



Technologies and Research for the Next Generation Regional Aircraft

Naples, June 15, 2012



- ✓ Outline
- ✓ Alenia Aermacchi
- ✓ The regional aviation market
- ✓ The next generation turboprop requirements
- ✓ Technological challenges
- ✓ The Alenia Aermacchi research strategy
- ✓ Overview of critical research areas for the next TP90
- ✓ Conclusions



✓ Alenia Aermacchi

Alenia Aermacchi: una nuova società integrata

Dal 1° gennaio 2012 Alenia Aeronautica, Alenia Aermacchi e Alenia Sia, società del Settore Aeronautico di Finmeccanica, si sono fuse in un'unica azienda, con il nome di Alenia Aermacchi.

L'integrazione consente di implementare le sinergie industriali, realizzando rilevanti economie di scala, sia sotto il profilo dei processi sia per quanto riguarda i prodotti, permettendo al comparto dell'ala fissa di Finmeccanica di mantenere una capacità sistemistica completa per lo sviluppo, integrazione, produzione e supporto per l'intera vita operativa di velivoli civili e militari.

Il nuovo marchio raccoglie uno straordinario patrimonio di conoscenze, di tecnologie, di esperienze, rappresentato da quasi 20.000 aerei progettati, costruiti e gestiti in cento anni di storia da aziende gloriose come Aeritalia, Fiat Aviazione, Macchi, Romeo e SIAI Marchetti.

La società ha due sedi operative, Pomigliano d'Arco (Na) per il settore civile e Torino Caselle per il settore militare, che sono il baricentro di attività industriali omogenee articolate su sei Centri Integrati di Produzione.

■ **Sistemi di Addestramento (Venegono Superiore - Lombardia)**

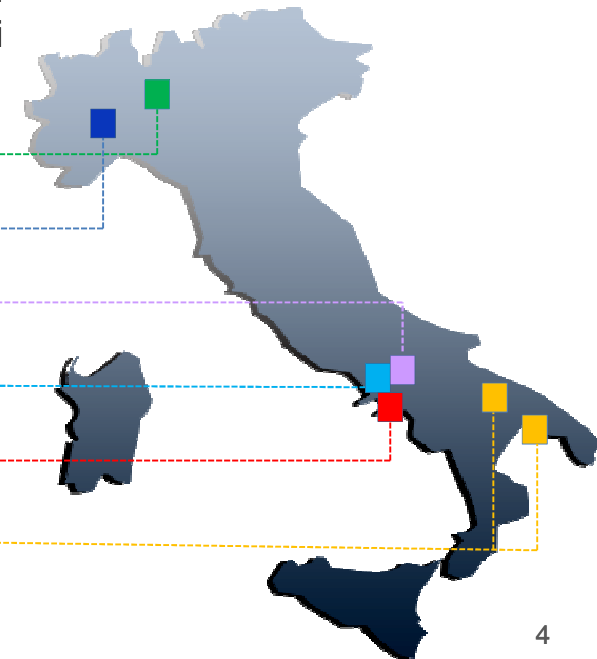
■ **Velivoli da Difesa (Torino Caselle Nord/Sud - Piemonte)**

■ **Strutture Metalliche (Nola - Campania)**

■ **Velivoli Civili (Pomigliano d'Arco - Campania)**

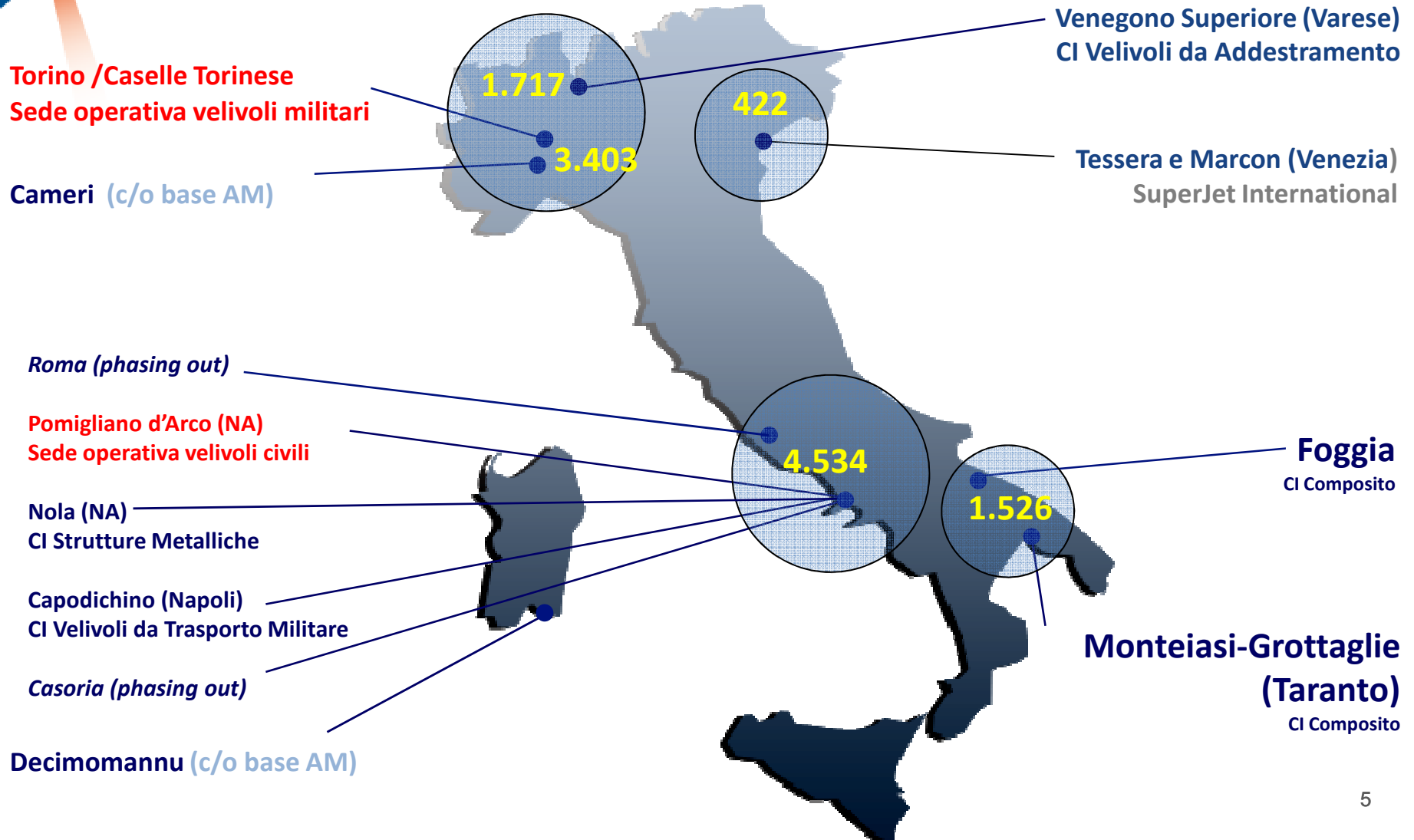
■ **Velivoli da Trasporto militare (Capodichino - Campania)**

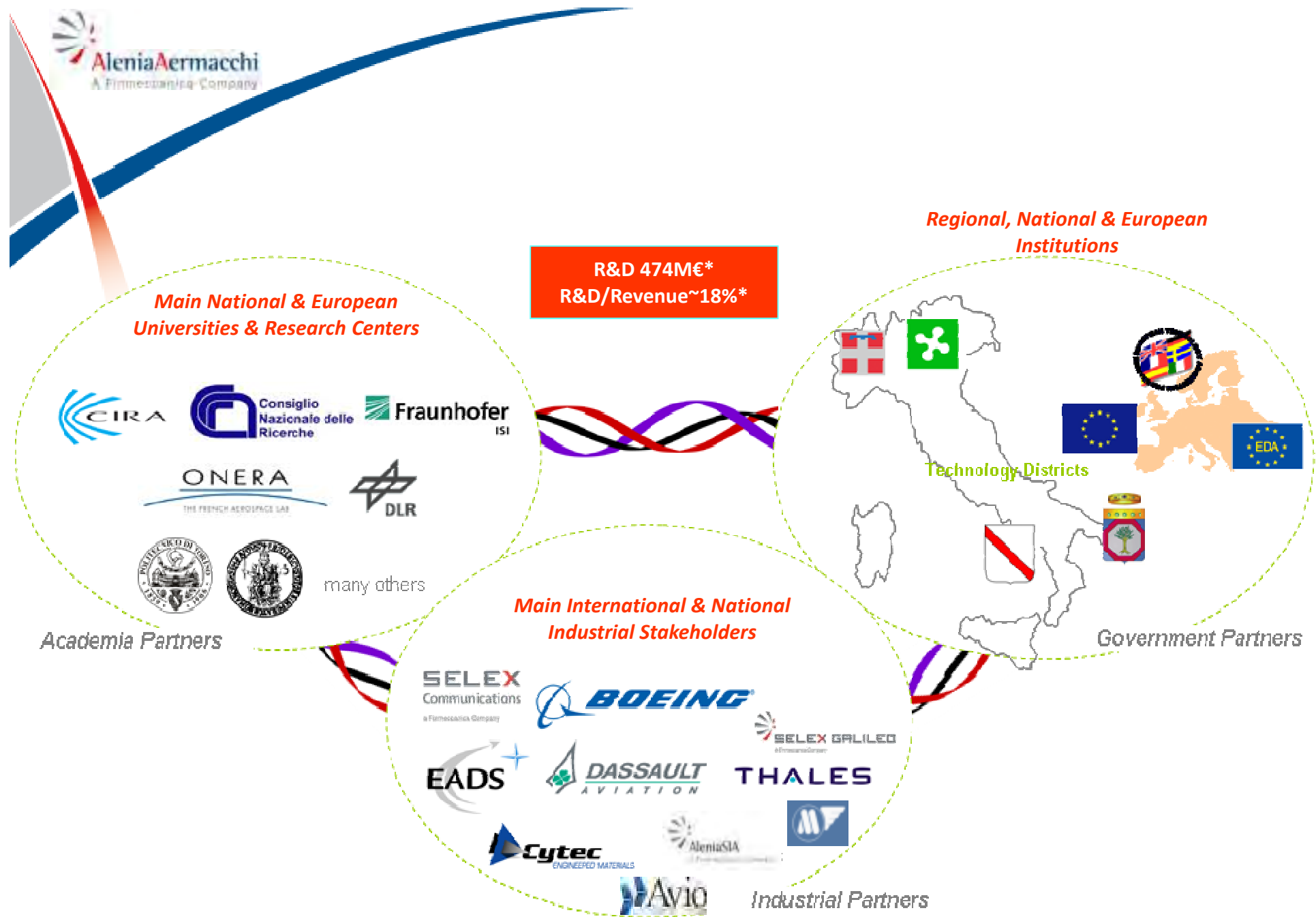
■ **Composito (Foggia e Monteiasi/Grottaglie - Puglia)**



Alenia Aermacchi in Italia (2011)

Totale personale in Italia: 11.602 unità



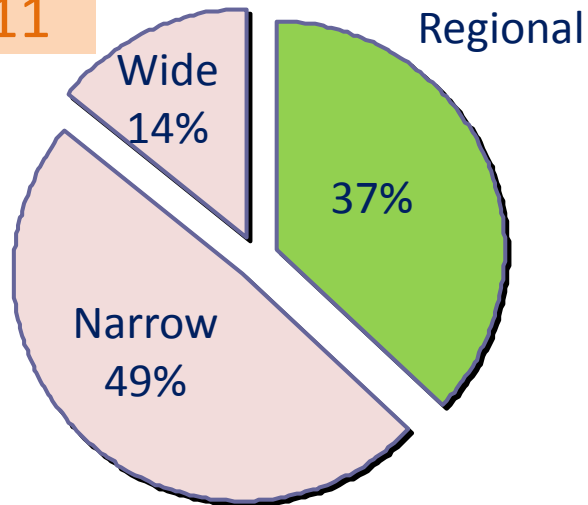


✓ The regional aviation market

Regional aviation plays a very important role in Air Transport System (1/2)

Regional fleet (9000 aircraft) accounts for 37% of world fleet

2011

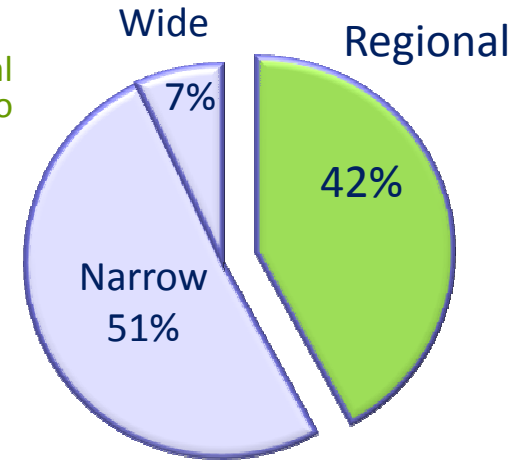


Total World Passenger Fleet – 24350 units

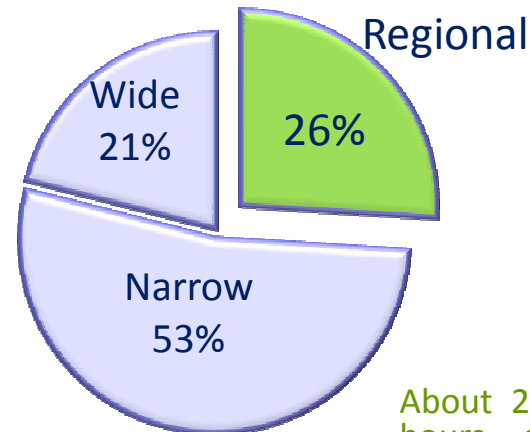
Sources: Lundkvist, Avsoft and OAG

Departures

About 42% of the total departures are to attribute to Regional air transport



Flown hours

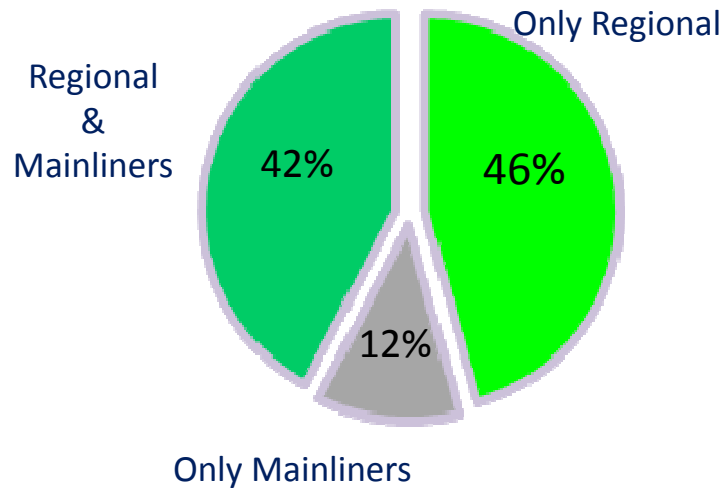


About 26% of the total flown hours are to attribute to Regional air transport

Regional aviation plays a very important role in Air Transport System (2/2)

2011

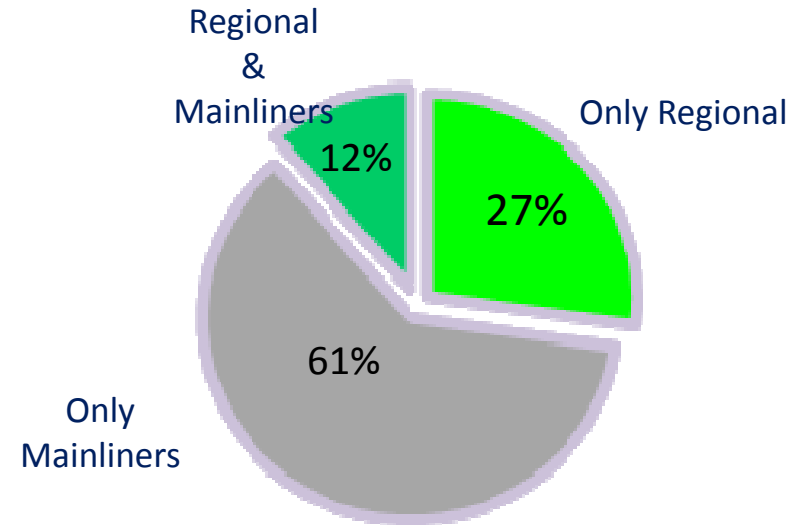
Airports operated by:



Total World Airports = 3310

Note: airports with passenger scheduled service

Airport-pairs operated by:



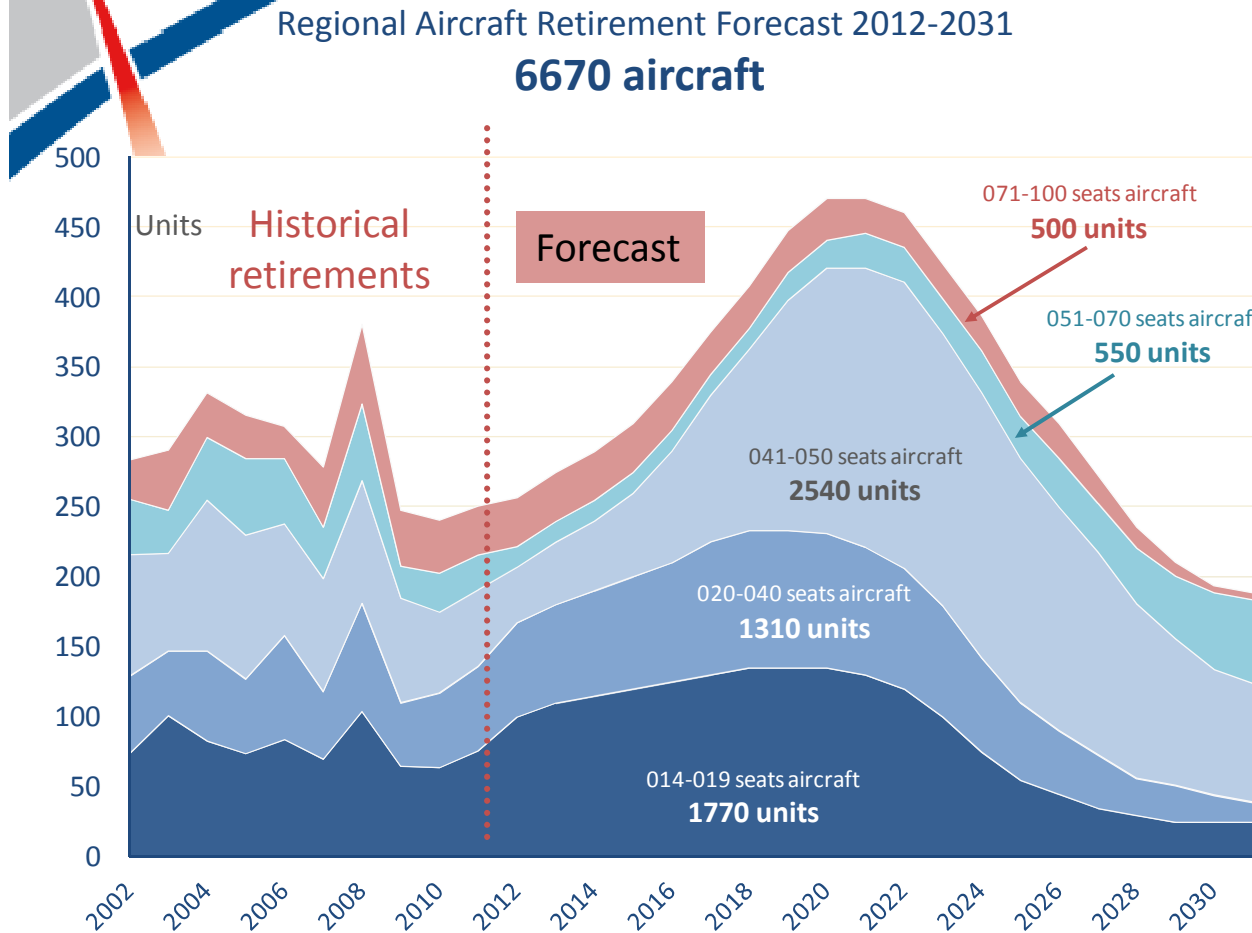
Total World City-pairs = 18822

Note: number of unoriented airport-pairs with passenger scheduled service

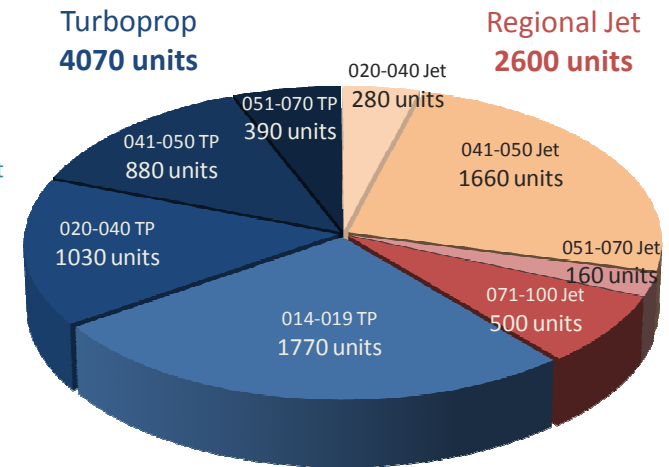
- ▶ Fully **88%** of airports with scheduled service are served by regional aircraft.
- ▶ **46%** of airports with scheduled service are served by regional aircraft only.
- ▶ In the past 10 years the airports operated with both Regional and Mainliners are increased.

- ▶ Fully **39%** of airport-pairs with scheduled service are served by regional aircraft.
- ▶ **27%** of airport-pairs with scheduled service are served by regional aircraft only.
- ▶ More than **25%** of new routes in the last 10 years are operated by regional aircraft only.

Regional Aircraft Retirements Forecast 2012-2031



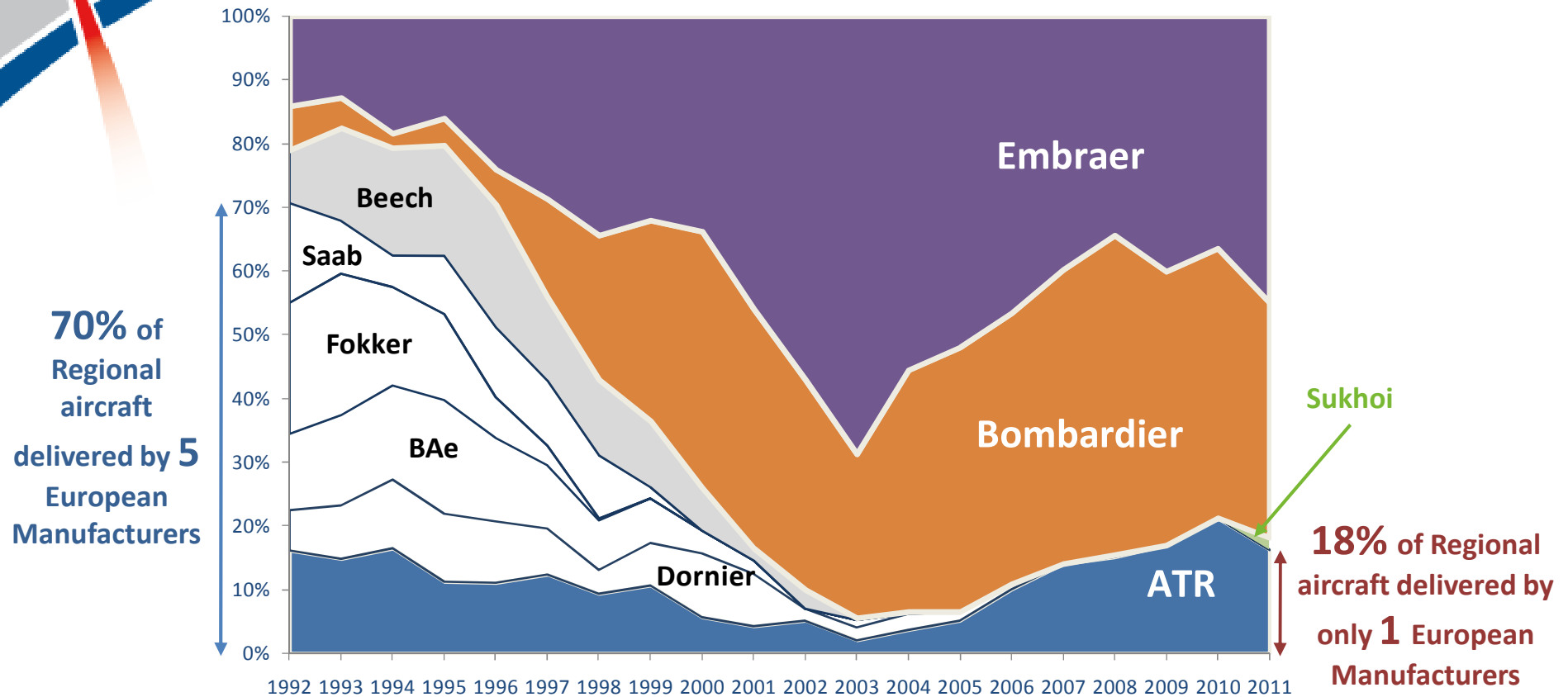
Retirements Forecast 2012-2031 by Seat Segment and Engine Type



- Over the next 20 years about 73% of current fleet of regional aircraft will be retired. More than 4000 retirements will be turboprop aircraft (one third of retired turboprop will occur in North America)
- 14-50 seat aircraft will be the segment capacities most impacted: 1660 units (CRJ100/200 and ERJ135/145) will be replaced in the next 20 years

Regional Aircraft – European Role

Regional (jet + TP) aircraft - Historical Deliveries by Manufacturers



- Over the last 20 years the number of European regional aircraft manufacturers is dramatically decreased. Currently only ATR faces competition from non European OEM as Canadian Bombardier (manufacturing both turboprop and jet), Brazilian Embraer (only jet) and Russian Sukhoi.

Market growth perspective

Regional Aircraft Traffic – ASK (Billions)

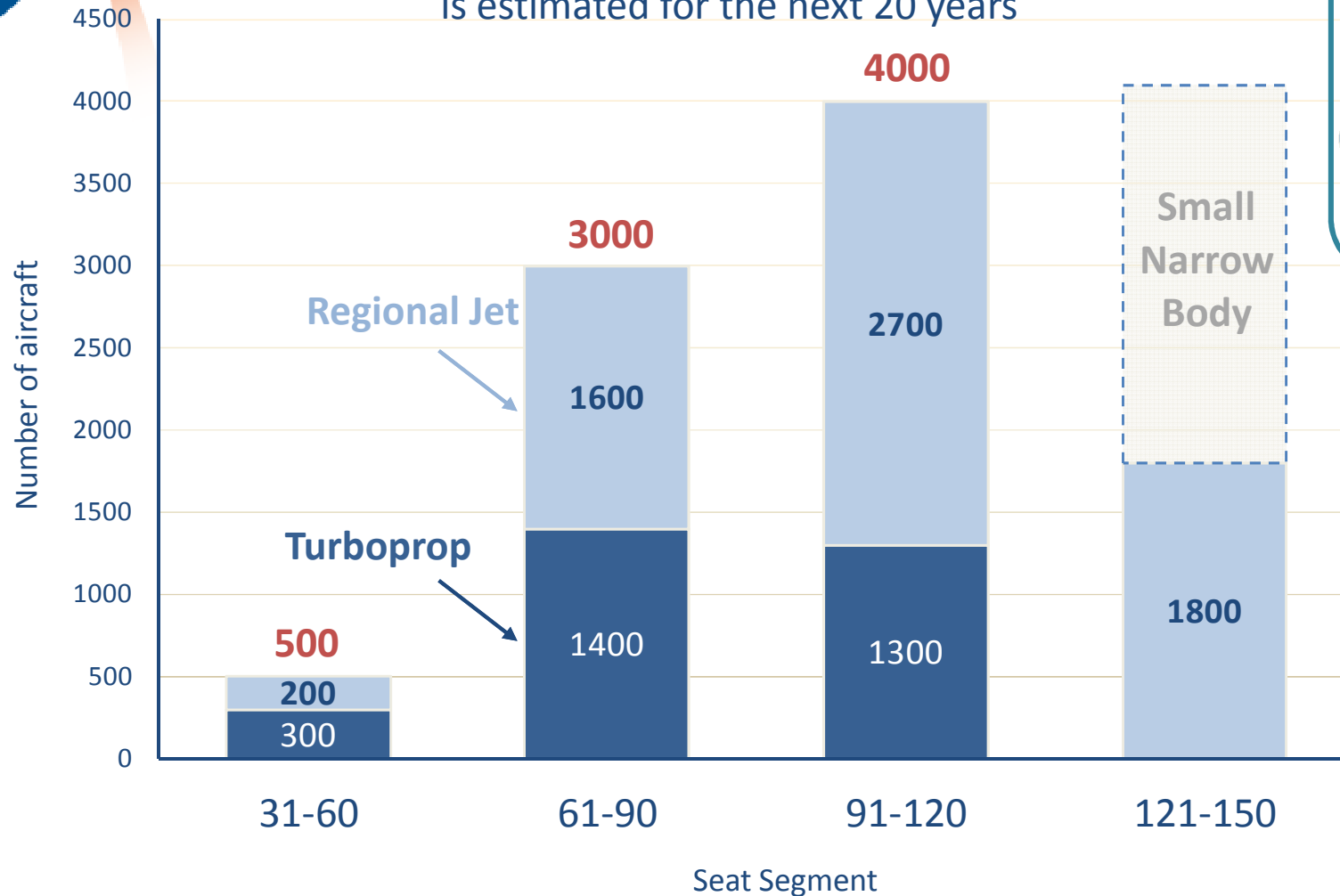


In the next 20 years the air traffic developed by regional aircraft will triplicate !!

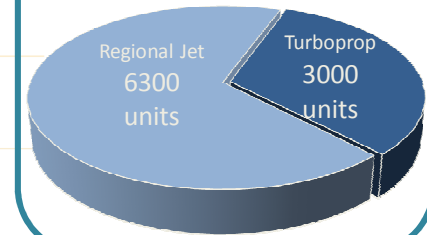
- Regional aircraft performed the strongest traffic growth in the last 20 years.
- For the next 20 years it is forecasted an average yearly growth rate of 6% vs 5% of total commercial aviation.

Regional Aircraft (TP/Jet): Delivery Forecast 2012-2031 Number of A/C

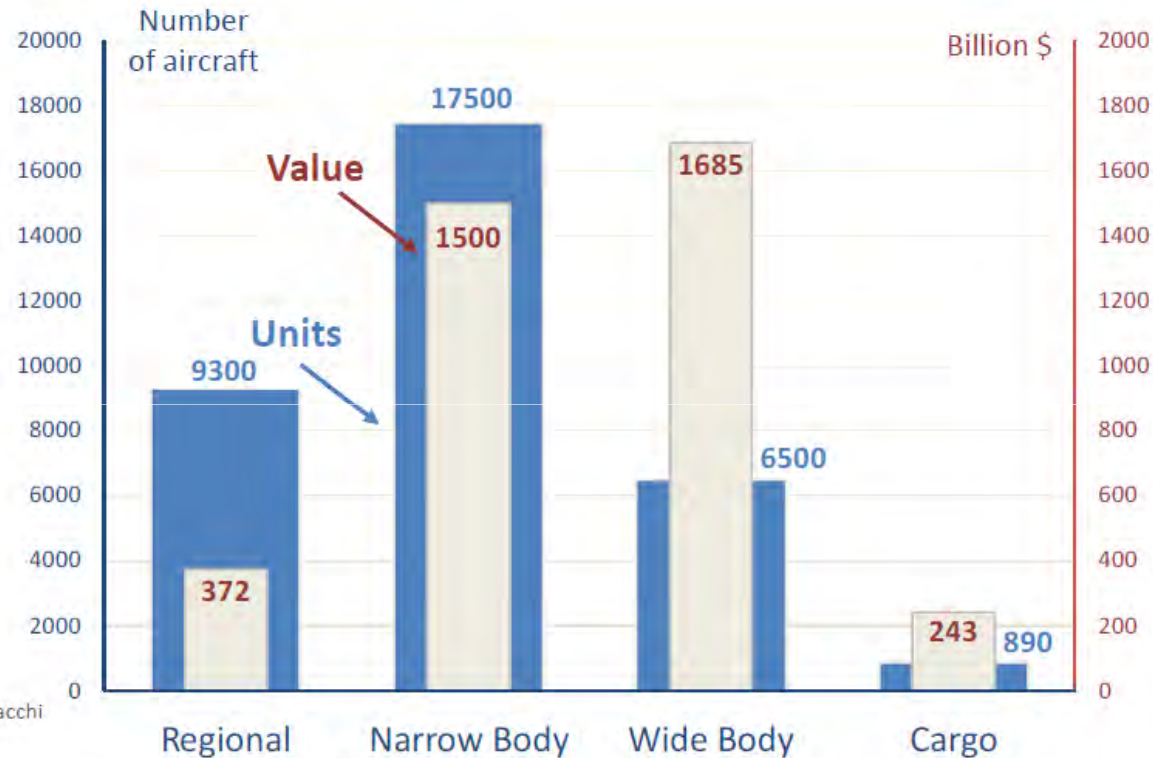
A potential market of about
9300 new regional aircraft deliveries
is estimated for the next 20 years



**New Deliveries
by Engine type**



Regional Aircraft (TP/Jet): Delivery Forecast 2012-2031 Value



Source:
Marketing Alenia Aermacchi

- The airlines demand for new aircraft will exceed 34,000 units with a value of about \$ 3.8 trillion. The most significant portion of demand (units) is represented by single-aisle aircraft of medium capacity.
- In terms of value the Wide Body aircraft represent the richest market segment
- **The Regional market demand will absorb more than 27% of the new deliveries** for a total value of about **372 Billion \$** (€ 270 billions - € 13.5 billion per year).

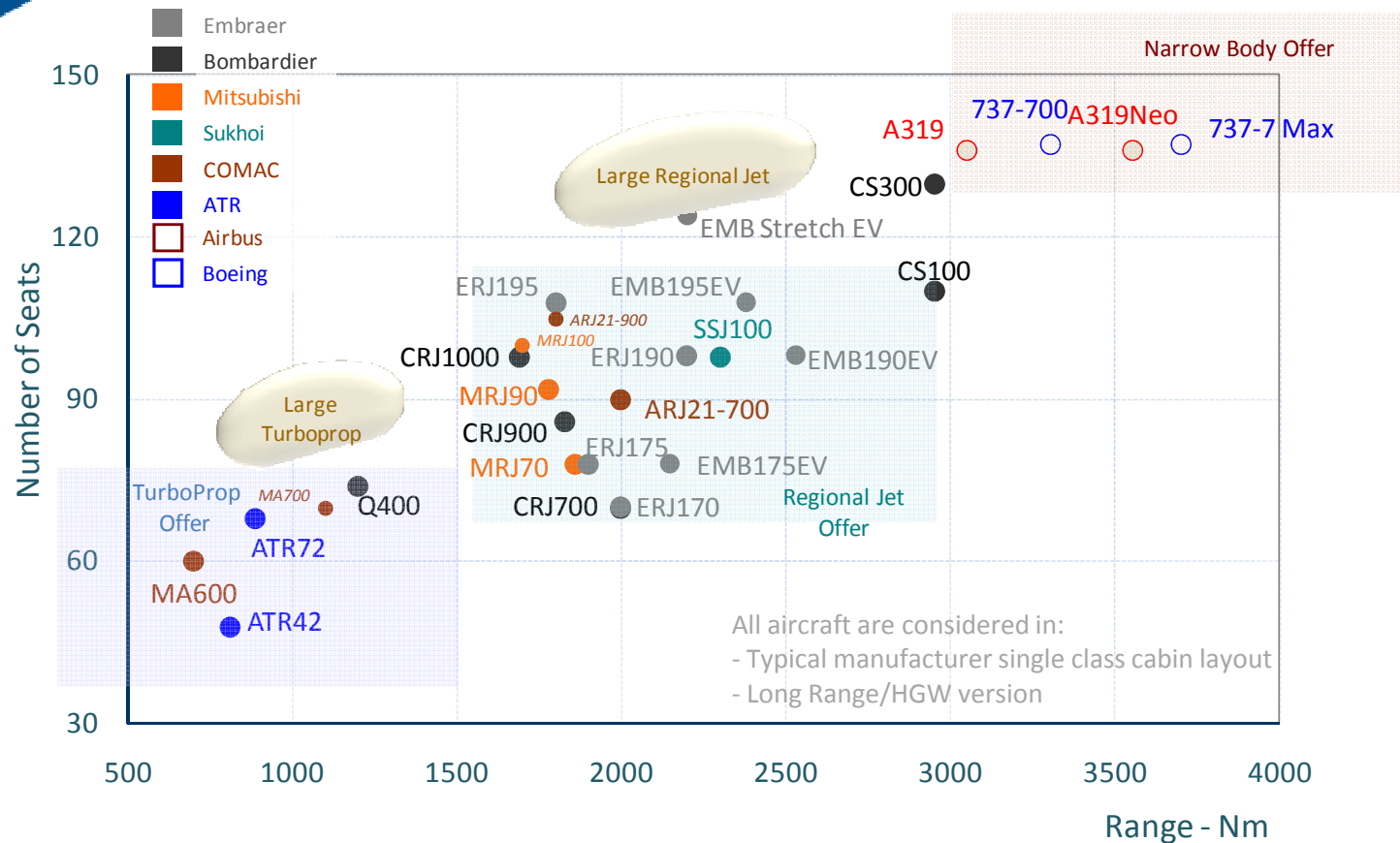
✓ The next generation turboprop requirements

Average Seat Capacity of new ordered aircraft



- Regional carriers are continuing to buy ever-larger-capacity aircraft, with the once-ubiquitous 50-seat regional jets starting to give way to 70-seaters and even 90-seaters. High fuel costs and other factors have made the operation of smaller RJs uneconomic.
- Scope clauses once barred the regional partners of major airlines from flying 70-seaters and even 50-seaters, but financial and competitive pressures eventually forced an easing of the clauses to allow operation of such aircraft. However it may take some years before 90-seat and larger aircraft are permitted, nevertheless it is the 90+ passenger aircraft segment that will experience the most dynamic growth in the regional aircraft market.

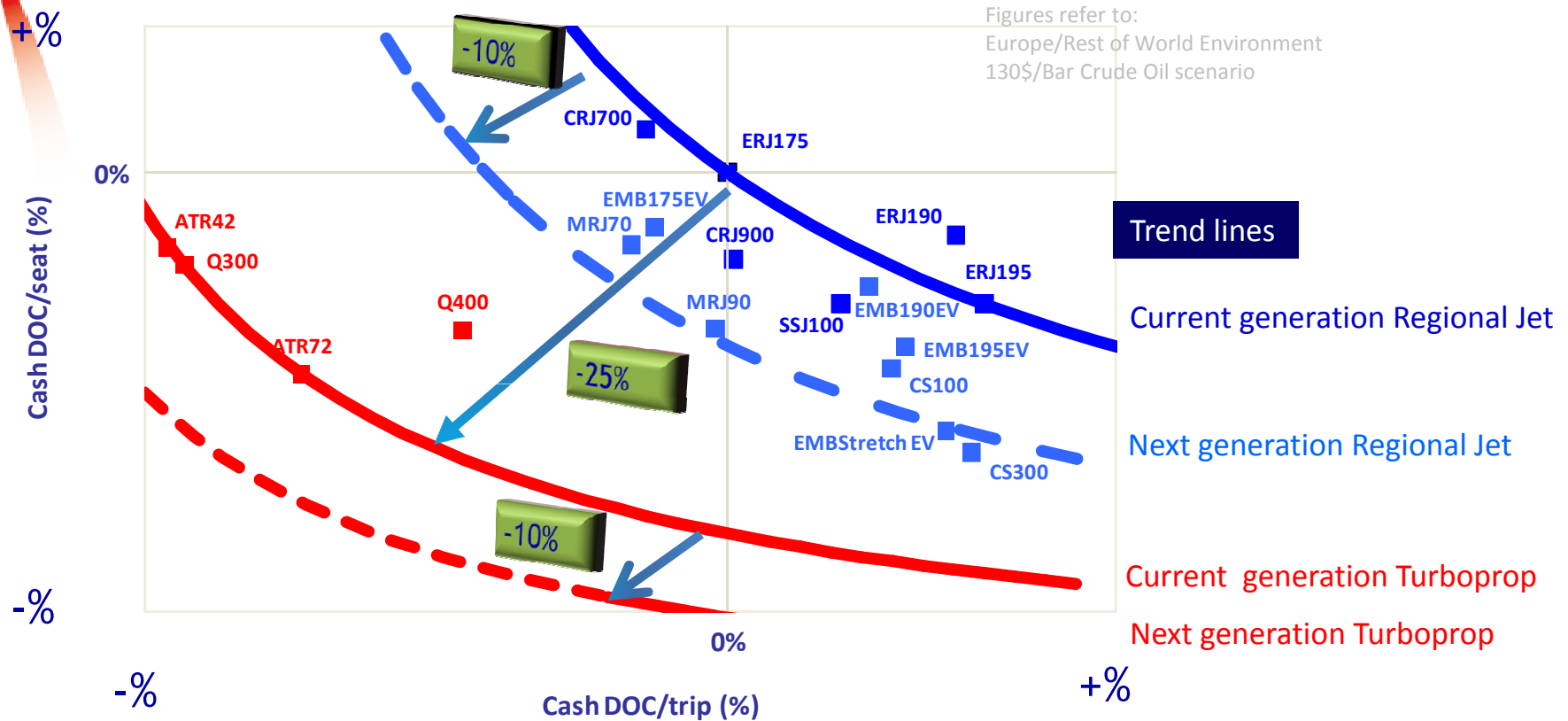
Regional Aircraft – Seat vs Range Positioning



- 3 programs represent the current Turboprop offer: ATR, Q400 and MA600
- The regional jet segment, with five non European manufacturers, is more crowded.
- A new regional program, thanks to larger capacity offered, would place at the same level of the most in demand jet aircraft on the market (90-100 seats) creating a new market segment (90plus TP) that would enable airlines to meet the expected growth of traffic while minimizing operating costs

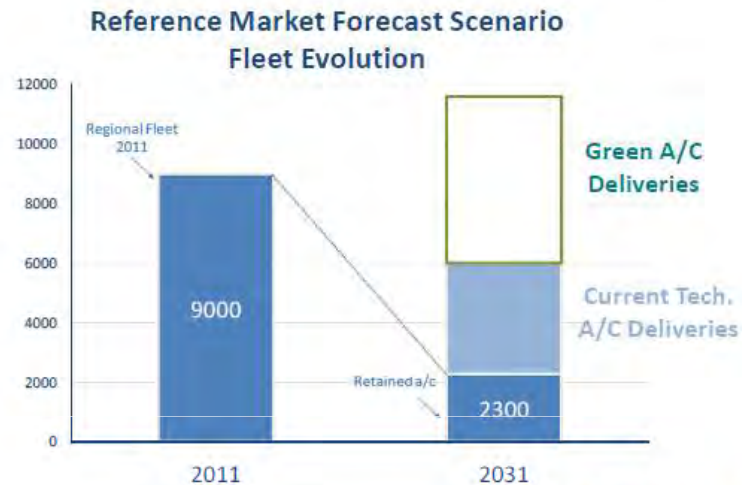
Regional Aircraft – CashDOC positioning

Cash DOC COMPARISON @ 130\$/Bar Oil Price
300 NM Stage Length - Rest Of World Environment - Single Class



- Next generation of regional jet, mainly thanks to innovative engines, will outperform current generation regional jet in terms of Cash Operating Costs.
- Turboprop OEMs (airframe and engine manufacturers) will be forced to develop new generation of products in order to maintain current economics saving towards regional jet.
- Fuel consumption is key driver, therefore lower weight, engines efficiency, more-electric and more aerodynamic efficiency 18

Improving fuel efficiency , toward a Green Regional A/C



2011 World Regional Fleet	9000 a/c
2031 World Regional Fleet	11600 a/c
Fuel Price estimation	4 \$/gal
Fuel consumption reduction	-20% per seat
Light weight advanced material	-10% per seat
Green aircraft deliveries	60%
Yearly flight	2100

Savings up to 2031

Fuel burnt - million t **23.6**

Fuel Cost - billion \$ **29.3**

Maintenance Costs - billion \$ **1.3**

Taxes Expenses - billion \$ **4.9**

Total Costs Savings - billion \$ **35.5**

CO2 Emissions Savings - million t **74**

✓ Technological challenges

Main Dimension

Overall Length	29.5 meters
Total Height (SGL)	9.49 meters
Wing Span	28.76 meters

Design Weight

Max payload	11700 kg
MTOW	33900 kg
MLW	32900 kg

High efficiency aerodynamics with reduced pollution impact

Engine

20% less SFC

30% Dry Weight / SHP

New generation lifting surfaces in carbon fiber with low production cost

FCS fly-by-wire



New generation avionics

(Integrated/Open architecture, advanced FMS functionalities for *green* operations)

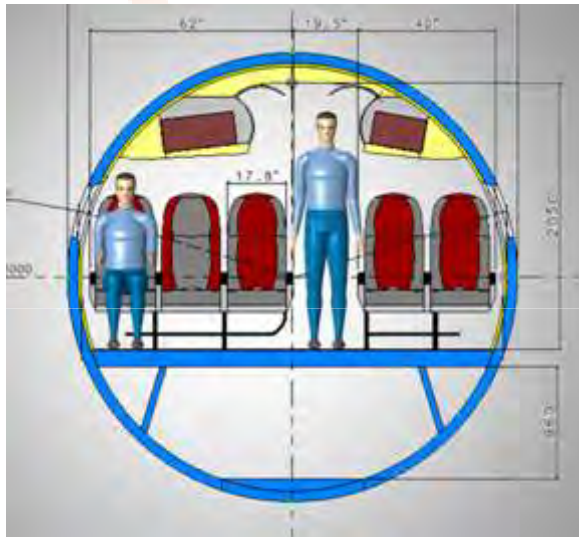
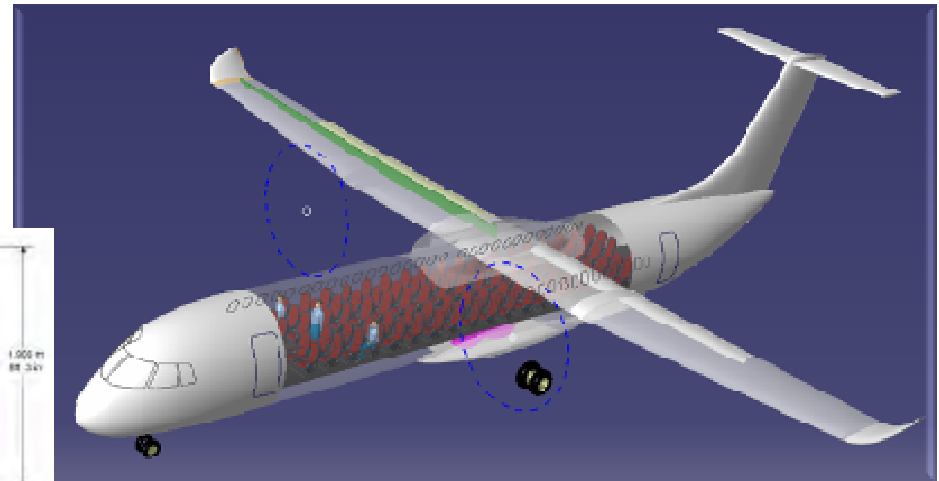
Cabin comfort with new interiors concept

Technological trade off on fuselage structural material metal (Al-Li) vs carbon-fiber (CFRB)

Health Management system

More electric A/C

Low noise and vibration transmitted due high lift device and landing gear new conception



NTP

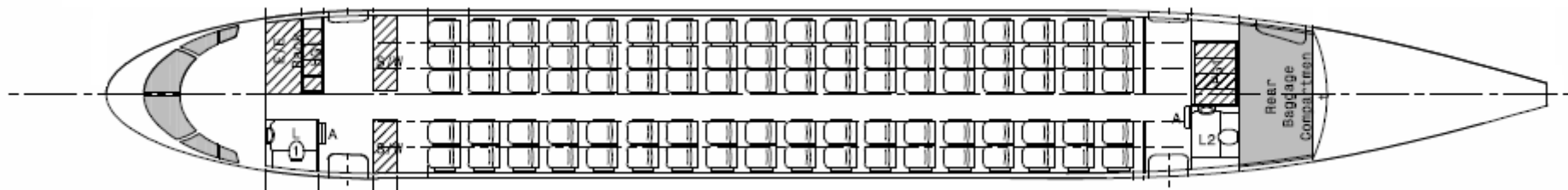
5 abreast configuration



ATR

New TP Cabin Layout and cross section arrangement

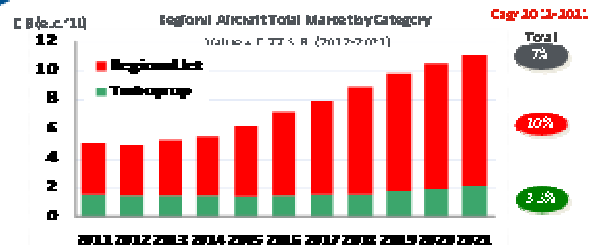
90 pax @ 32" pitch



✓ The Alenia Aermacchi research strategy

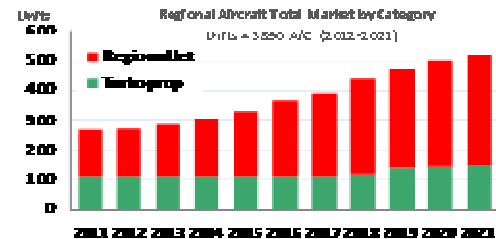
Regional A/C - Technology Roadmap

Market



Exchange rate: 4/5 (Jan 2011)

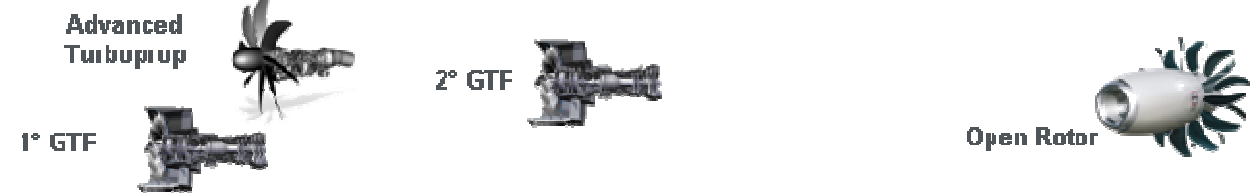
Total units	3280
Far East	1640
Regional	1640
Total Value (\$B)	77.5
Far East	16.7
Regional	60.8



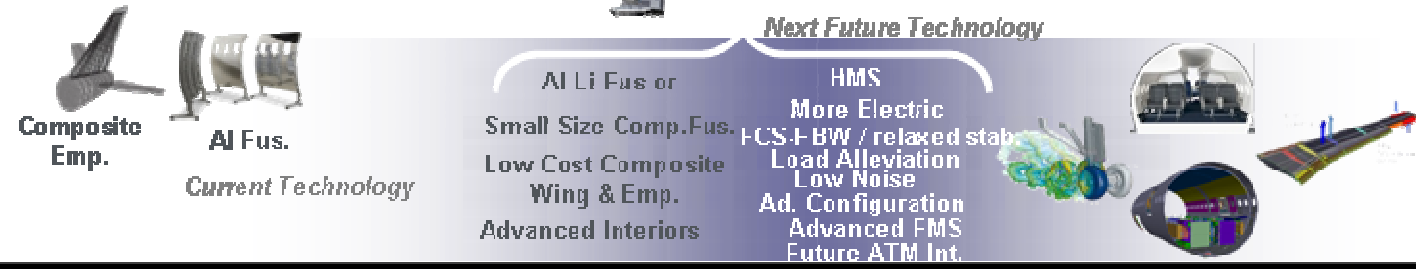
Product



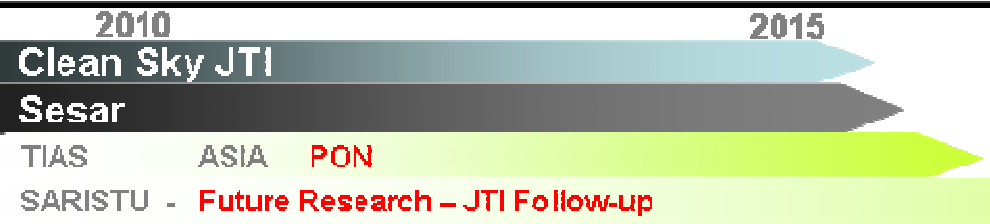
Engine



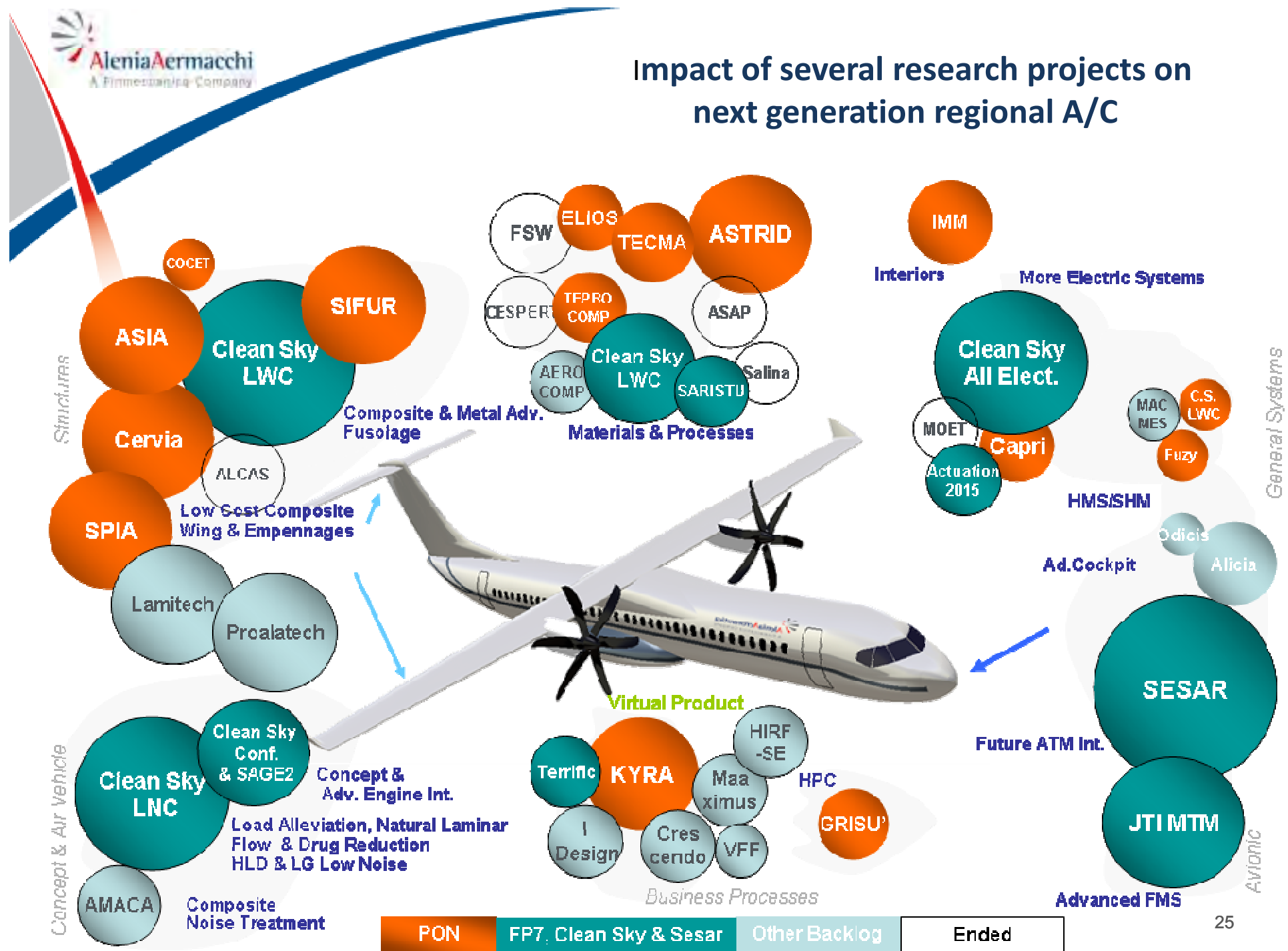
Distinctive Technologies



Technological Development Programs

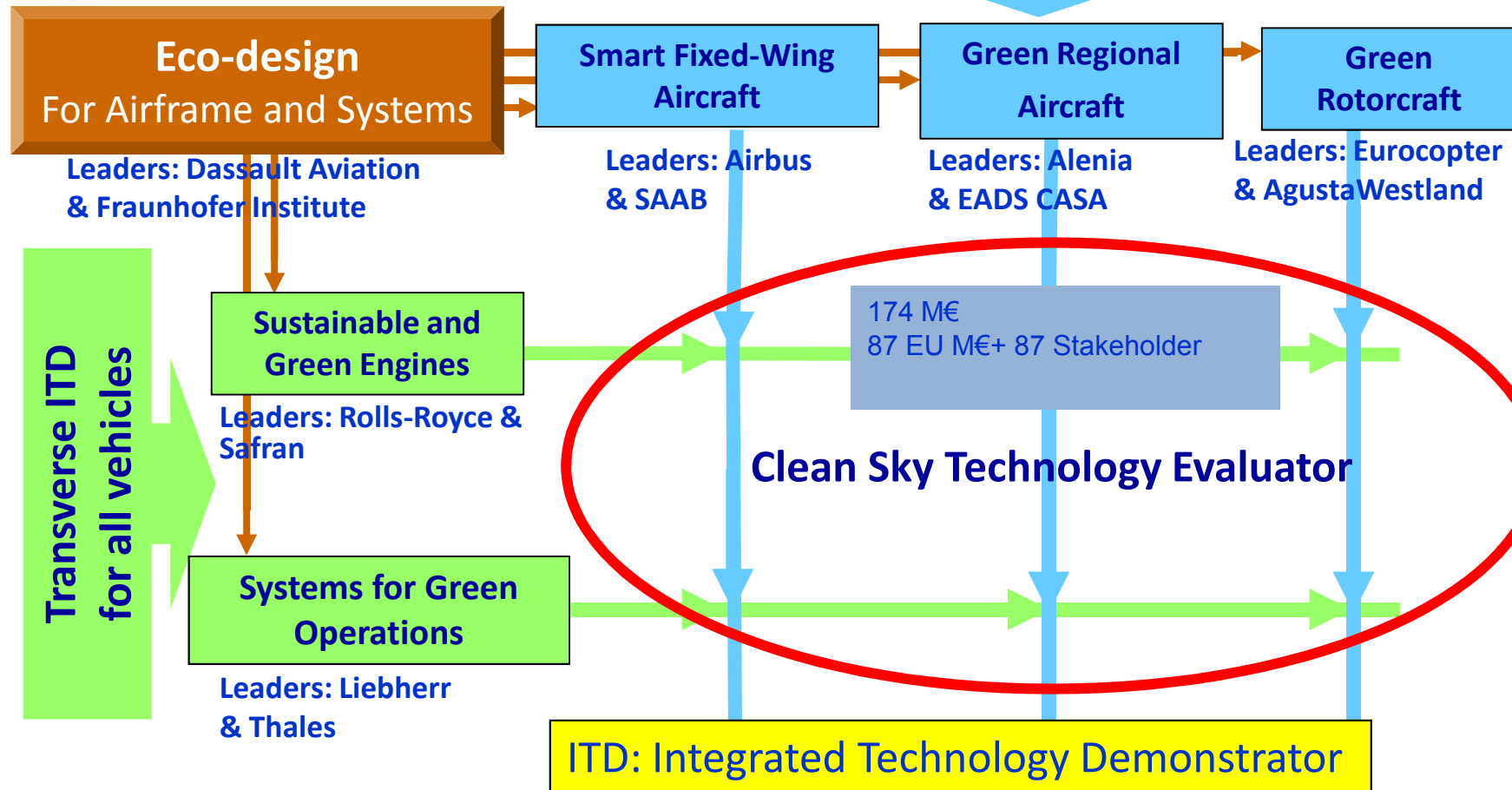


Impact of several research projects on next generation regional A/C



1600 M€
800 EU + 800 Stakeholder

Vehicle ITD



Regional A/C under development in Clean Sky Green Regional A/C Program



90 SEAT CLASS A/C

130 SEAT CLASS A/C

Under wing engine installation

Rear engine Installation

LOW SPEED TURBOPROP

ADVANCED TURBOFAN

PUSHER OPEN ROTOR



GEARED TURBOFAN



Turboprop 90 pax - Revision of A/C requirements



	June 2010	December 2011
	Loop 1	Loop 2
Reference document	Annual Review 2010 presentation	Requirement refinement activity GRA-5.1.1-DL-ATR-TECH-210003 B
Design range (95 pax @ 32" seat pitch @ 103 kg each)	1300 nm	1000 nm
Passenger Payload @ 103kg + 3kg/pax catering	95 pax	
Max Cruise Speed @ 97% MTOW @ FL250	M = 0.56 (337 ktas)	
Time to Climb [MTOW] (from 1500 ft to FL200)	≤ 13min	
Max Payload (Structural) @ (121 kg + 3 kg/pax catering + 500 kg)	95 pax	
Take-off field length @ [MTOW, SL, ISA]	≤ 4600 ft (1400 m)	
Landing distance @ [MLW, SL, ISA]	≤ 4260 ft (1300 m)	
One Engine Inoperative [97% MTOW, ISA+10]	≥ 15000 ft	
AEO Ceiling [97% MTOW, ISA]	≥ 25000 ft	



Main result of market survey: reduction of A/C design range from 1300 nm to 1000 nm.
Market survey results
Call for Proposal JTI-CS-2009-1-GRA-05-003

✓ Overview of critical research areas for the next TP90

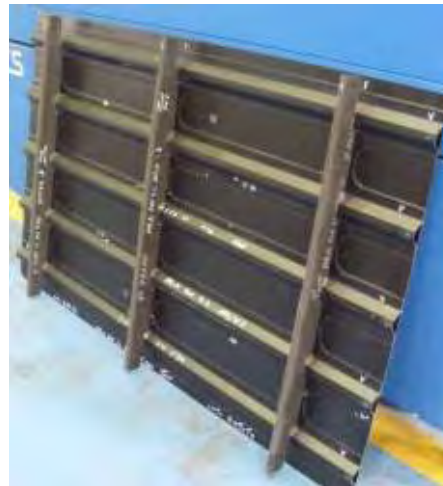
Turboprop 90 pax – Weight Reduction Program Advanced Composite



Fuselage GRA-2011 Composite stiffened panel for high impact resistance (ALA)



Panel for Test 1



Panel for Test 2



Panel for Test 3

- 3 CFRP panels (size 1626 x 1012 mm)
- 5 Omega stringers and 3 frames per panel
- Material for skin and stringers: GRA-2011 Composite
- Process: Co-bonding of pre-cured stringers on green skin



NDI on Panel for Test 3

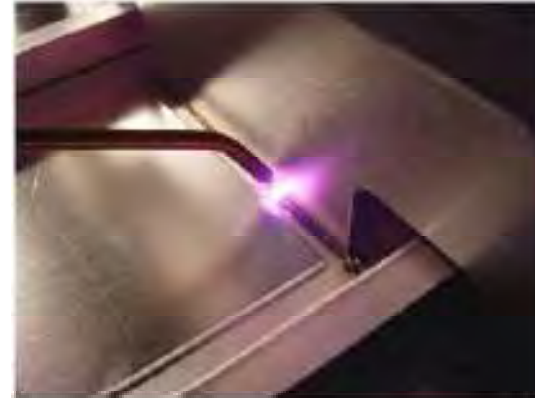
Ref.: D1.3.7-12
Due to: Oct. 2011
Issues:
Mar. 2012 (A)

Turboprop 90 pax – Weight Reduction Program AL-Li and LBW

Fuselage AL-Li laser beam welded stiffened panel

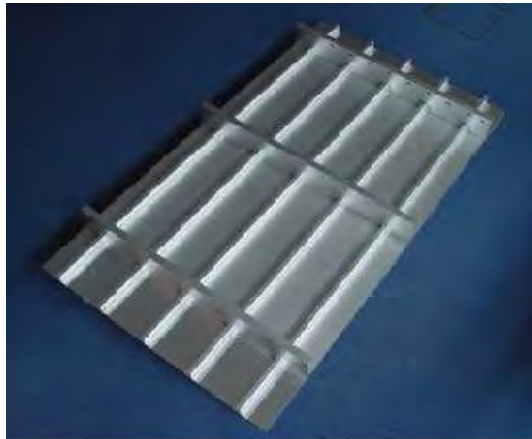


Laser beam welding process for entire panel



Laser beam welding process for skin/frame application

Ref.: D1.3.7-20
Due to: Oct. 2011
Issues:
Mar. 2012 (A)



Panel for Test 1

- 2 Al-Li panels (size 1600 x 900 mm)
- 5 stringers and 3 frames
- Material for skin: sheet of AA 2198 T8 aluminium
- Material for stringer: extrusion of AA 2198 T8 aluminium
- Laser beam welding by Nd:YAG laser source

Turboprop 90 pax – Weight Reduction Program Advanced Manufacturing for CFRP fuselage



Materials and Processes Baseline / Option

Frames:

- Material: CFRP UD Tape
- Process: One Piece Frame (OPF)

Pressure Bulkheads:

Baseline

- Material: Carbon Fiber pre-preg
- Process: Out Of Autoclave curing process

Option #1

- Metal

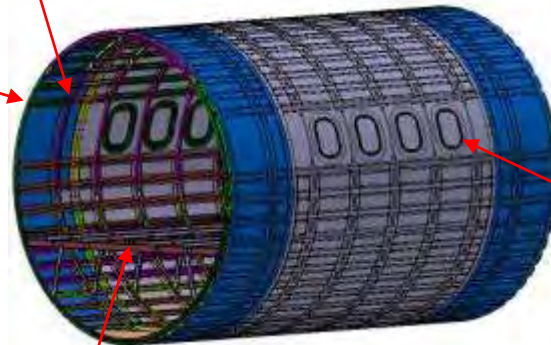
Skin-Stringer:

Baseline

- Material: CFRP.
- Process: One Piece Barrel (OPB), cobonding
- Backup process: Multiple panels mechanically fastened

Option #1

- Material: Al-Li Alloy.
- Process: Laser welding on Al-Li alloy



Windows Frames:

Baseline

- Material: Thermoplastic fabric
- Process: Compression moulding

Option #1

- Material: Carbon Dry pre-forms, resin film
- Process: RFI

Pax & Cargo floor (CfP: JTI-CS-2012-1-GRA-01-042)

- Material: Thermoplastic Carbon Reinforced Polymers
- Process: Progressive Roll Forming

Turboprop 90 pax – Weight Reduction Program Advanced Manufacturing for CFRP fuselage

- A representative small scale tool has been provided to perform tests to support feasibility of single piece barrel.
- After fabrication small scale single barrel will be destructively evaluated



OML Cure tool



Skin lamination on auxiliary tool



Part bagged inside OML cure tool



Part after cure

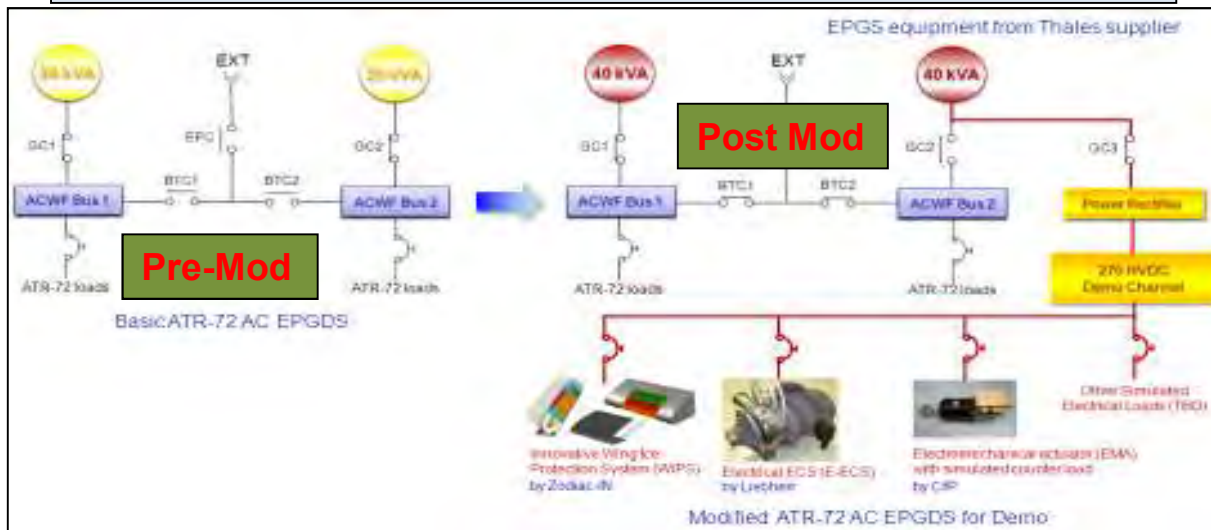
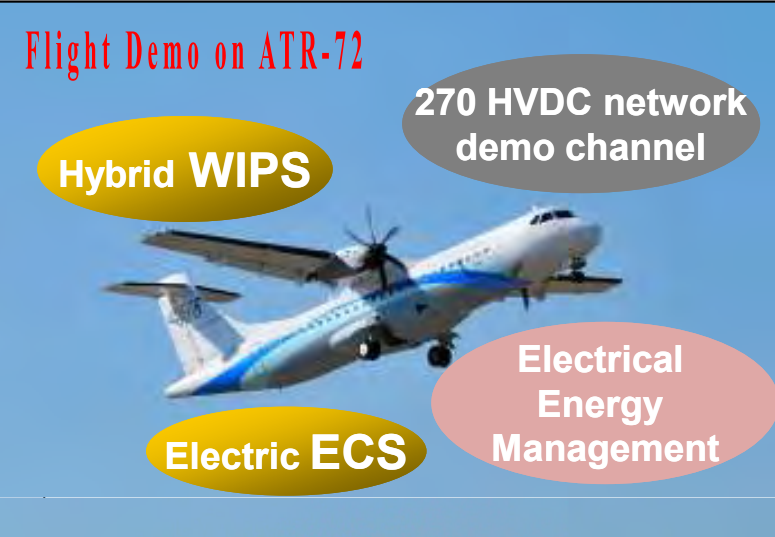


Turboprop 90 pax – Aircraft Efficiency – More electric A/C

“Bringing selected energy management technologies and solution to flight “

ATR configuration for technologies demonstration in flight

- **E-ECS and H-WIPS** innovative technologies introduction
- Enlarged Electrical Power Generation (EPG) with:
 - ✓ dedicated 270 VDC Power channel (demo channel)
 - ✓ dedicated Electrical Distribution to supply and control the additional loads (E-ECS, H-WIPS, EMAs, Programmable Resistive Load) and featuring **Electrical Energy Management** control logic



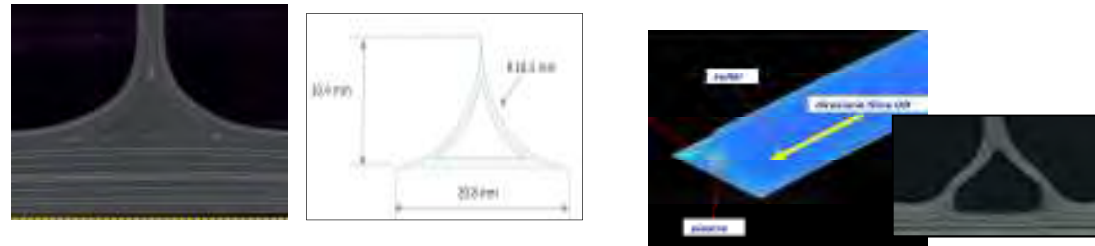
Enlarged Electrical Power Generation (EPG) to power the new large additional Electrical Load and Provide 270 High VDC (Architecture' schematic)

Turboprop 90 pax – Innovation in Empennages Structure

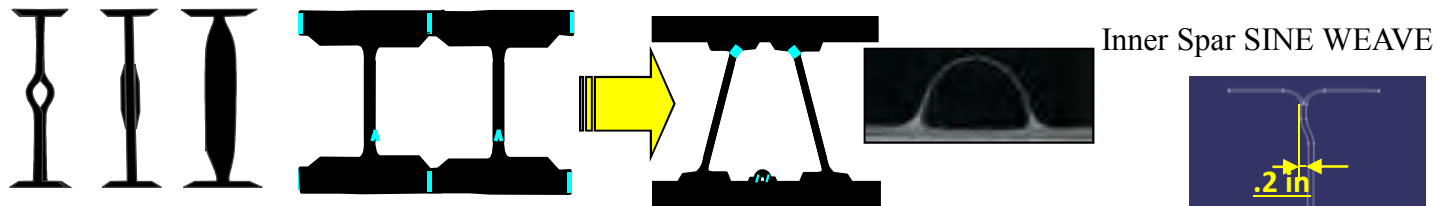
PROALATECH

Innovation in Composite Horizontal Stabilizer Structure
(Evolution in the Monolithic Horizontal Stabilizer Box Fabrication)

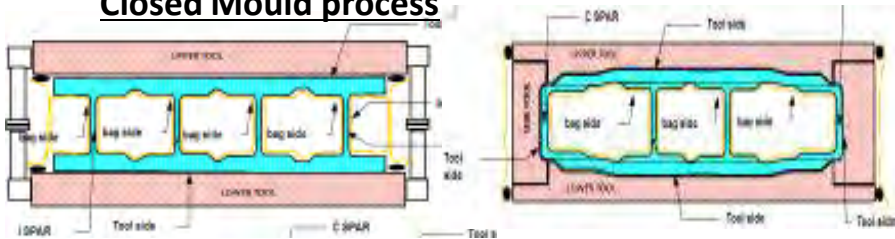
New noodle concept



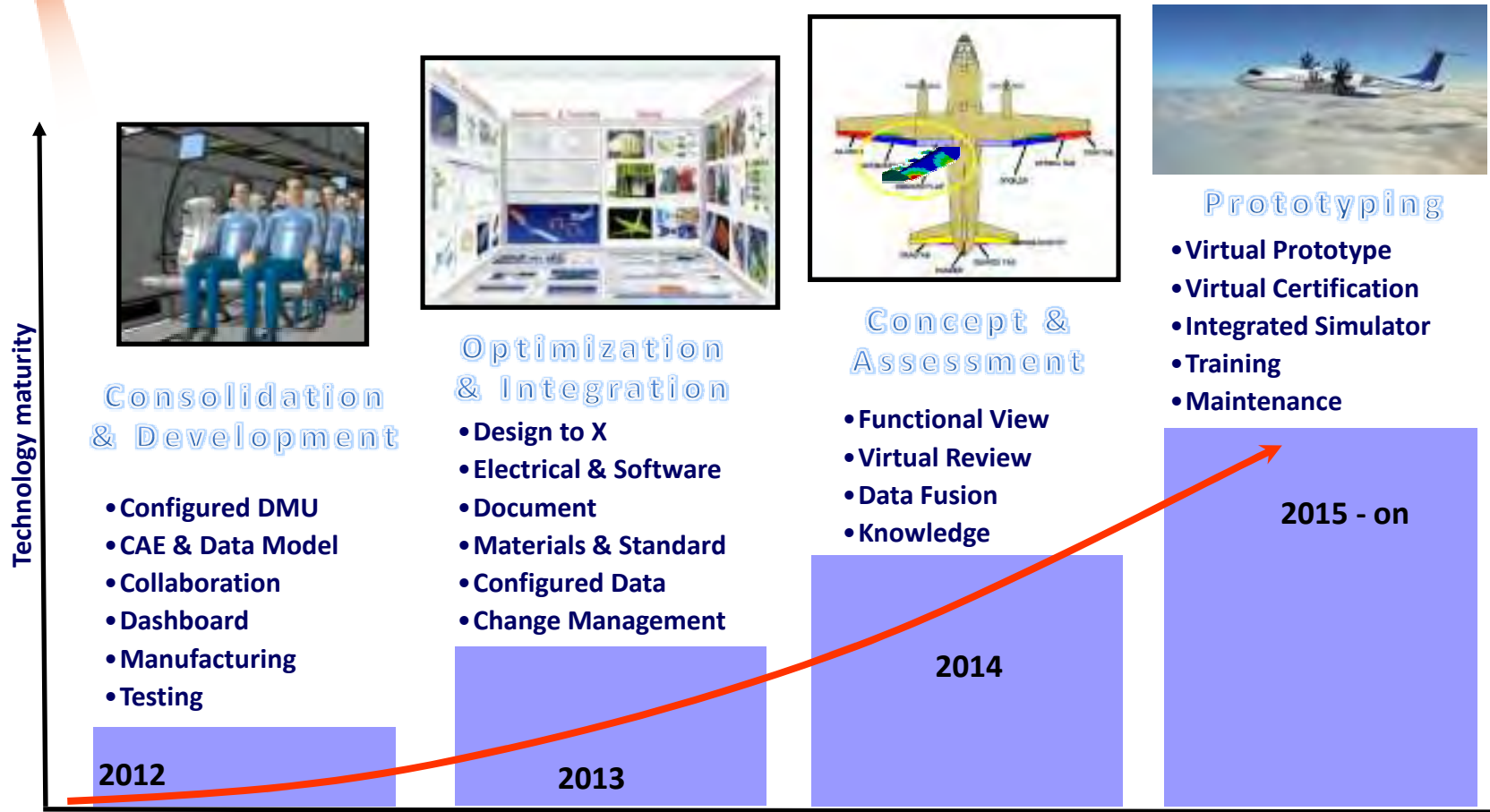
Innovative Spar Web Stiffening



Closed Mould process



Process Innovation Roadmap



Innovation through Process Engineering

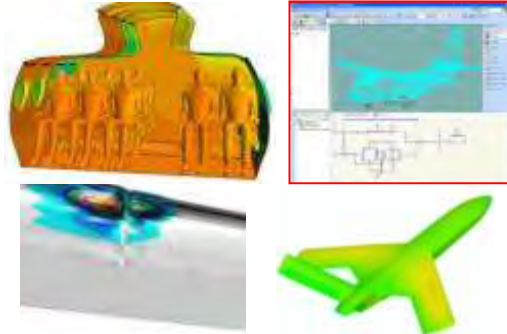
Virtual & Physical Prototyping & Simulation in Programs and Research

Virtual Product



Concept

Virtual Testing



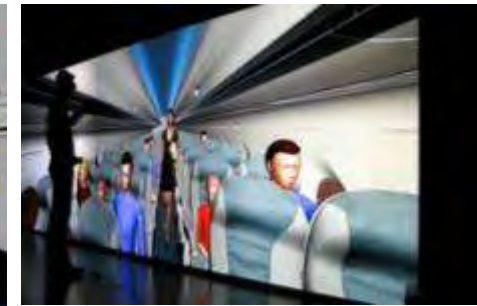
Performance & Validation

Virtual Manufacturing

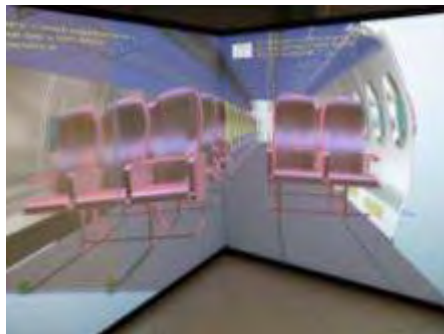


Industrialization

Virtual Utilization

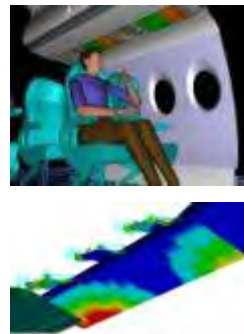


Operation

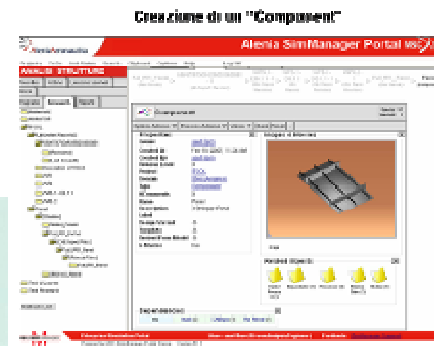
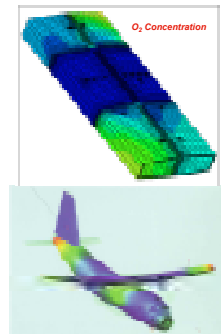


Virtual Product Navigation

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*Multi-disciplinary
Integration*



*Process, Data &
Knowledge Management*



Full Scale Testing

✓ Conclusions

COMING SOON



Thanks you all indeed