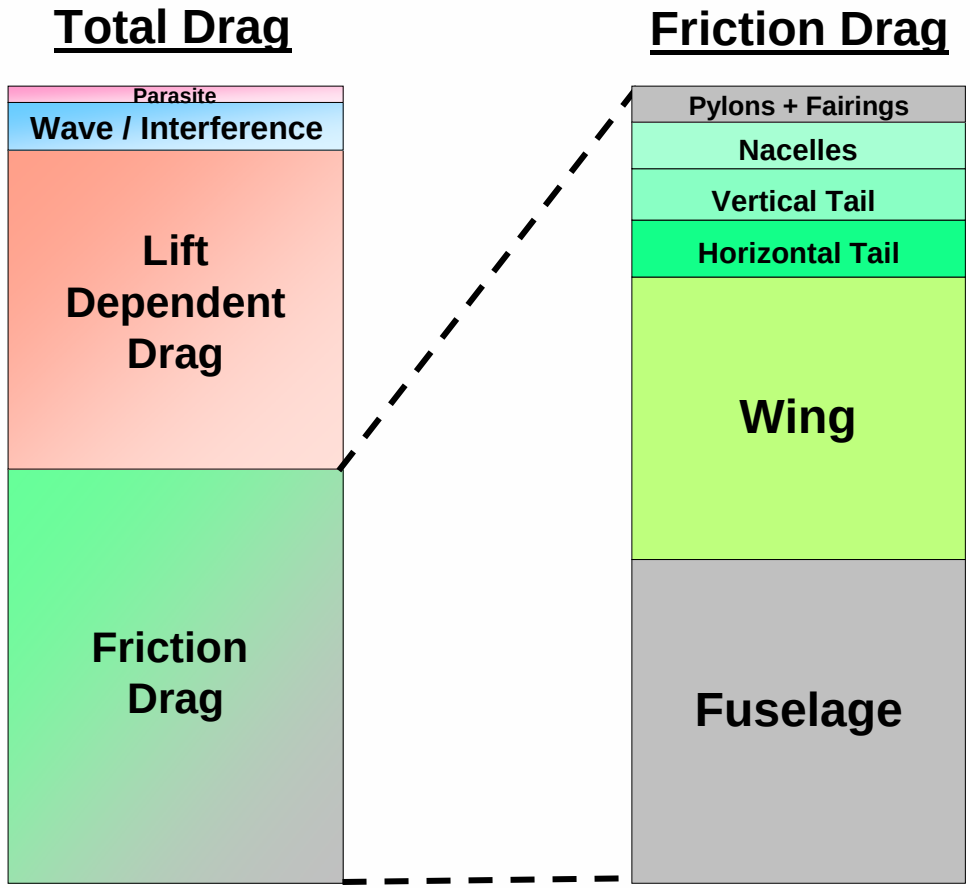
Output providing data to:

- TE– **SFWA technologies for a Green ATS**

Potential of Laminarity to reduce aerodynamic drag

Drag components on aircraft level

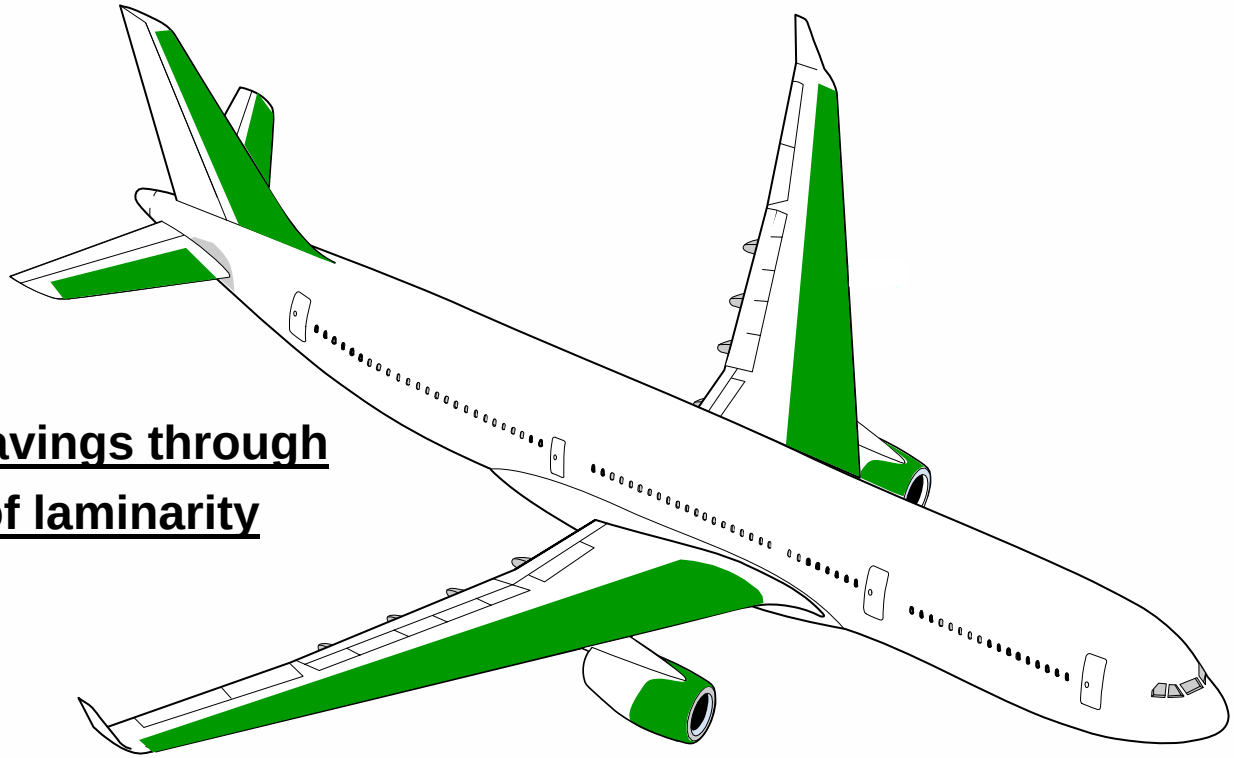




The Wing offers (beside fuselage) highest potential for friction drag reduction

e.g. 50% laminarity at upper wing surface translates into 5-7% total drag reduction

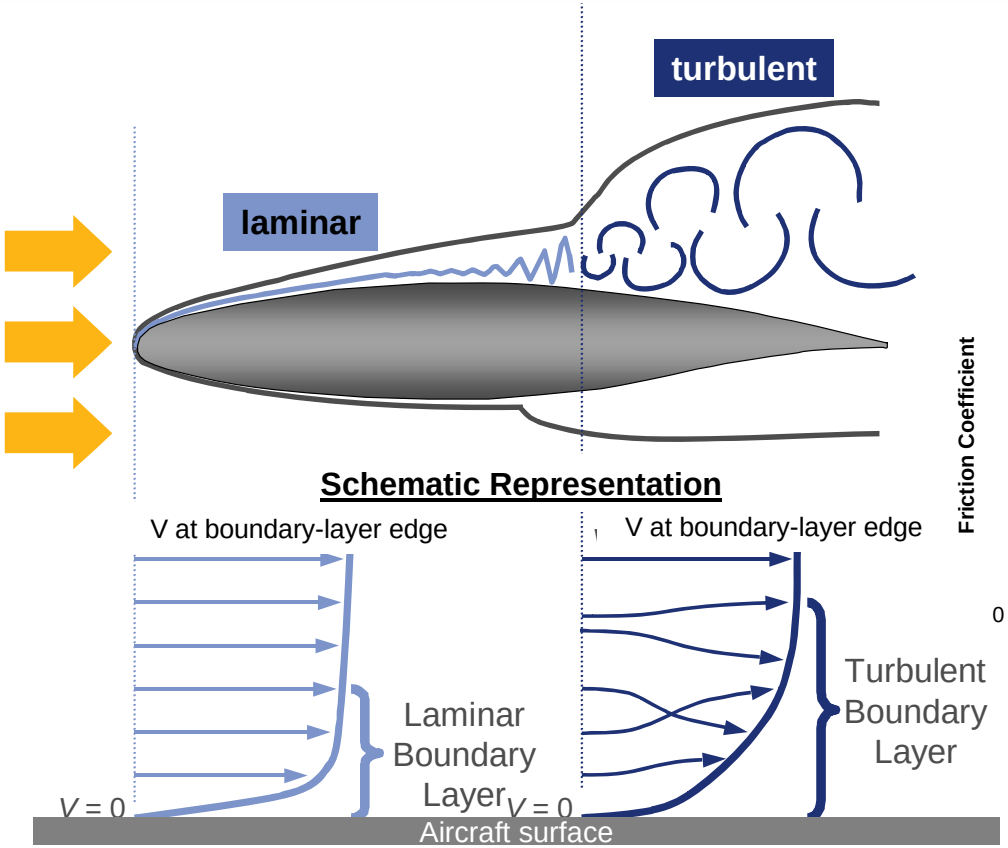
Potential of laminarity to reduce aerodynamic drag

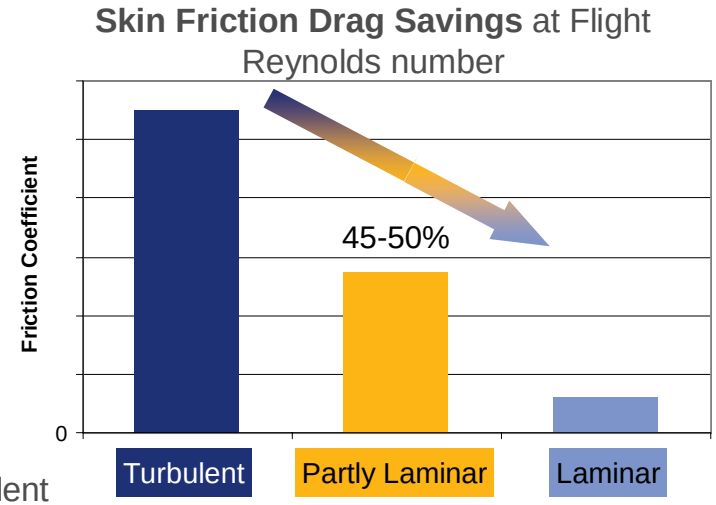


Potential drag savings through the application of laminarity

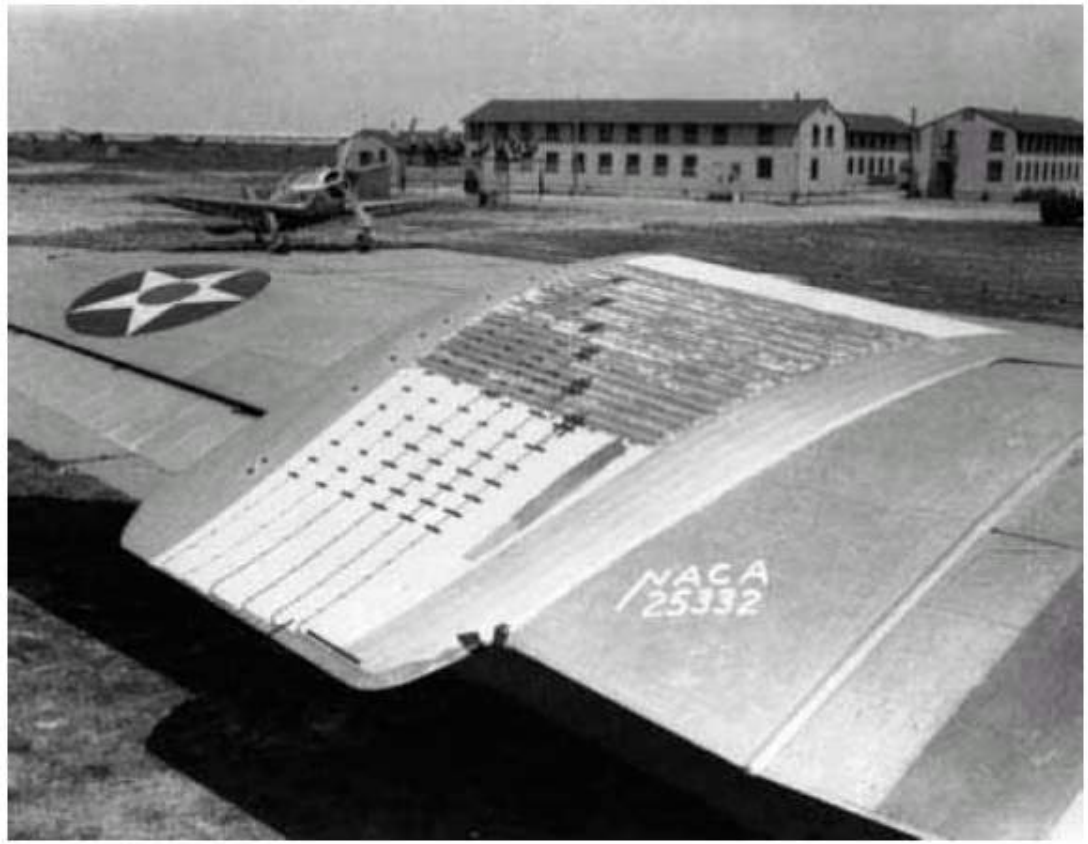
- Wing
- Tail
- Nacelles

Laminar Flow Drag Reduction





Historic attempts to integrate laminar flow technologies



LFC glove (slot type) at Douglas B18
(NACA, Langley Research Center 1941)

Historic attempts to integrate laminar flow technologies

North American P-51 Mustang (1941). A laminar air foil was used at the design of the P-51 wings, as well as some other aircraft. Operationally, the wing did not enhance performance as good as tunnel tests suggested due to high manufacturing tolerances and surface imperfections.

Historic attempts to integrate laminar flow technologies

First all fiberglas -composite based composite fs 24 Phönix (1957). The choice of material offered to gain substantial benefit from natural laminarity (max. total L/D 1:40)

Applied laminar flow technology on commercial aircraft

The most made – of - composite Piagio P-180 Avanti (first flight 1986). The forward fuselage is designed by Gates Learjet, the natural laminar wing design is made by the OHIO state university

Recent Laminar-Flow Flight Demonstrations 1985 – 2008

1990 1995 2000 2005

F-14
Variable-Sweep Wing
NLF

ATTAS
Wing
NLF

ATTAS
Nacelle
NLF

Piaggio
P-180
Wing
Fuselage
NLF

F-100
ELFIN
Wing
NLF

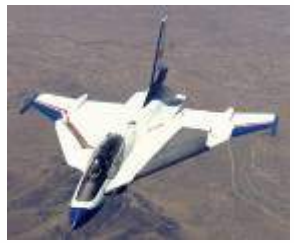
HondaJet
Wing
Fuselage
NLF

NLF

HLFC
(Suction)

JetStar
HLFC
Operationality

757 Wing
HLFC



F-16XL
Supersonic Wing
HLFC

A320
Vertical Fin
HLFC

Falcon 9000
Wing
HLFC
Operationality

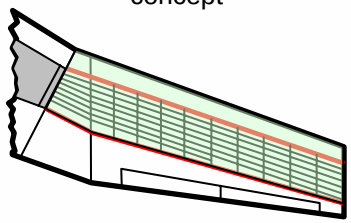
SFWA-ITD Contribution to JTI CleanSky Targets

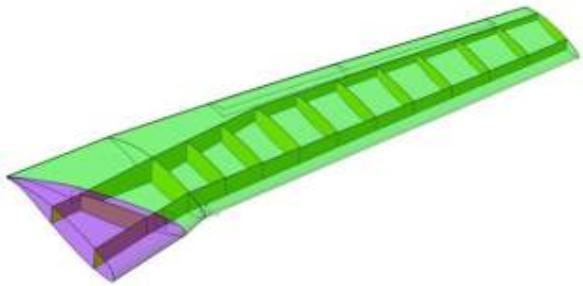
Smart Passive Laminar Flow Wing

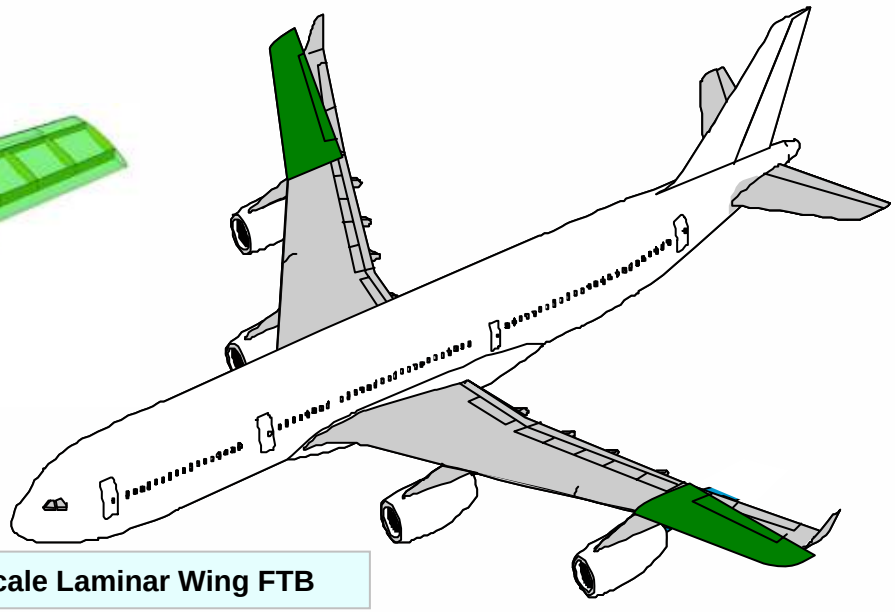
- Design of an all new natural laminar wing
- Proof of natural laminar wing concept in wind tunnel tests
- Use of novel materials and structural concepts
- Exploitation of structural and system integration together with tight tolerance / high quality manufacturing methods in a large scale ground test demonstrator
- Large scale flight test demonstration of the laminar wing in operational conditions

Laminar Wing Ground test demonstrator to address structural, system and manufacturing aspects

Laminar wing structure concept







Laminar Wing aerdynamic layout and performance

Full scale Laminar Wing FTB

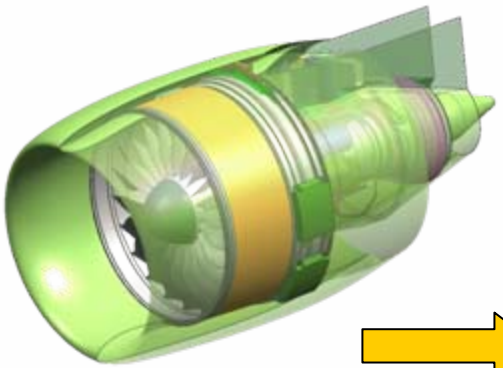
CLEANSKY

Quid of Demo FTB for Novel PPS concept ?

Mainly For Critical Features Technology Demonstration

General Electric GE36 UnDucted Fan (UDF)

- Flight tested on B727-100 in August 1986
- Flight tested on MD80 in April 1987

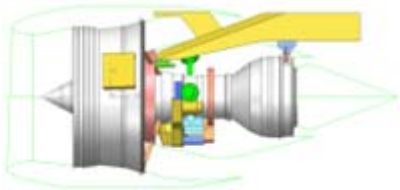
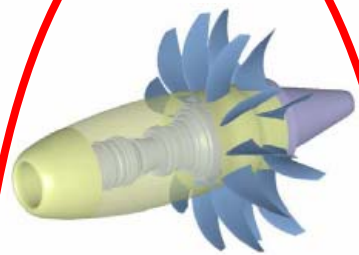


Pratt & Whitney Geared Turbo Fan (GTF)

- To be Flight tested on PW B747SP in May-08
- To be Flight tested on A340-600 in Sep-08

In addition, Novel Prototypes must demonstrate project viability (performance, acoustic…), integration timing similar to current state of the art and market acceptability of the concept

CROR demo FTB: PPS architecture vs. FTB vehicle

	Ducted Turbofan (GTF…)	Open rotor pusher	Open rotor puller	Open rotor "ducted"
Engine Architecture				
Potential FTB Vehicle	 A340-600 selected for GTF demo flight in 2008	 CROR Demo	 Or ? 	

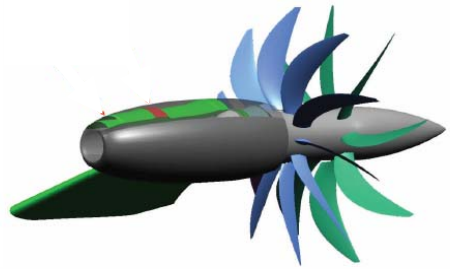
-> Potential FTB vehicle selection is linked to A/C config. down selection & powerplant achitecture

SFWA-ITD Integration of the CROR Engine Concept

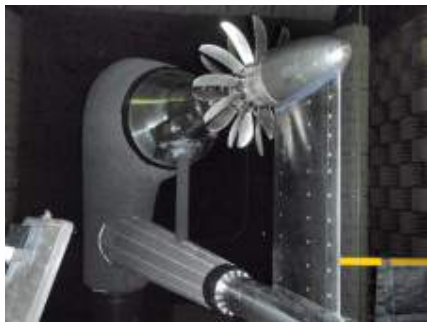
Innovative Power-Plant Integration

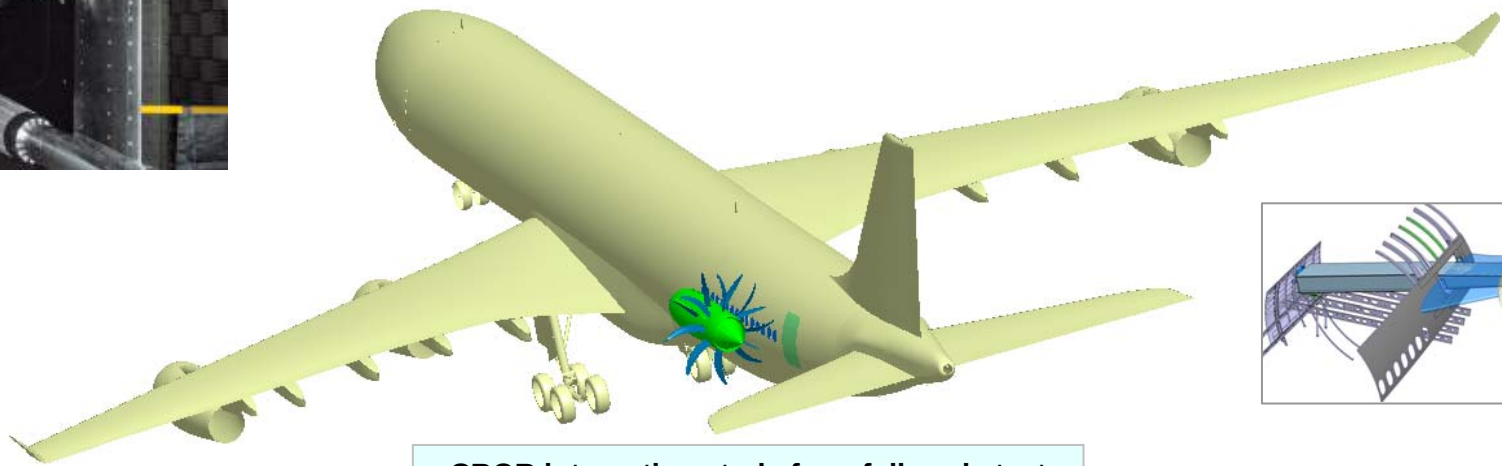
- Design of innovative CROR blades and pylon
- CROR installation effects: aero, noise, vibrations, handling qualities
- CROR propeller kinematics, study of fragment impact depending on size and propeller and fuselage materials
- Structural technologies for armour and shielding
- Feasibility study of a full scale CROR engine in a **F**lying **T**estbed **D**emonstration (FTB)

CROR design study with new blade and engine design



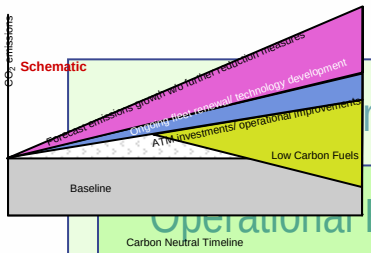
CROR Aero -Acoustic experimental characterization with / without pylon. Example of the RR - CROR (Dream, Dowty Design)





CROR integration study for a full scale test of a CROR engine on-board a modified Airbus A340-600 Flying Test Bed.

Contributions to environmental objectives

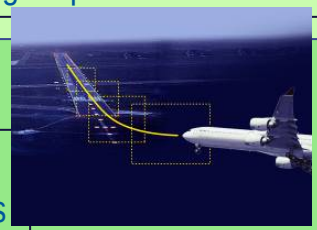


Choice of fuel

Manufacture and disposal

Operational Environment

Flight operations and maintenance



Aircraft

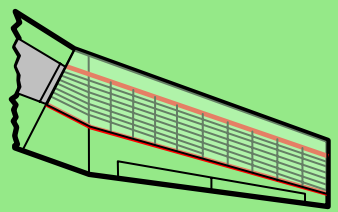
Fuel

Aircraft Flight and Navigation Systems

Aircraft Equipment Systems

Work

Waste



Powerplant

Work

Waste

Pollution

Heat

Noise

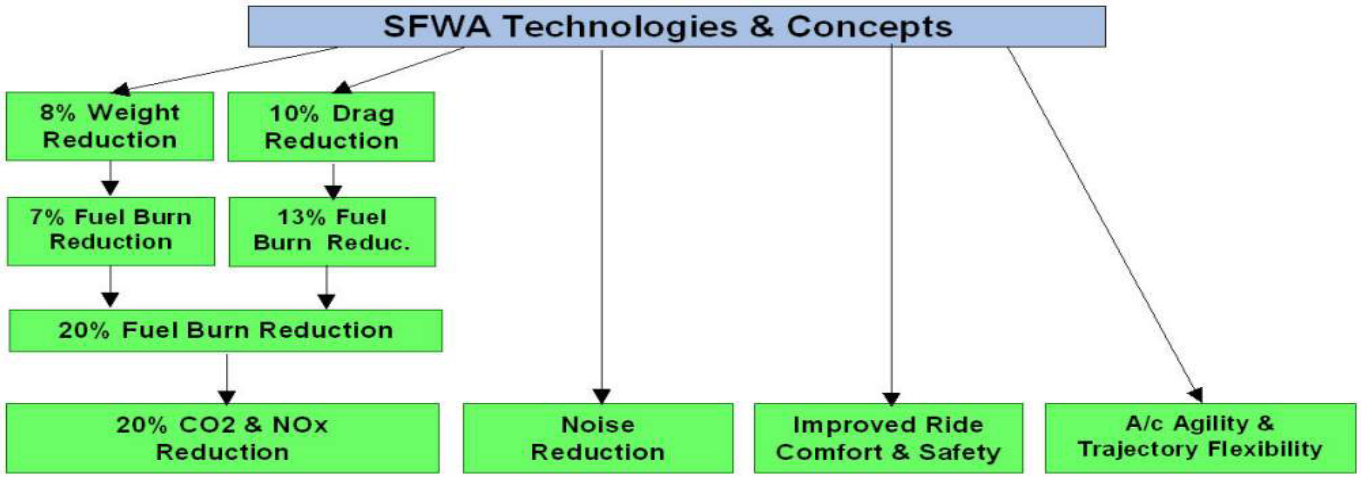
CO_2 and NO_x

Other Chemicals

SMART FIXED WING AIRCRAFT - CONTRIBUTION TO ACARE GOALS

Smart Wing Technologies

- **Natural Laminar Flow (NLF)**
- **Hybrid Laminar Flow (HLF)**
- **Active and passive load control**
- **Novel enabling materials**
- **Innovative manufacturing**



Sammanfattning

- Saabs roll som ledande flygindustri i utvecklingen av ett nytt miljövänligt flygtransportsystem

Sammanfatting

- *Flyget bidrar med ca 2% till de globala utsläppen av CO_2*
- *Flygindustrin gör stora satsningar för att ta fram ny teknik som minskar miljöbelastningen*
- *Clean Sky är det viktigaste industriella utvecklingsprogrammet för att nå ACARE målen.*
- *Clean Sky stärker Saabs teknologibas ytterligare*
- *Vi stärker vår roll som partner till de stora (Airbus och Boeing)*
- *Som företag är vi väl positionerad i internationella forskningsprogram*
- *Vi har en stark ambition att vara med i kommande flygplansprogram*

Tack!

SAAB

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