8 a 10 de junho de 2010

São José dos Campos - SP - Brasil

SEMINÁRIO - FONTES RENOVÁVEIS DE ENERGIA NA AVIAÇÃO

REALIZAÇÃO

DCA-BR Organização Brasileira para o Desenvolvimento da Certificação Aeronáutica

APOIO INSTITUCIONAL

ABETAR

ANAC Agência Nacional de Aviação Civil - Brasil

Sindicato Nacional das Empresas Aeroviárias SNEA

PATROCÍNIO

MAGNETI MARELLI

São José dos Campos, June 8th, 2010

Future of Commercial Aviation

Prof. Bento Silva de Mattos
ITA – Aircraft Design Department

V39

Content

- Quotes
- Look into the past
- World of today
- Near future
- The shape of things to come

Quotes

“Inventions reached their limit long ago, and I see no hope for further development.”
- *Julius Frontinus, 1st century A.D.*

”Heavier-than-air flying machines are impossible!”
- Physicist, Lord Kelvin, President, Royal Society, [ENGLAND] 1885.

“Only time is wanted to make cars disappear…”

— Scientific American Editorial, 1895

“All attempts at artificial aviation are not only dangerous to life but doomed to failure from an engineering standpoint.”

— editor of 'The Times' of London, 1905

“Airplanes are interesting toys but of no military value.”
— Marshal Ferdinand Foch, professor of strategy, Ecole Superiure de Guerre, 1911

“We do not consider that aeroplanes will be of any possible use for war purposes”
- Richard Haldane, British Secretary of State for War, 1910

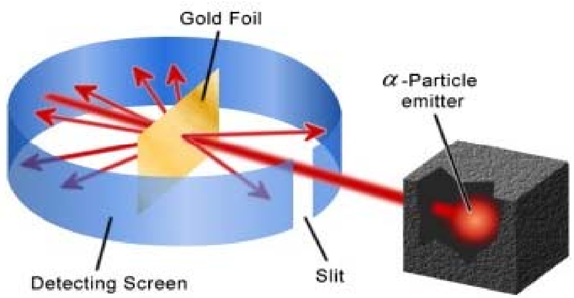
“Deregulation will be the greatest thing to happen to the airlines since the jet engine.”--Richard Ferris, CEO United Airlines, 1976

Airbus will never launch the A380 airliner, and we will built the Sonic Cruiser

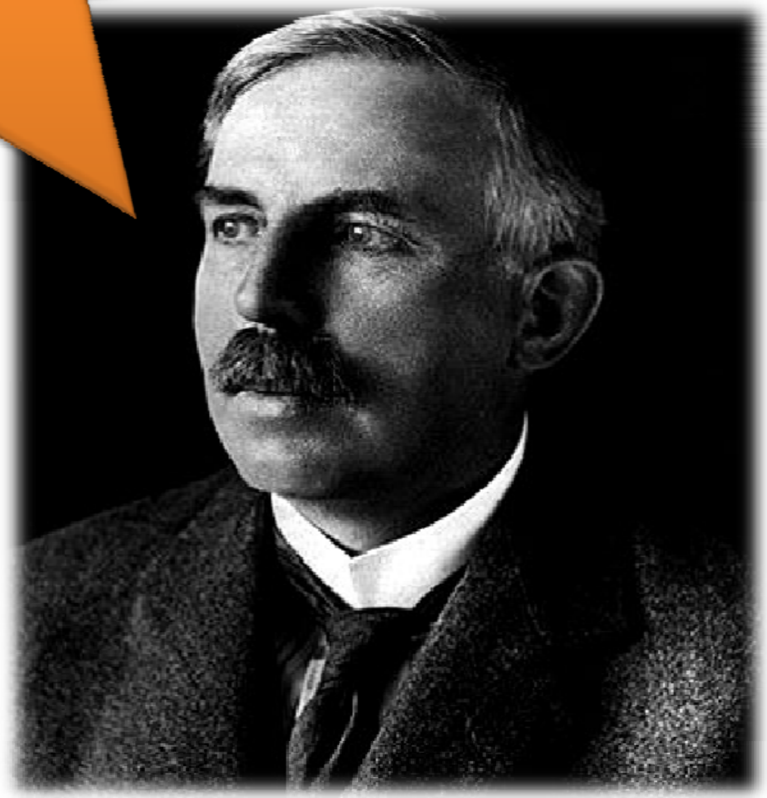
— *Phil Condit, former Boeing Co. CEO*

Failed Predictions about the Future

The energy produced by the breaking down of the atom is a very poor kind of thing. Anyone who expects a source of power from the transformation of these atoms is talking moonshine



In 1909, two researchers in Ernest Rutherford's laboratory at the University of Manchester, Hans Geiger and Ernest Marsden, fired a beam of alpha particles at a thin metal foil. Alpha particles had been identified and named (they were called "alpha rays" to begin with) a decade earlier by Rutherford, as one of the types of radiation given off by radioactive elements such as uranium. Being fast-moving and positively charged (they're now known to be high-speed helium nuclei), Rutherford reasoned they'd serve as a good probe of the atomic structure of matter.



Ernest Rutherford

Prof. Bento Mattos

Failed Predictions about the Future

There will be years – not in my time – before a woman will become Prime Minister

Margaret Thatcher, October 26th, 1969

Prof. Bento Mattos

Failed Predictions about the Future

640 K ought to be enough for anybody

The Internet?
We are not interested in it

Microsoft Products are
Generally Bug Free

Bill Gates

Successful Prediction about the Future

Peter Schiff – Financial Crisis that Started in 2008

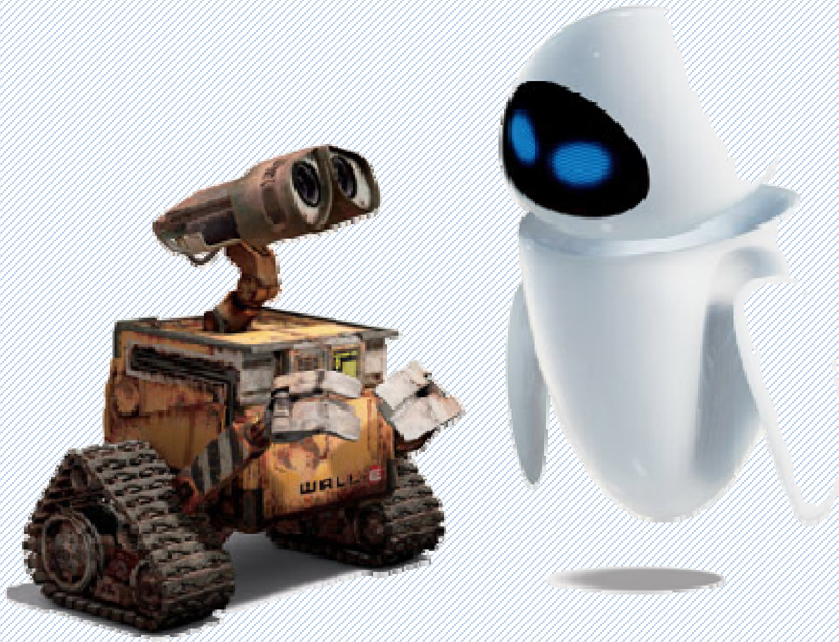
Schiff is one of a minority of economists credited with accurately predicting the financial crisis of 2007–2010. While "nearly all [macroeconomists] failed to foresee the recession despite plenty of warning signs," Schiff is described as detailing specific issues within the economy and how they would result in recession.

Specifically, Schiff described particular individual facets such as the housing bubble and resulting subprime mortgage crisis, the automotive industry crisis and the banking and financial market collapse; however, the profitability of Schiff's advisement has received scrutiny. One dispute involved Michael Shedlock, economic blogger and investment advisor representative for a rival asset management firm, who stated that "I have talked with many who claim they have invested with Schiff and are down anywhere from 40% to 70% in 2008"; Shedlock's statements prompted the Director of Communications at Schiff's investment firm to respond, "While it is true, that our accounts have suffered badly in 2008, a fact that we have never disputed or ran from, [Shedlock's] estimates for the size our of typical client losses are exaggerated and unfair."

Schiff personally responded to Shedlock's criticism by saying, "to examine the effectiveness of my investment strategy immediately following a major correction by looking only at those accounts who adopted the strategy at the previous peak is unfair and distortive," and called Shedlock's blog entry "nothing more than an overt advertisement (and a highly deceptive one at that) to use my popularity to advance his career." He added that losses were felt mostly by recent clients and not by others. In a November 2009 videoblog, Schiff said that five stocks he picked for Fortune Magazine in January 2009 had gained a total of 360%.

Much of the broker's notoriety for the accurate predictions came from a video entitled "Peter Schiff was right" that was uploaded to the popular video sharing site YouTube in late 2008 and again in 2009, and subsequently went viral and garnered hundreds of thousands of views over the next few months. The video consists of a compilation of clips of his many appearances on various financial news programs from networks including CNBC, Fox News, MSNBC and Bloomberg, most of which took place from 2005-2007. In the segments Schiff explains specifically the fundamental problems he saw with the United States economy and the results they would ultimately lead to. In many cases the conversations led to debates in which other talking heads openly laughed at Schiff's assessments, stating they had no idea what he was talking about.

Schiff's constant warnings of a coming economic collapse earned him the moniker "Dr. Doom."



Look into the Past

Some Inventions to Take Note

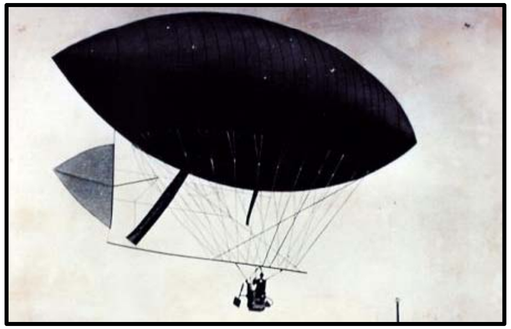
- **Beer by Sumerians circa 6000 B.C.**
- **Airplane - 1906**
- **Color Television – 1940**
- **Computer Hard Disk – 1956**
- **Electronic Fuel Injection - 1966**
- **Bar Code Scanners – 1970**
- **Liquid Crystal Display (LCD) – 1970**
- **Celullar Phones – 1979**
- **Digital Versatile Disc (DVD) – 1995**
- **Blue-ray Disc – 2007**
- **??? 2010**

Open-Source Aviation Ambience in Europe

Tissandier Brothers - 1883

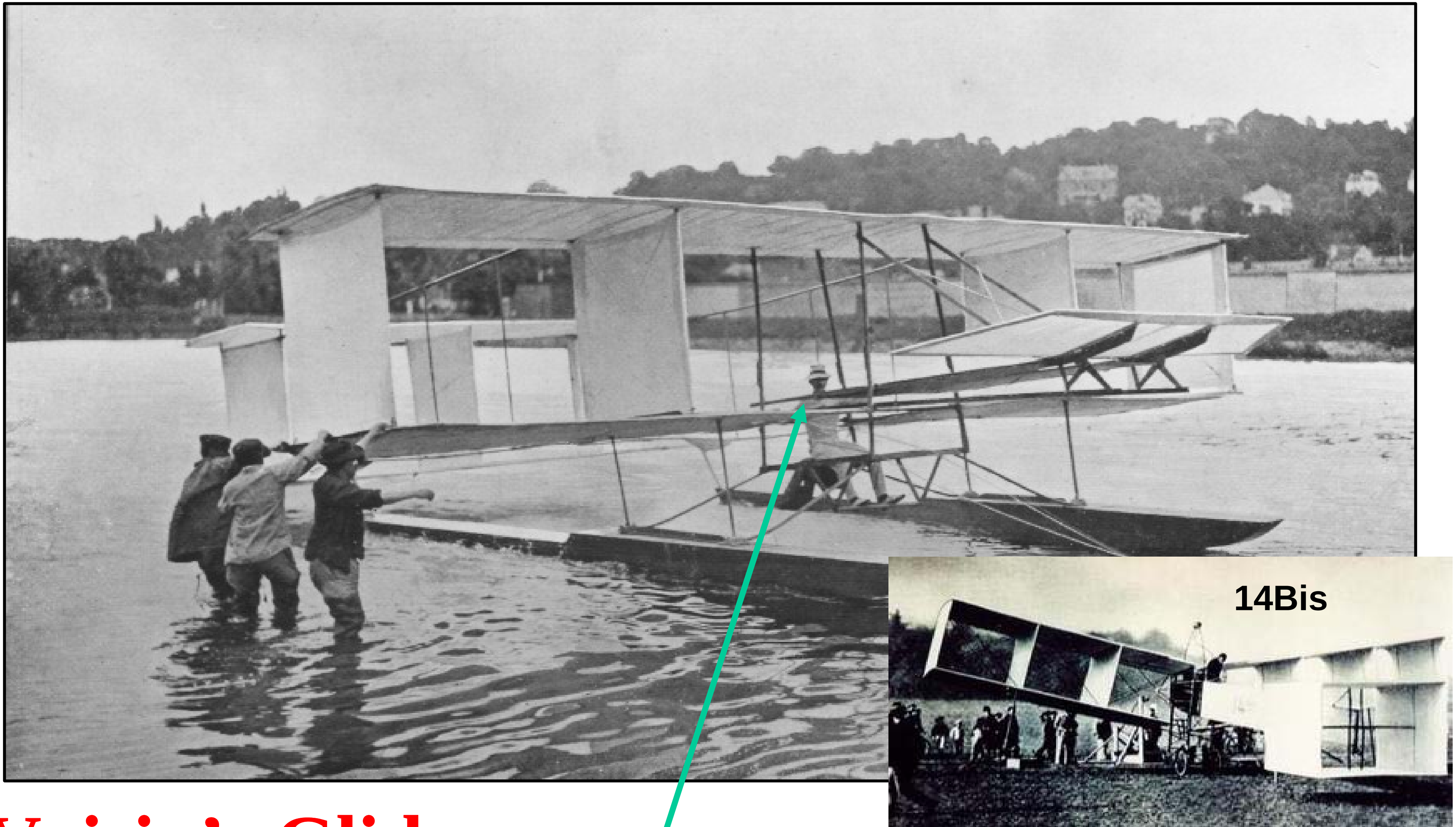
The brothers Albert and Gaston Tissandier of France designed and constructed the **first airship powered by electricity**. The current was supplied by 24 bichromate of potash cells to a Siemens 1.5 horsepower (1.1 kilowatts) at 180 revolutions per minute. The engine drove a large two-bladed pusher propeller through reduction gearing. The speed achieved in calm air was still only 3 miles per hour (4.8 kilometers per hour) since the ratio of power to weight was no better than Giffard's had been. It can be clearly observed the influence of Tissandier airship configuration on the design of Santos-Dumont no. 3. That can be credited to the collaborative ambience that prevailed in continental Europe at that time.

- Very similar to Tissandier's airship
- First fully operational in history



🡐Santos-Dumont No. 3

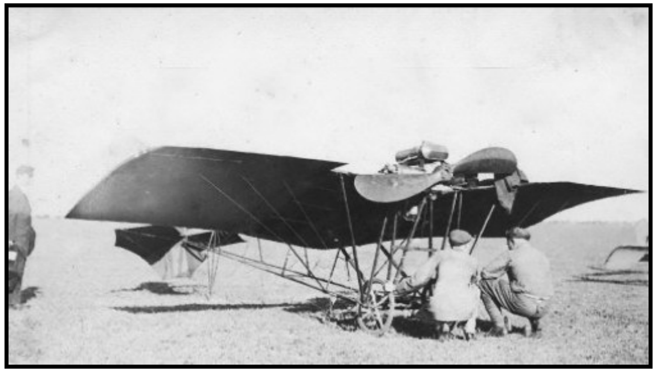
Open-Source Aviation Ambience in Europe

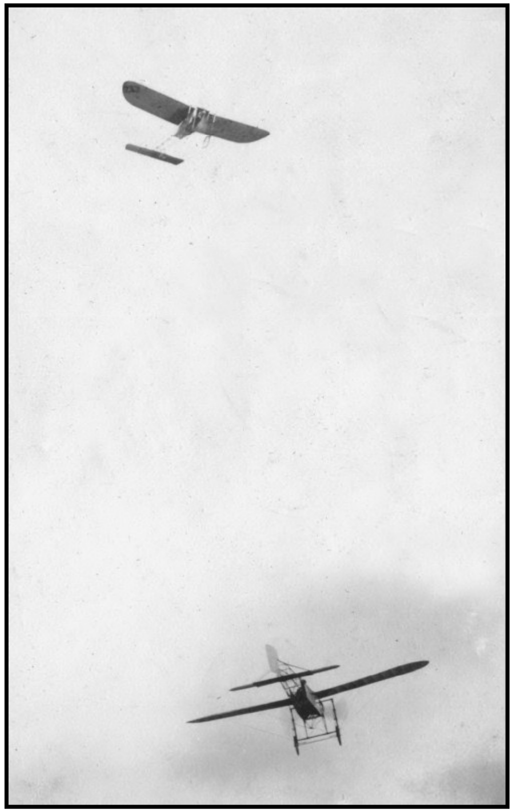


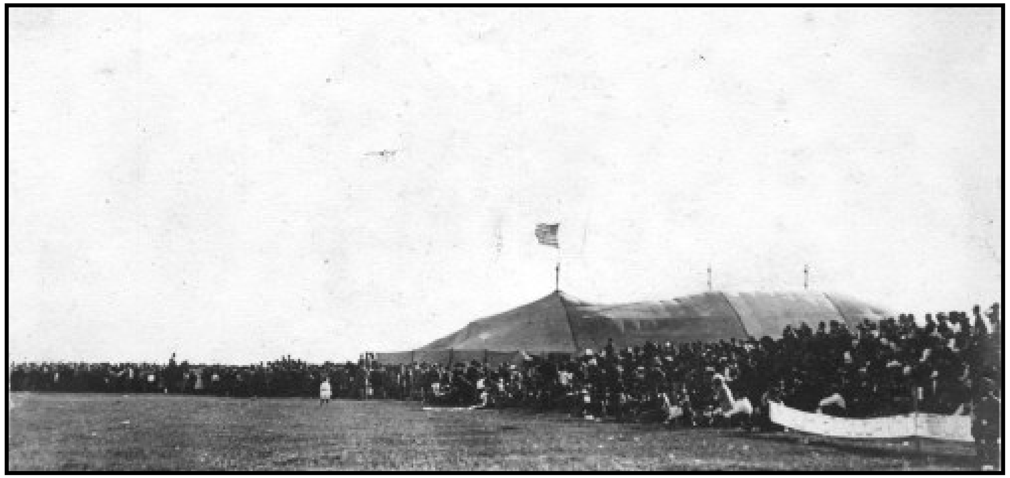
Voisin's Glider

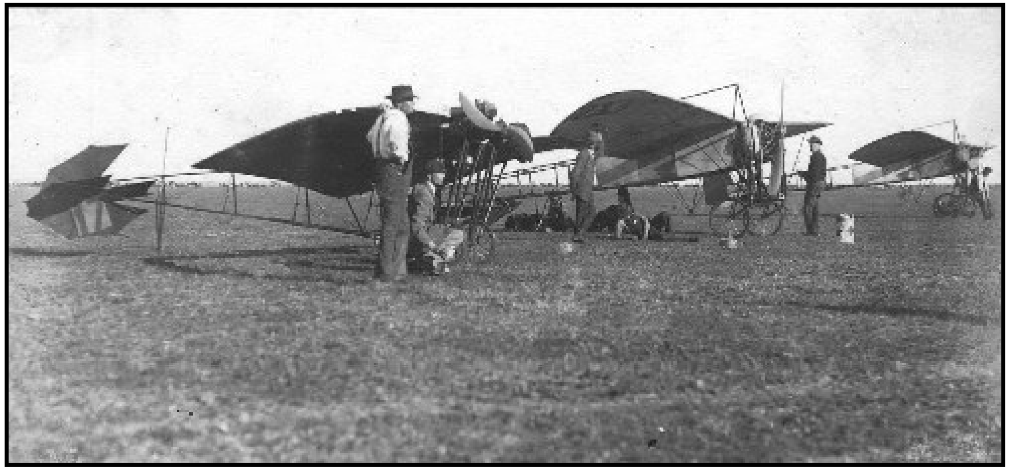
Santos-Dumont

Open-Source Aviation Ambience in Europe









Demoiselle and Blériots – Airshow in Texas in January 1911

USA lag behind Europe at the Beginning of WWI

Source: Angelucci, Enzo. Illustrated Encyclopedia of Military Aircraft. Edison: Chartwell Books, 2001.

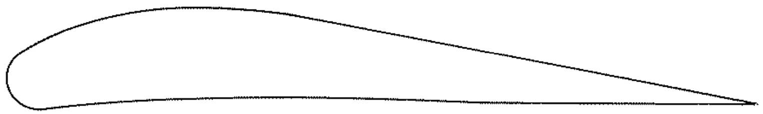
AIRFOIL THICKNESS: WWI AIRPLANES

English Sopwith Camel

RAF 14. British

Thin wing, lower maximum C_L
Bracing wires required – high drag

German Fokker Dr-1 and Fokker D-VII



Göttingen 298. German

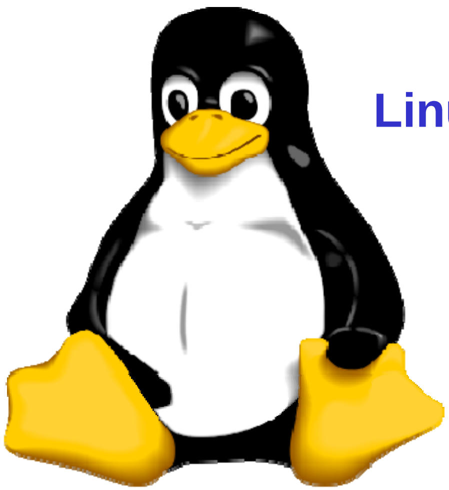
Higher maximum C_L
Internal wing structure
Higher rates of climb
Improved maneuverability

Open-Source Aviation Community in Europe

Open-Source Strategy is a Success Formula Today

SETI HOME

SOURCEFORGE.NET®

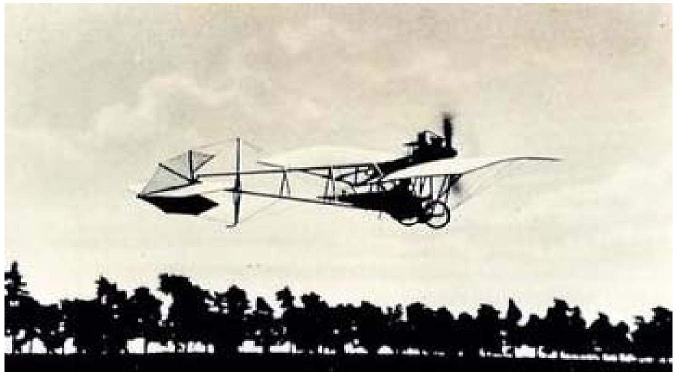


Linux

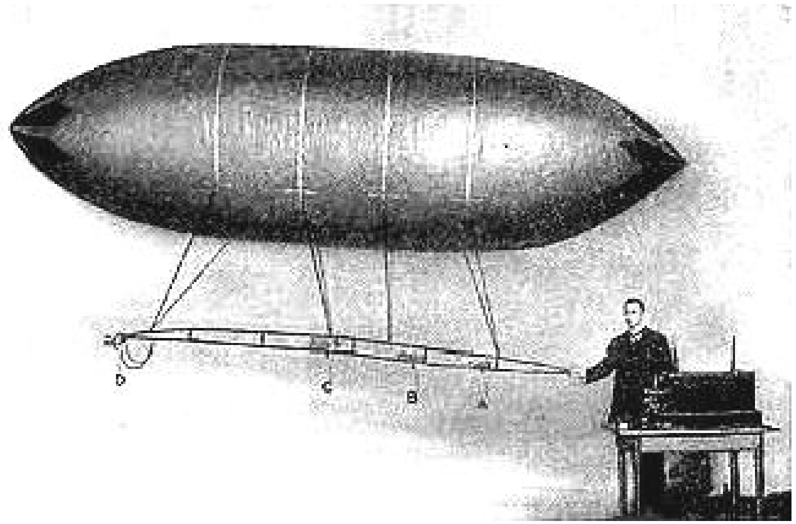
Wikipedia
The free encyclopedia

Concorde: Collaborative work

Airplane in dawn of aviation in Europe



Remote piloted dirigible c. 1900



Well before the race for wireless telegraphy and as far back as 1893 in St. Nikola Tesla demonstrated remote control of objects by wireless. This was two full years before Marconi began his experiments. His demonstrations of remote control climaxed in an exhibition in 1898 at Madison Square Garden in which Tesla caused a small boat (right) to obey commands from the audience. Of course, it was Tesla interpreting the verbal requests and sending appropriate frequencies to tuned circuits in the miniature ship, but to the audience it was magic. To the press, Tesla prophesied a future in which telautomatons (robots) did man's bidding, perhaps some day exceeding mankind. Tesla had already decided that men were "meat machines", responding only to stimuli and incapable of free will, so to him the succession of man by machine seemed less preposterous. He also chose to join others in the race to use America's newfound technological superiority to devastate the Spanish in the Spanish-American War. He offered his remote controlled boat to the military as a new kind of "smart-torpedo" that would make war so terrible nations would cease to wage it.

Wireless Energy Transfer

Long-Range Wireless Energy Transfer: Tesla explored the wireless transmission of energy through his work with radio and microwaves and his creation of the Tesla coil and the magnifying transmitter. But he sought to create a system where energy could be broadcast across vast distances. To that end, he constructed Wardenclyffe Tower in Shoreham, Long Island, which was to function as a wireless telecommunications facility and broadcast electrical power. But JP Morgan, who financed the construction of the tower, eventually pulled Tesla's funding. Unable to find additional backers, Tesla was forced to abandon construction of the tower, and never fulfilled his dreams of creating a worldwide wireless electrical energy system.

American Airliners Operating in the 30s


Ford Stout 2-AT (1925)


Aerial Mercury (1926)


Douglas M-3 (1926)


Swallow Mailplane (1926)


Stearnan C-3B (1927)


Boeing Model 40 (1927)


Boeing Model 80A (1928)

Curtiss Falcon (1929)

Northrop Alpha 2 (1930)


Boeing Model 247 (1933)


Douglas DC-3 (1936)


Lockheed Lodestar (1939)

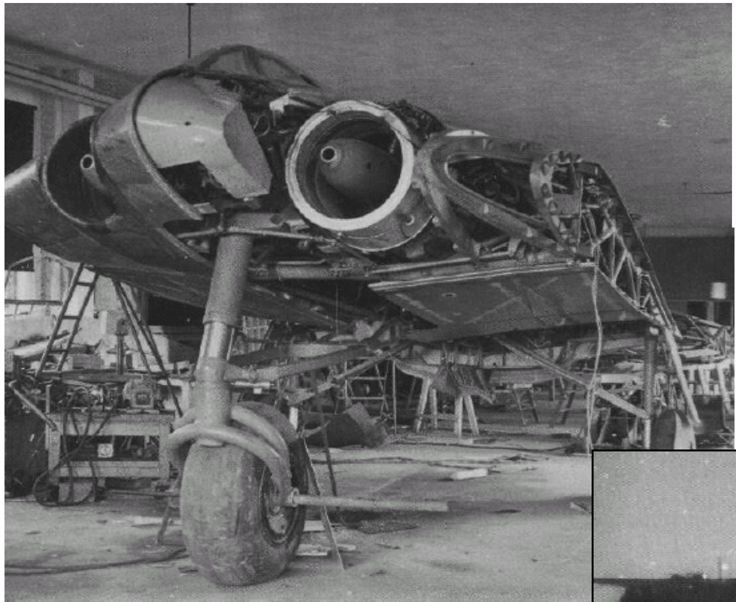
British Miles M.52
1943

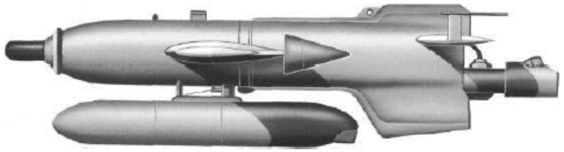
The Miles M.52 was a turbojet powered supersonic research aircraft project designed in the United Kingdom in the mid 1940s. Design work was undertaken in secrecy between 1942 and 1945. In 1946 the Air Ministry prudently but controversially changed the project to a series of unmanned rocket powered scale aircraft, launched from a modified de Havilland Mosquito. In a successful test flight Mach 1.38 was achieved by a scale model in normally controllable transonic and supersonic level flight, a unique achievement at that time which validated the aerodynamics of the M.52. At that point the ministry cancelled that project and issued a new requirement which was to result in the English Electric Lightning. Work on the afterburning version of the Power Jets W.B.2/700 turbojet was also cancelled and the Power Jets company was incorporated into the National Gas Turbine Establishment.

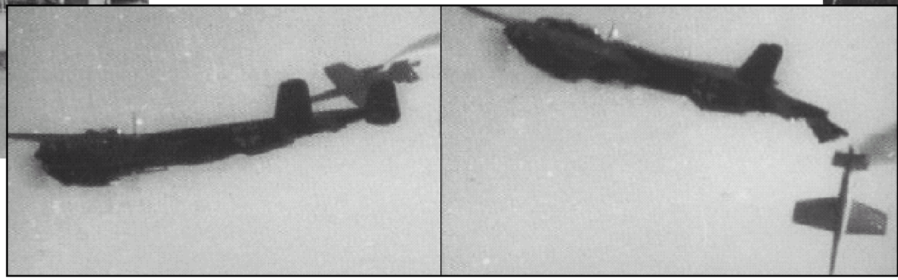
A large number of advanced features were incorporated into the resulting M.52 design, many of which hint at a detailed knowledge of supersonic aerodynamics. With no other sources of such information Miles had turned to design data for stabilizing projectiles. In particular, the design featured a conical nose and sharp wing leading edges, as it was known that round-nosed projectiles could not be stabilized at supersonic speeds. The design used very thin wings of biconvex section proposed by Jakob Ackeret for low drag. The wing tips were "clipped" to keep them clear of the conical shock wave generated by the nose of the aircraft. The fuselage had the minimum cross-section allowable around the centrifugal engine with fuel tanks in a saddle over the top.

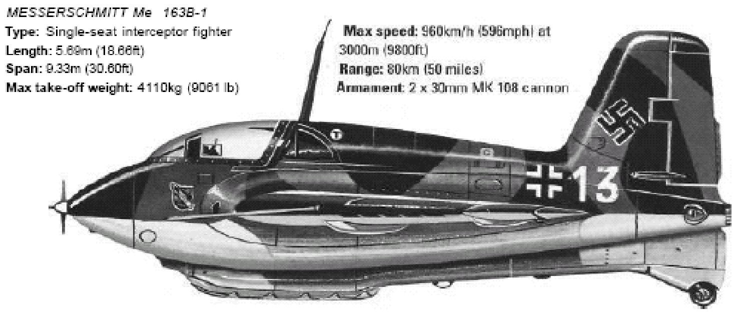
Another critical addition was the use of a stabilator, also known as the all-moving tail or flying tail, a key to supersonic flight control which contrasted with traditional hinged tailplane (horizontal stabilizer) designs. Conventional control surfaces became ineffective at the high subsonic speeds then being achieved by fighters in dives, due to the aerodynamic forces caused by the formation of shockwaves at the hinge.

German Advanced Weapons



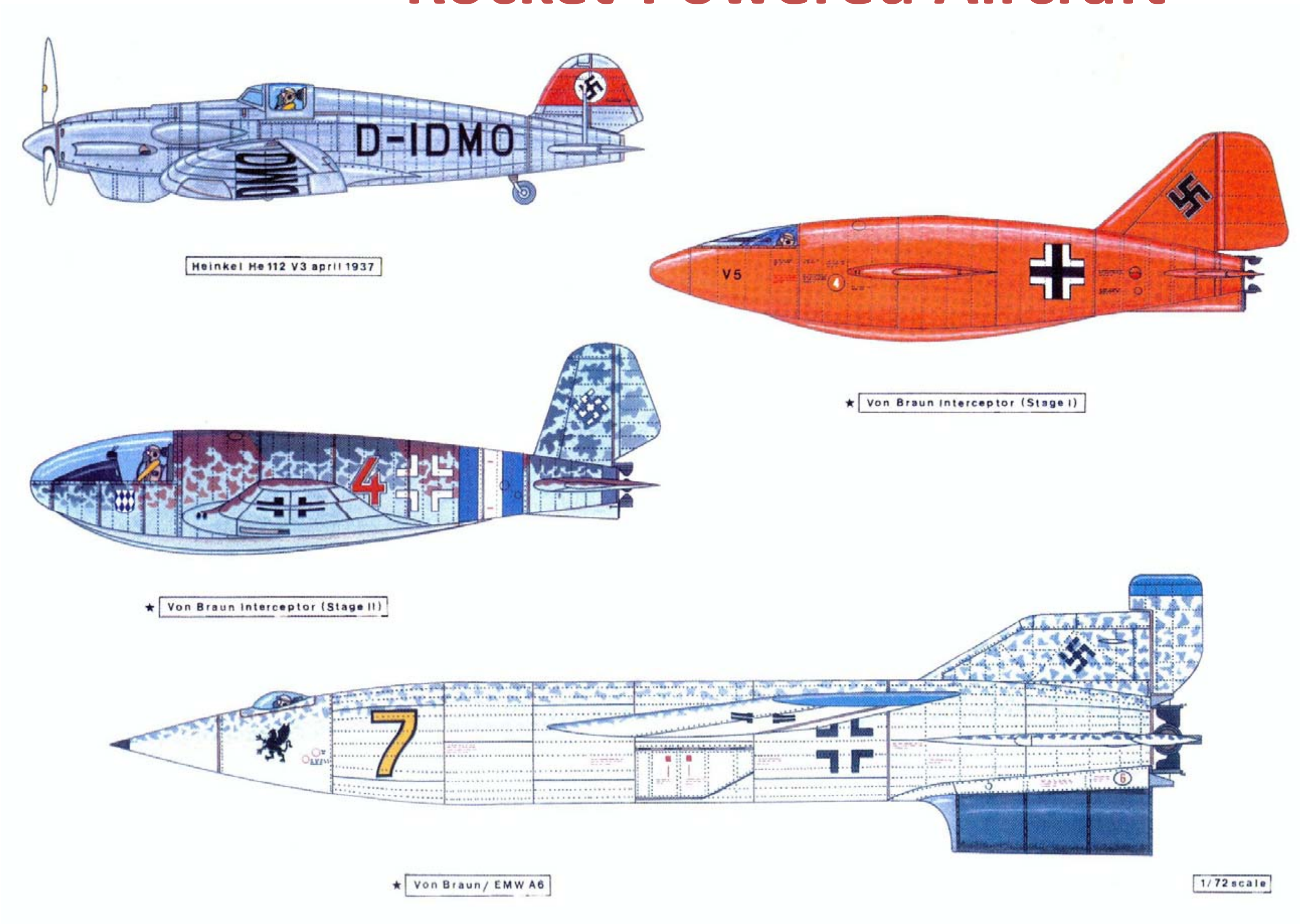






German Advanced Weapons

Rocket-Powered Aircraft

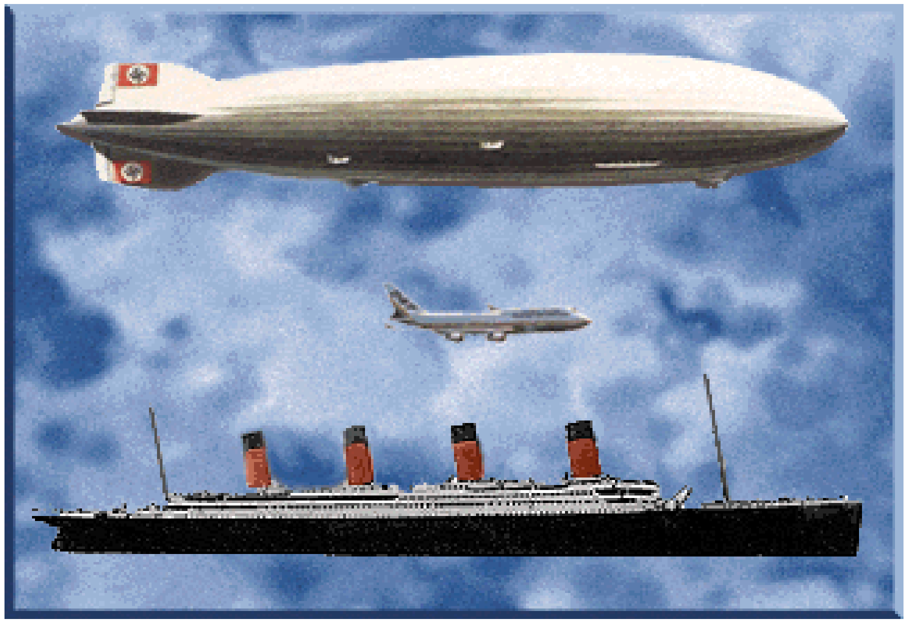


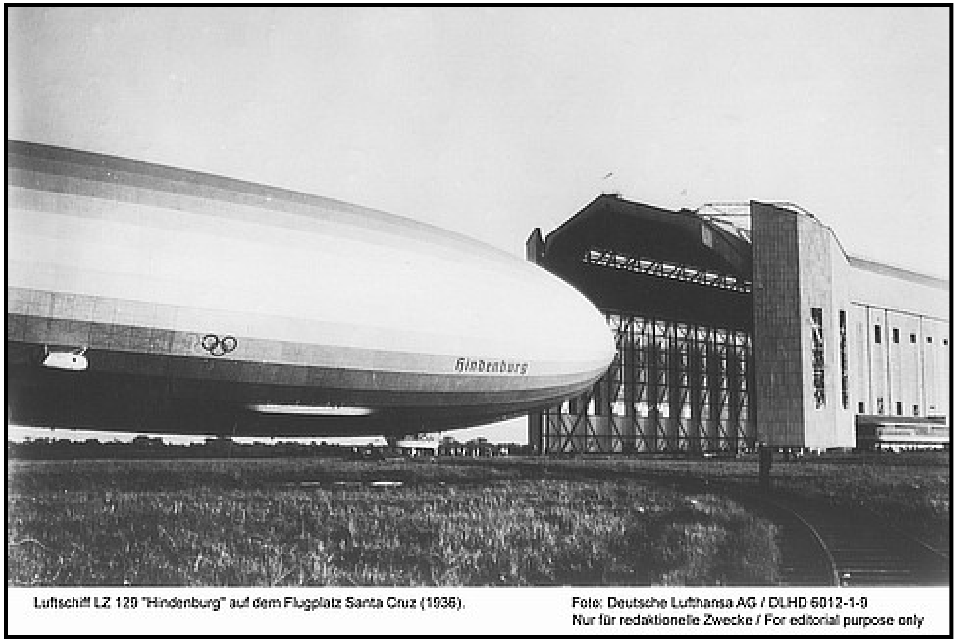
North American X-15

Rocket-Powered Aircraft

The North American X-15 rocket-powered aircraft/spaceplane was part of the X-series of experimental aircraft, initiated with the Bell X-1, that were made for the USAF, NASA, and the USN. The X-15 set speed and altitude records in the early 1960s, reaching the edge of outer space and returning with valuable data used in aircraft and spacecraft design. It currently holds the official world record for the fastest speed ever reached by a manned rocket powered aircraft. During the X-15 program, 13 of the flights (by eight pilots) met the USAF spaceflight criteria by exceeding the altitude of 50 miles (80.47 km, 264,000 ft), thus qualifying the pilots for astronaut status. The USAF pilots qualified for USAF astronaut wings, while the civilian pilots were later awarded NASA astronaut wings. Of all the X-15 missions, two flights (by the same pilot) qualified as space flights per the international (Fédération Aéronautique Internationale) definition of a spaceflight by exceeding a 100 kilometer (62.137 mi, 328,084 ft) altitude.

Long-distance Flight - The Golden Age of Airships





Hindenburg (LZ 129)

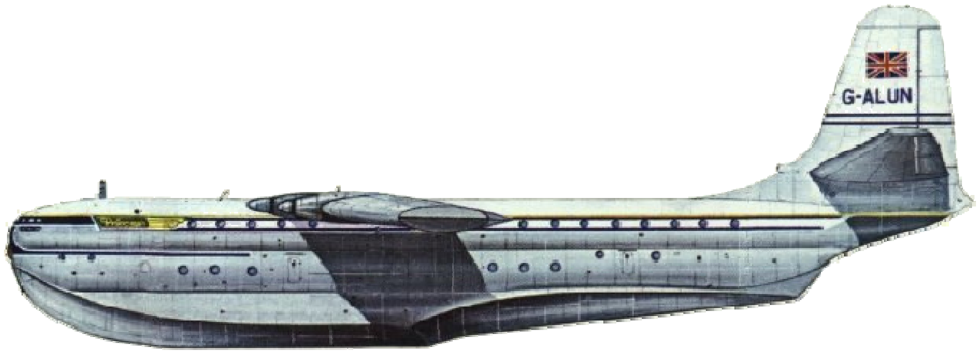
Long-distance Flight - The Golden Age of Flying Boats

Above – Boeing 314 Clipper

Below - Breakfast in bed on a Short Empire Flying Boat 'Canopus', c 1940s.

Left - Lady being served breakfast in her compartment, positioned just behind the wing. The spacious and elegant Empire flying boats, powered by four Bristol Pegasus engines, provided luxury travel across the Empire though conceived to deliver the mail. They operated from 1936 to 1947, many ending their lives in Australasia.

Seaplanes

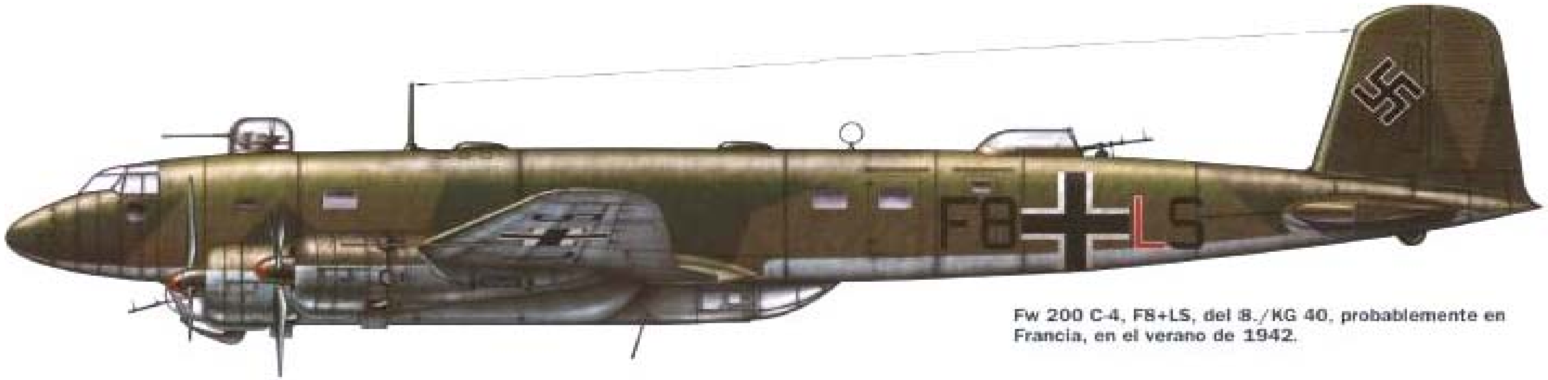


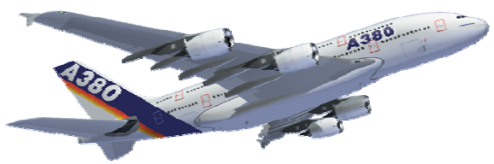
The **Saunders-Roe Princess** was a British flying boat aircraft built by Saunders-Roe, manufacturer that was based in Cowes on the Isle of Wight. The Princess was one of the largest aircraft in existence.

By the 1950s, large, commercial flying boats were being overshadowed by land-based aircraft. Factors such as runway and airport improvements added to the viability of land-based aircraft, which did not have the weight and drag of the boat hulls on seaplanes nor the issues with seawater corrosion.

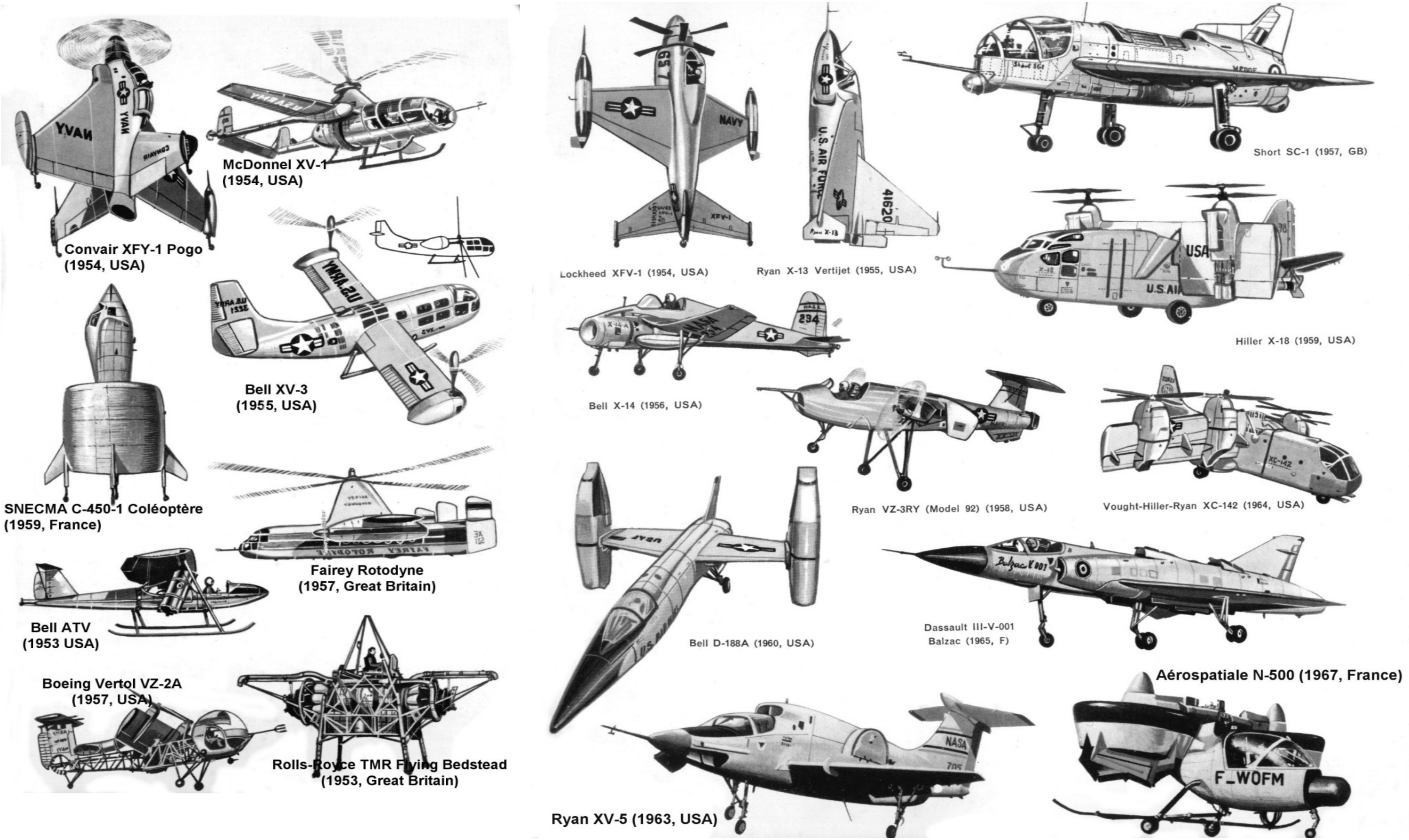
Landplanes X Airships

The Winner is...

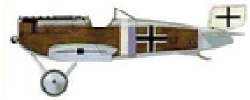
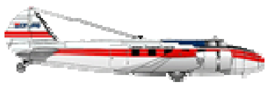
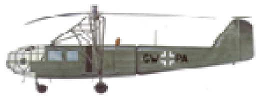




VTOL Aircraft



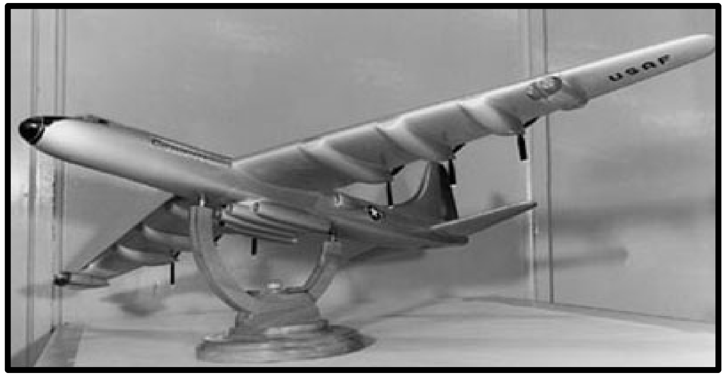
Evolution of Aircraft Technology

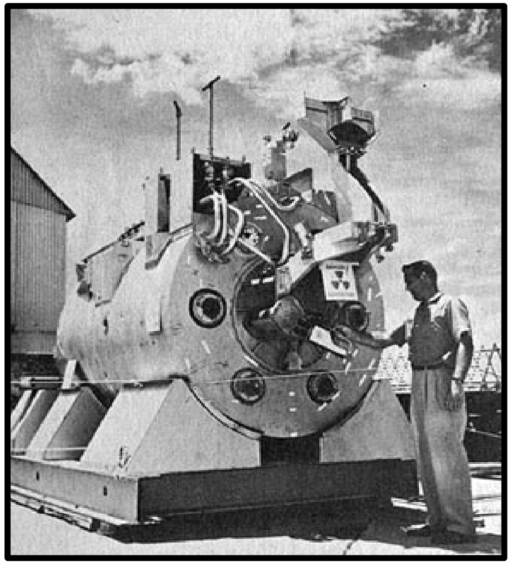
Aircraft	Entry into Service	Major Innovations
 Junkers D-I	1919	• First all-metal airplane • Cantilevered low-wing design • Corrugated duralumin skin • Variable-incidence horizontal empennage • Advanced engine radiator design layout: the radiator was placed in a ventral belly position under the forward fuselage
 Polikarpov I-16	1933	• First low-wing monoplane with a retractable undercarriage • Cantilever wing construction • Variable-pitch propeller • Enclosed cockpit (some versions) • Ailerons acting as flaps (flaperons)
 Boeing 247	1933	• First autopilot in civil aircraft • First civil aircraft with de-icing boots • Variable-pitch propellers • All-metal semi-monocoque construction • Cantilever wing • NACA cowlings • Air conditioning
 Messerschmitt Me 262	1944	• First production aircraft with jet engines • Swept wings • Tricycle landing gear
 Focke-Achgelis Fa 223	1944	• Thanks to its rotor design it was the first Helicopter able to externally transport outsized cargo even at higher altitudes. • Some cabin equipment could be throw out for crew evacuation in an emergency event
 Chance-Vought Cutlass	1950	• First swept-wing naval aircraft • First production aircraft with afterburning • First fighter to carry radar-guided missiles • High-pressure hydraulic system (3000 psi) • Tailless configuration
 Sud-Aviation Caravelle	1959	• Rear-mounted engines configuration • Jet transport for short-range operations

Aircraft	Entry into Service	Major Innovations
 SAAB Draken	1960	• Double-delta wing configuration • Capable of operating from public roads • Ram air turbine providing emergency power
 SAAB Viggen	1972	• Canard surfaces • Engine fitted with afterburner and thrust reverser
 Airbus A-300	1974	• First medium-range wide-body airliner • Supercritical airfoils • Structures made of metal billets, reducing weight • First airliner fitted with wind shear protection • Advanced autopilots capable of flying the aircraft from climb-out to landing • Electrically controlled braking system • Two-man crew by automating the flight engineer's functions, an industry first • Glass cockpit flight instruments • Extensive use of composites for an aircraft of its era • Center-of-gravity control by shifting around fuel • The first airliner to use wingtip fences for increasing flutter margins • Manufacturing employed just-in-time concept, an industry first • First ETOPS compliant aircraft
 Concorde	1976	• Ogee/Ogival- shaped delta wing • Supercruise capability • Variable inlet ramps • Thrust-by-wire engines, predecessor of today's FADEC-controlled engines • Droop-nose section for improved visibility in landing • Mach 2.04 cruising speed • Full-regime autopilot and autothrottle allowing "hands off" control of the aircraft from climb out to landing • Fully electrically controlled analogue fly-by-wire flight controls systems • Multifunction flight control surfaces • High-pressure hydraulic system of 28 MPa (4,000 lbf/in²) for lighter hydraulic systems components • Fully electrically controlled analogue brake-by-wire system • Pitch trim by shifting fuel around the fuselage for centre-of-gravity control • Parts milled from single alloy billet reducing the part-number count

Nuclear Airplane Project

The P-1 reactor/X39 engine complex would have been flight tested aboard a highly modified B-36 bomber known as the X-6. The P-1 would have been installed in the X-6's bomb bay for flight and removed shortly after landing by taxiing the plane over a huge pit equipped with an elevator that would lower the engine into a shielded isolation area to reduce irradiation of the airframe, crew and ground personnel. The model (below) shows the four X39 pods protruding from the belly of the X-6.





One-megawatt reactor

Roadable Aircraft: ConvairCar




The ConvAIRCAR was a noble attempt and a notable machine--it was truly the stuff of commuters' fantasies. Not only did it have a design straight out of a dime-store sci-fi novel, it had "all the advantages of a Cadillac" according to its manufacturer. So what happened? The same thing that happens to all flying cars--the dream crashed and burned before it could take off...this time literally. The ConvAIRCAR was not the first flying car to make it to the drawing board. That honor goes to the Curtiss Autoplane of 1917. But public interest in a car-plane hybrid didn't take hold until after World War II. Airplane manufacturers, after the war, were shifting away from military aircraft to consumer production lines. The Consolidated Vultee Aircraft Company of San Diego, California was one of those companies looking for a new outlet to sell their aircraft. Sensing the time was right for a flying car, they poured hundreds of thousands of dollars into developing a prototype built by aerodynamic engineer Theodore P. Hall.

Also lending a hand was Henry Dreyfuss, one of the outstanding industrial designers of the 20th century. Dreyfuss designed telephones for Bell, tractors for John Deere, thermostats for Honeywell, and cameras for Polaroid. But a flying car? What motivated the famously no-nonsense Dreyfuss--a devotee of the Louis Sullivan's dictum that "form follows function"--to lend his talents to such a far-fetched endeavor? The cynic would say money; but, in truth, a flying car didn't seem that far-fetched at the time. "The market for this flying automobile will be far greater than a conventional light plane," Consolidated Vultee promised, "because the purchasers can obtain daily use from the car to get more out of his investment." The estimated cost: $1500. Flight attachments were an additional cost. These attachments were integral to the ConvAIRCAR's design. After driving to the airport, an owner had to connect a flight unit (which included a propeller) to take off. At the next airport they simply removed the detachable wings and drove away in what was an otherwise ordinary car. Well, not exactly ordinary. Thanks to a "plastic-impregnated" fiberglass body that weighed only 725 pounds, the ConvAIRCAR achieved an astounding 45 miles per gallon. And it looked great--the aerodynamic envelope of "the only automobile that flies" was a remarkable achievement, truly years ahead of its time. On November 17, 1947, the New York Times announced the news: a prototype of the ConvAIRCAR had circled San Diego for one hour and 18 minutes. These trials confirmed the best hopes of Consolidate Vultee. But success was short-lived. A few days after the test flight, a pilot crash-landed the ConvAIRCAR in the desert (it was later discovered a gas gauge had accidentally been shut off) and the only prototype in existence was demolished beyond repair. Eventually another model of the ConvAIRCAR was built but the damage was done. The high cost of production and the limited market potential--not to mention the negative publicity--spelled doom (sadly no examples of the ConvAIRCAR survive; the second prototype perished in a fire at the San Diego Air & Space Museum). The failure of the ConvAIRCAR was not unique. Dozens of inventors and aerodynamic engineers have tried to create similar vehicles in the last fifty years--none has successfully marketed a flying car. According to a 1989 article in Smithsonian, over 30 patents for flying cars have been filed this century in the United States alone; usually boasting fanciful names like Aerocar, Autoplane, Airphibian, and Skycar.

In the past a lot of alternative configurations were investigated

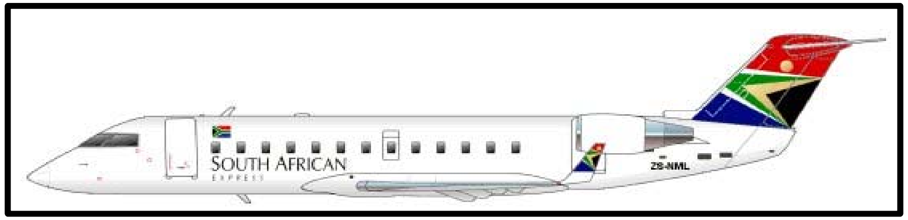
Larger post-war turboprop airliners

Aircraft	First Flight	Service Entry
Vickers Viscount	July 1948	July 1950
Bristol Britannia	August 1952	February 1957
Vickers Vanguard	January 1959	February 1961
Lockheed Electra	December 1957	January 1959

Early Jet Airliners

Aircraft	First Flight	Service Entry
Boeing 707	July 1958	October 1958
Douglas DC-8	May 1958	September 1959
Convair 990 Coronado	January 1961	January 1962
Vickers VC-10	June 1962	April 1964

Regional jets



No Props

Aircraft	First Flight	Service Entry	Capacity (Pax)
Embraer ERJ-145	August 1995	December 1996	50
Bombardier CRJ-100	May 1991	November 1992	44 - 50
Fokker 70	July 1994	October 1994	70 - 85
Avro RJ 70	July 1992	September 1993	70 - 82

Jet Ages

Early jet age

Boeing 707 / Douglas DC-8 / Convair 990

Late jet age

Bombardier CRJ-200/ Embraer ERJ-145 / Embraer E-Jets

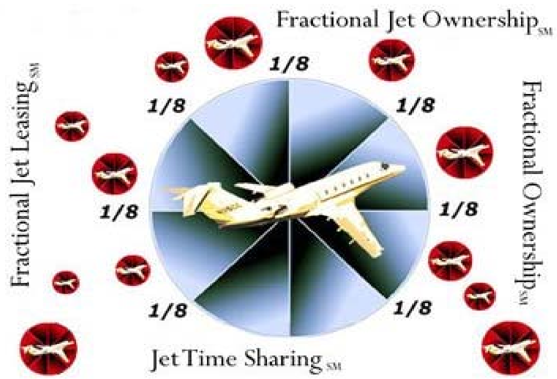
Revolution with Business Models

Commercial Aviation

Low Cost/Low Fare Airlines → More airliners being sold and more people flying

Business Aviation

Fractional Ownership

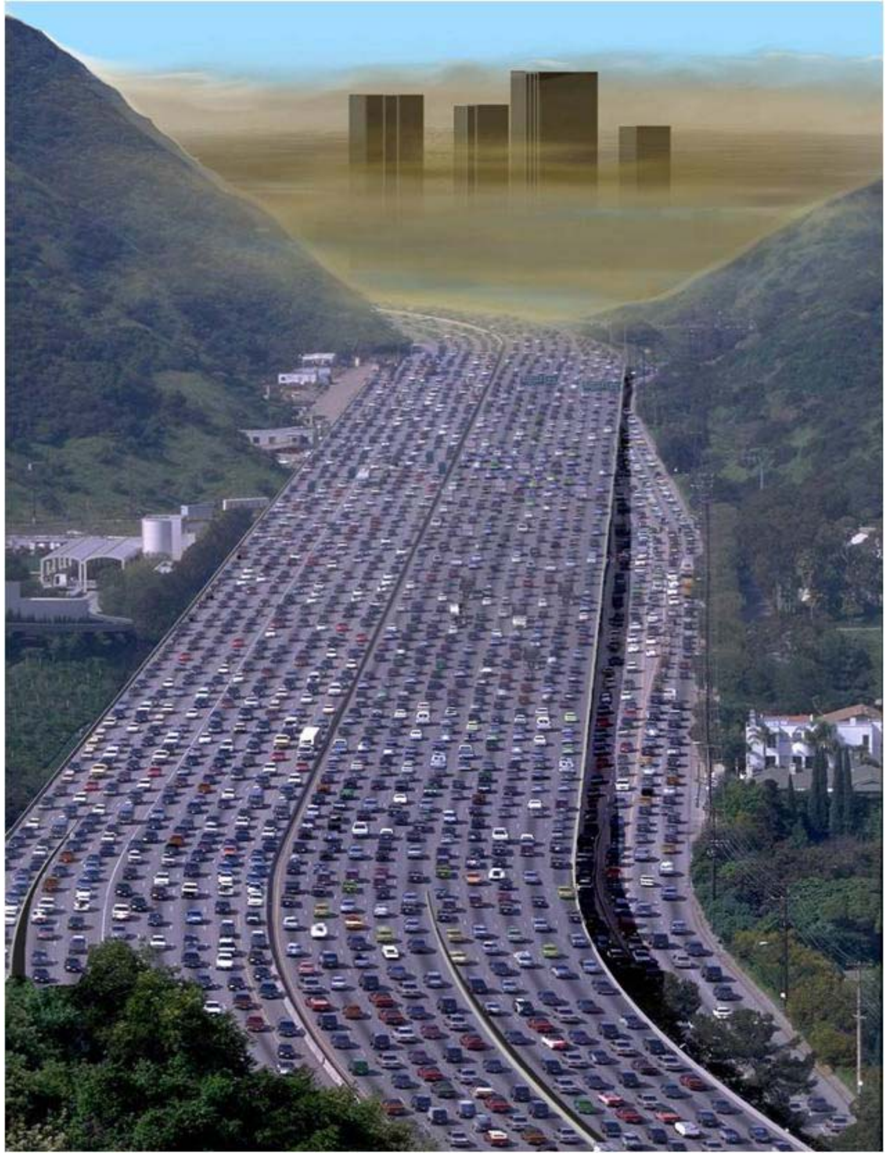


→ More business jets being sold; new designs; and more people flying BA

World of Today

Falkirk Wheel in Scotland

Living Together

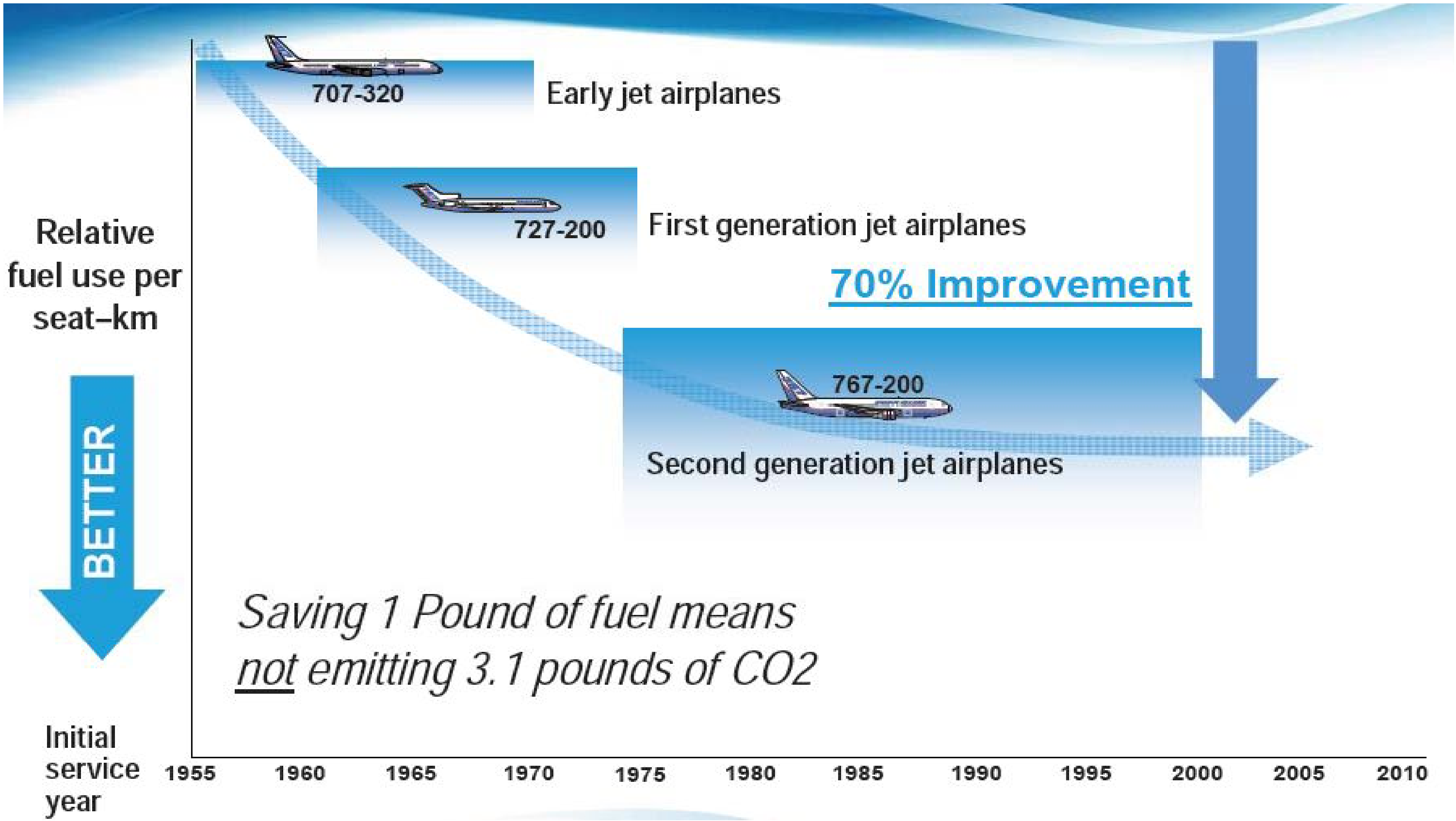


Clever Ideas

Havana, Cuba

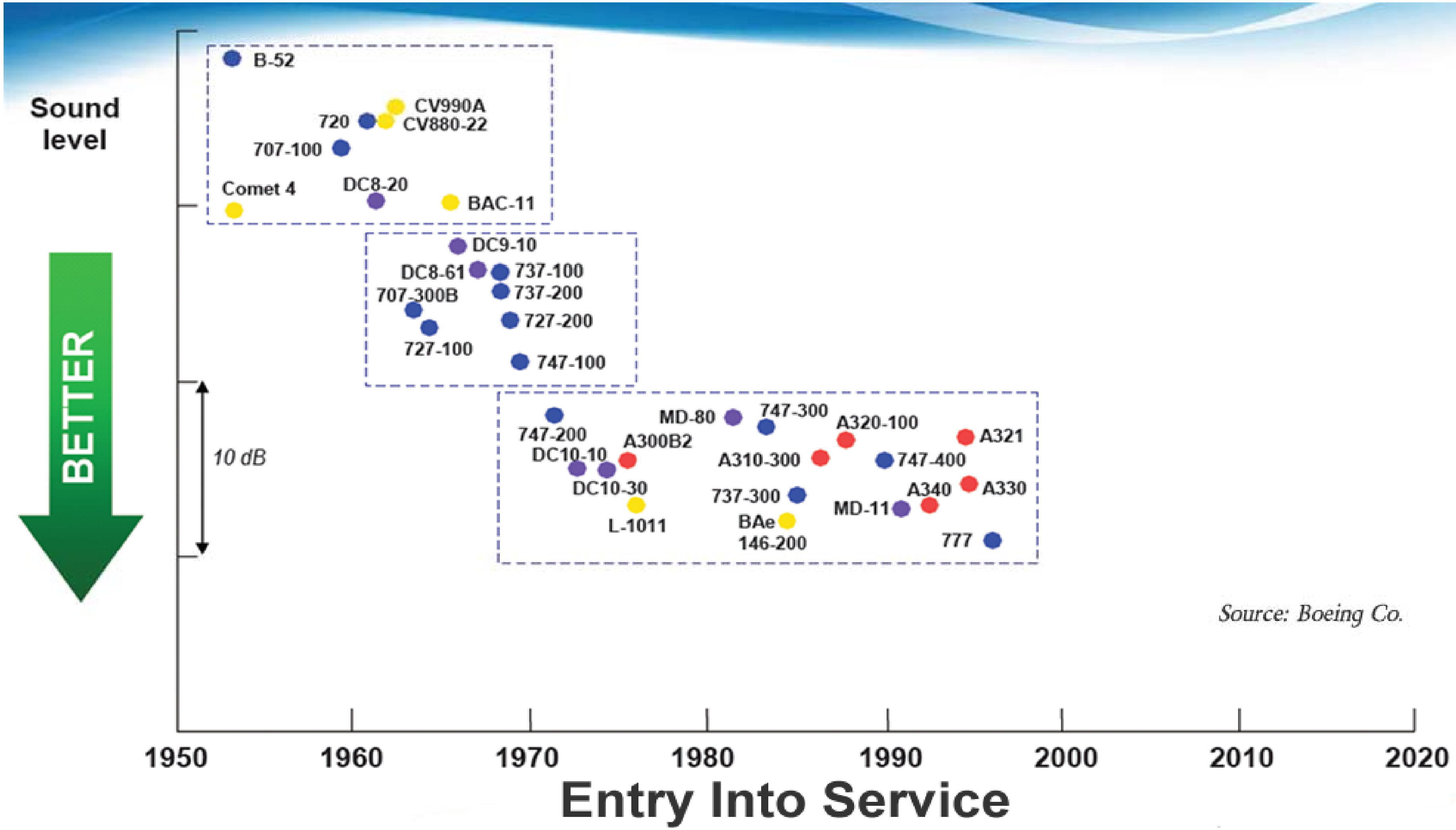

Oresund, Sweden

Modern Airplanes Are More Fuel Efficient



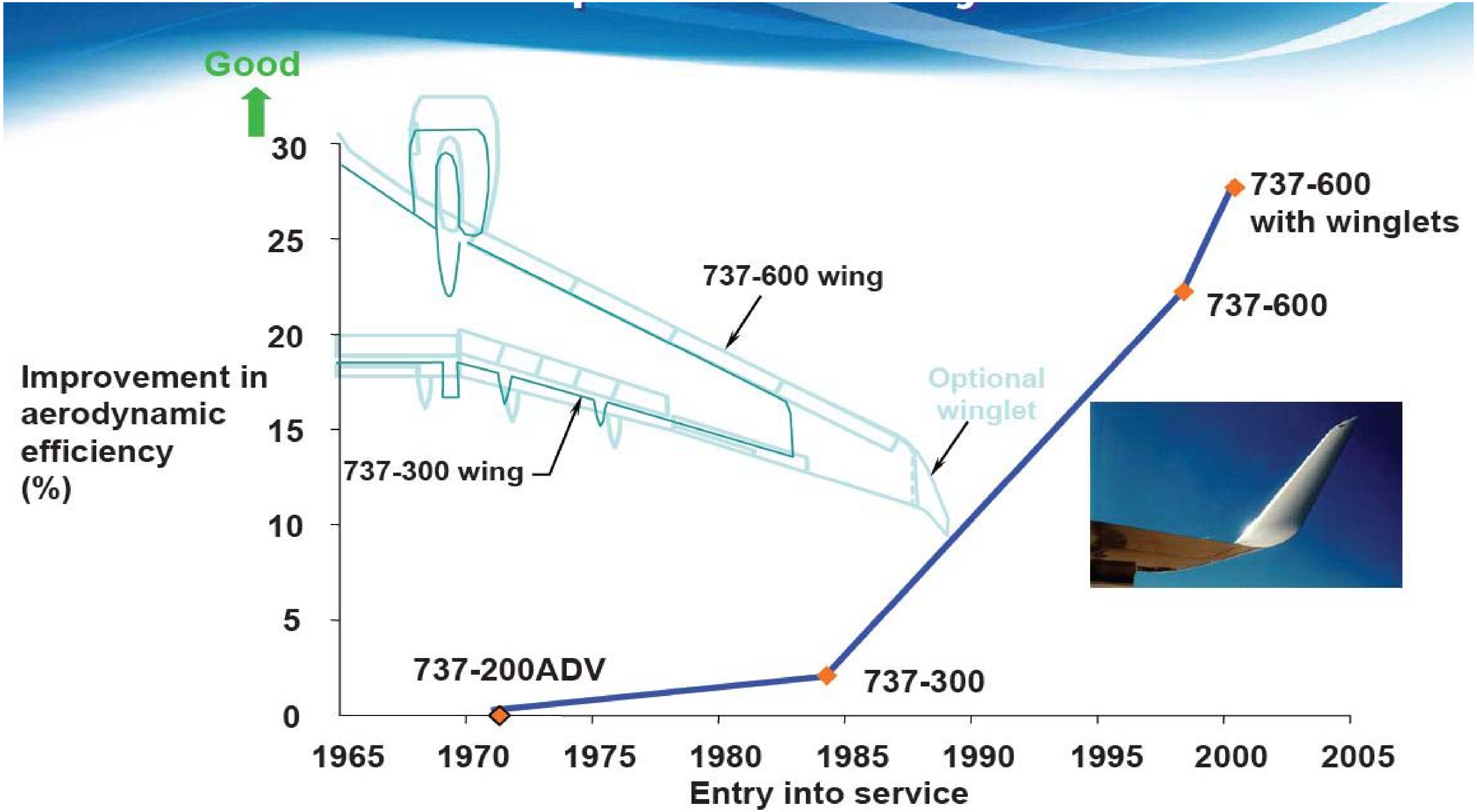
Source: Boeing

Modern Airplanes Are Quieter



Source: Boeing

Wing Aerodynamics is Improving



Source: Boeing

Some Airplanes there were Operating in 2008

Airbus A320

Early 80's technology

Boeing 767

Late 70's technology

Boeing 737-200

Late 60's technology

Airbus Technology 1/2

1974 A300

- Twin-engine, twin-aisle configuration
- Triplex power and control systems
- Advanced supercritical aerofoil
- Full flight regime auto-throttle
- Automatic wind-shear protection
- Just in Time manufacturing

1977 A300

- Cat. IIIA autoland

1982 A300FF

- Digital auto-flight system
- Two-person cockpit

1983 A310

- Increased wing aspect ratio and thickness
- Advanced CRT cockpit displays with unique electronic centralized aircraft monitor
- Composite materials (secondary structure)
- Electrical signaling of secondary controls

1985 A300-600

- Half-generation advance” turbofan powerplant (CF6-80C2)

Airbus Technology 2/2

1985 A310-300

- Advanced aluminium alloys
- Composite materials in primary structure
- Trim tank/centre-of-gravity control
- Carbon brakes, radial tyres

1988 A320

- Sidestick controller
- Fly-by-wire
- Second generation digital auto flight system
- Extensive use of composites and advanced aluminium alloys
- Active controls

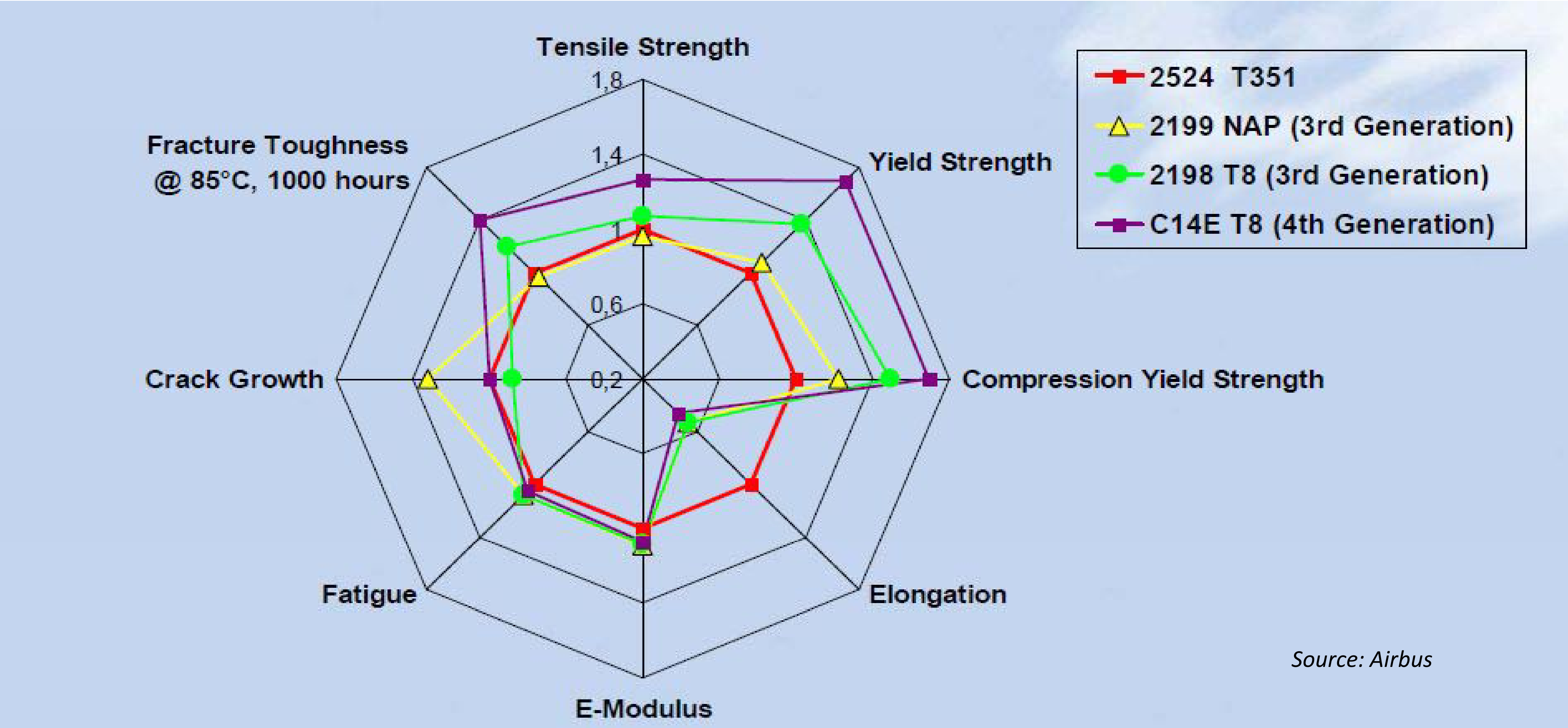
1993 A330 A340

- Extension of A310/A300 and A320 advanced technology
- All new advanced technology wing
- CCQ & MFF

1999 A380

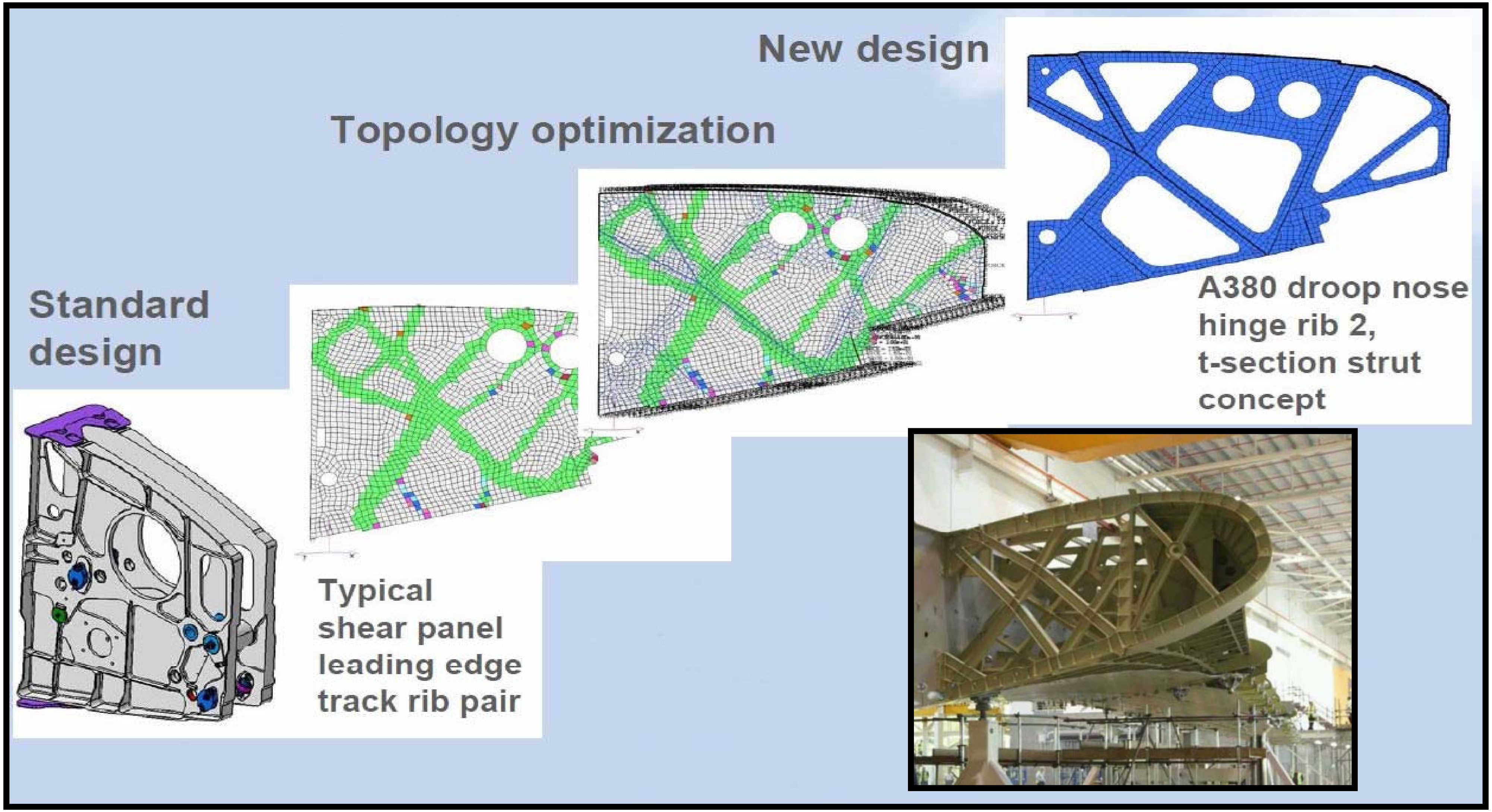
- Carbon Fiber Reinforced plastic (CFRP) for primary structures
- GLARE on upper fuselage panels
- Laser welded lower fuselage
- New Ethernet architecture for flight controls
- Decentralized & high pressure hydraulics system

Application of Advanced Al-Li Alloys



- The 3rd generation of Al-Li alloys (<2% Li) is designed for high strength and stiffness, improved corrosion resistance and lower density
- The 4th generation of Al-Li alloys (<1% Li) enable further static strength and fracture toughness improvement

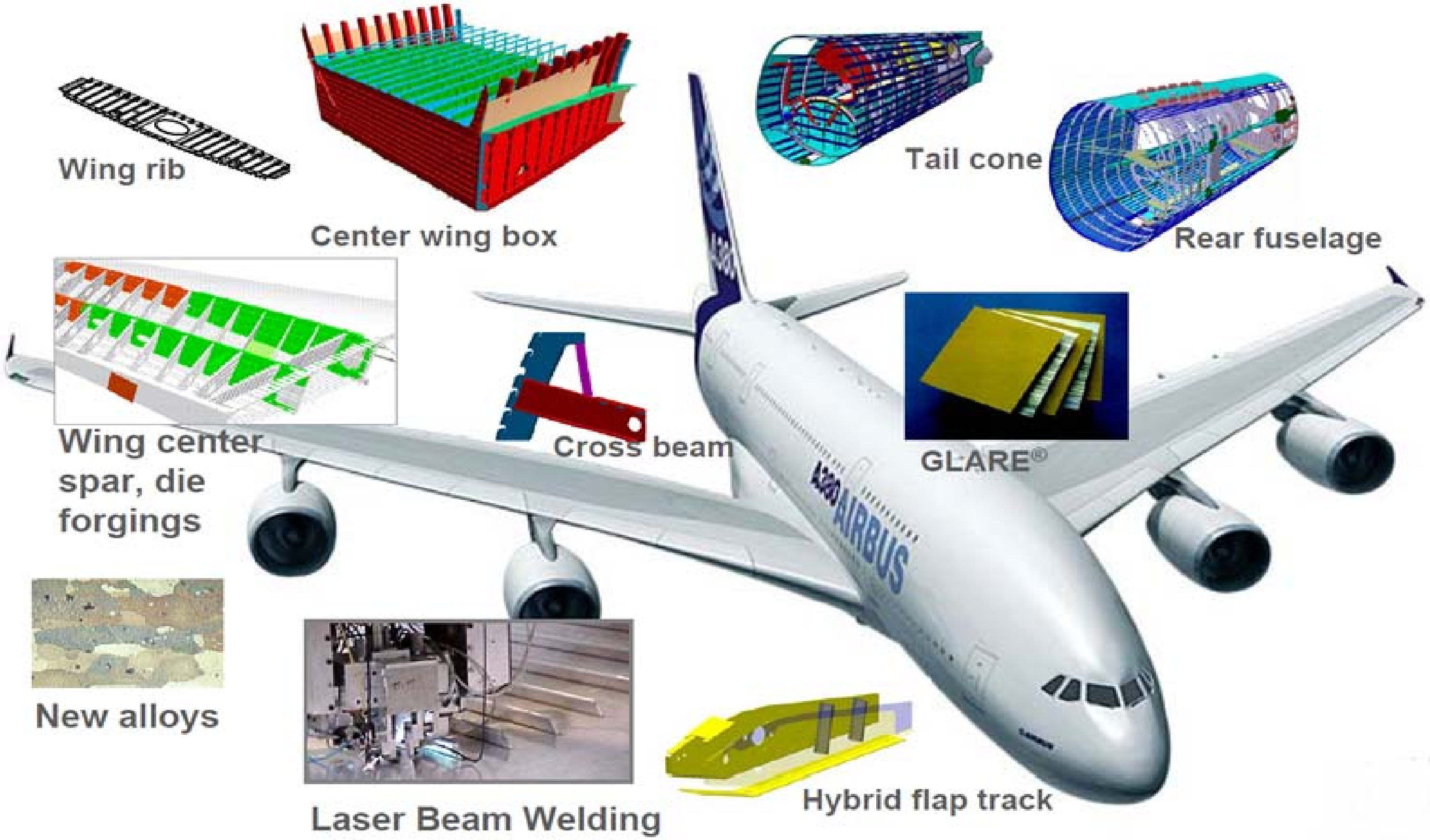
Advanced Design by Structural Optimization



Topology optimization enables efficient weight optimization. The results are comparable to nature solutions.

Source: Airbus

Examples of Innovations Applied to A380

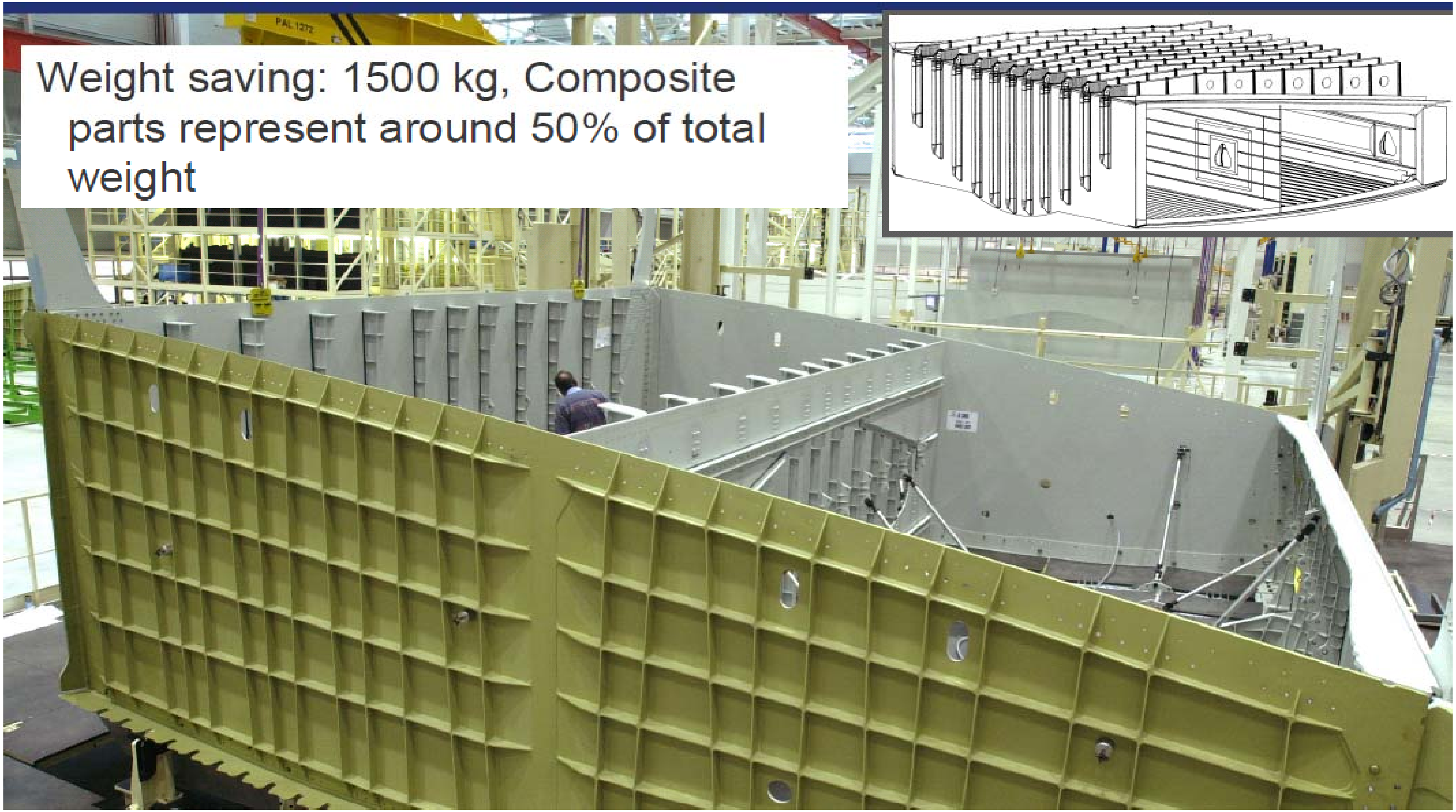


Source: Airbus

Examples of Innovations Applied to A380

Source: Airbus

Examples of Innovations Applied to A380

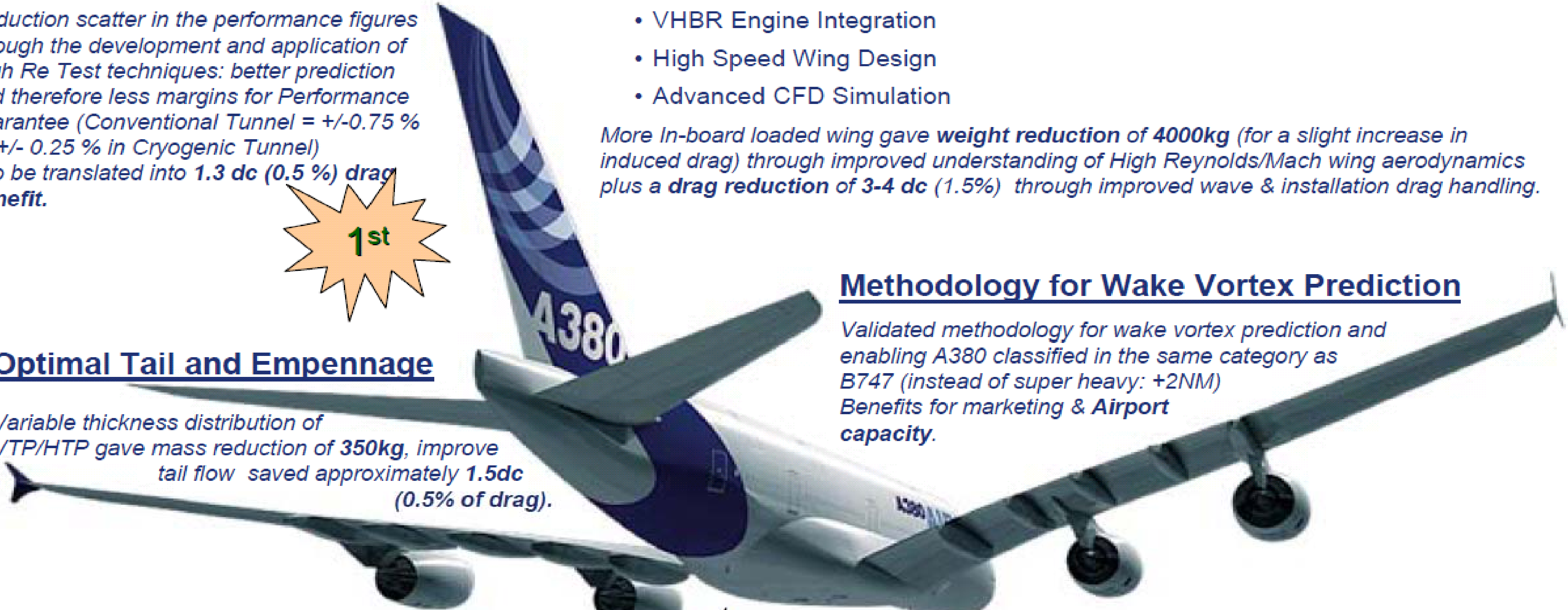


Center Wing Box

Source: Airbus

Examples of Innovations Applied to A380

Flight Physics



High Reynolds Number W/T Testing

Reduction scatter in the performance figures through the development and application of High Re Test techniques: better prediction and therefore less margins for Performance guarantee (Conventional Tunnel = +/-0.75 % vs +/- 0.25 % in Cryogenic Tunnel) – to be translated into ***1.3 dc (0.5 %) drag benefit.***

1st

Integrated Wing Design

- VHBR Engine Integration
- High Speed Wing Design
- Advanced CFD Simulation

More In-board loaded wing gave ***weight reduction*** *of* ***4000kg*** *(for a slight increase in induced drag) through improved understanding of High Reynolds/Mach wing aerodynamics plus a* ***drag reduction*** *of* ***3-4 dc*** *(1.5%) through improved wave & installation drag handling.*

Methodology for Wake Vortex Prediction

Validated methodology for wake vortex prediction and enabling A380 classified in the same category as B747 (instead of super heavy: +2NM)
Benefits for marketing & ***Airport capacity****.*

Optimal Tail and Empennage

Variable thickness distribution of VTP/HTP gave mass reduction of ***350kg****, improve tail flow saved approximately* ***1.5dc (0.5% of drag).***

Nacelle Anti-ice Cyclone Concept

*50% reduction in Nacelle Anti-Icing system weight (****100kg****) plus reduced in Anti-Ice System* ***Maintenance***

1st

Droop Nose

Lower drag, improved lift / drag ratio for take-off performance, tailored maximum lift.

Advanced Load Control

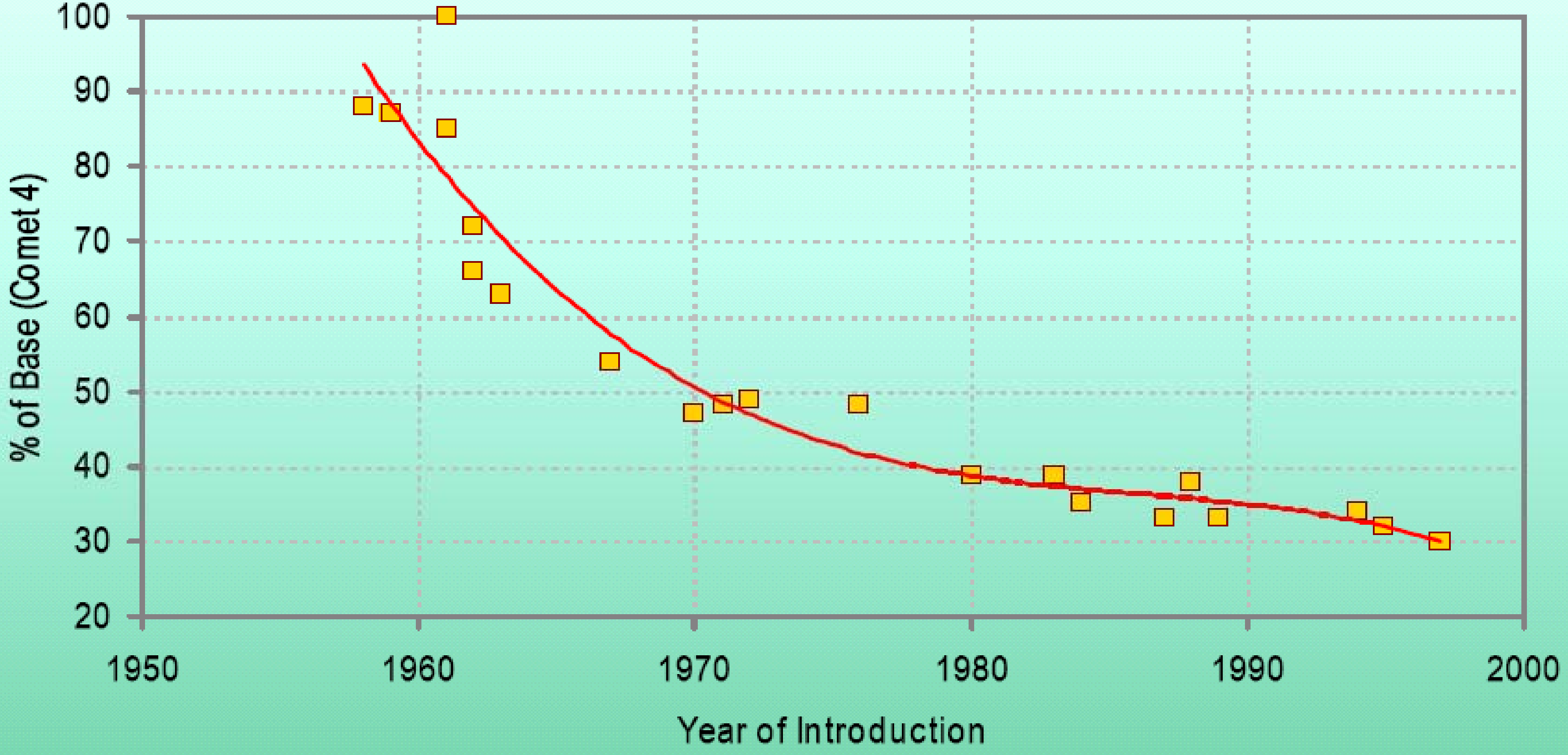
Reduction of 2200kg of wing weight *through further improvements in Aircraft load control (fatigue/manoeuvre/ turbulence Wing Loads alleviation)*

Source: Airbus

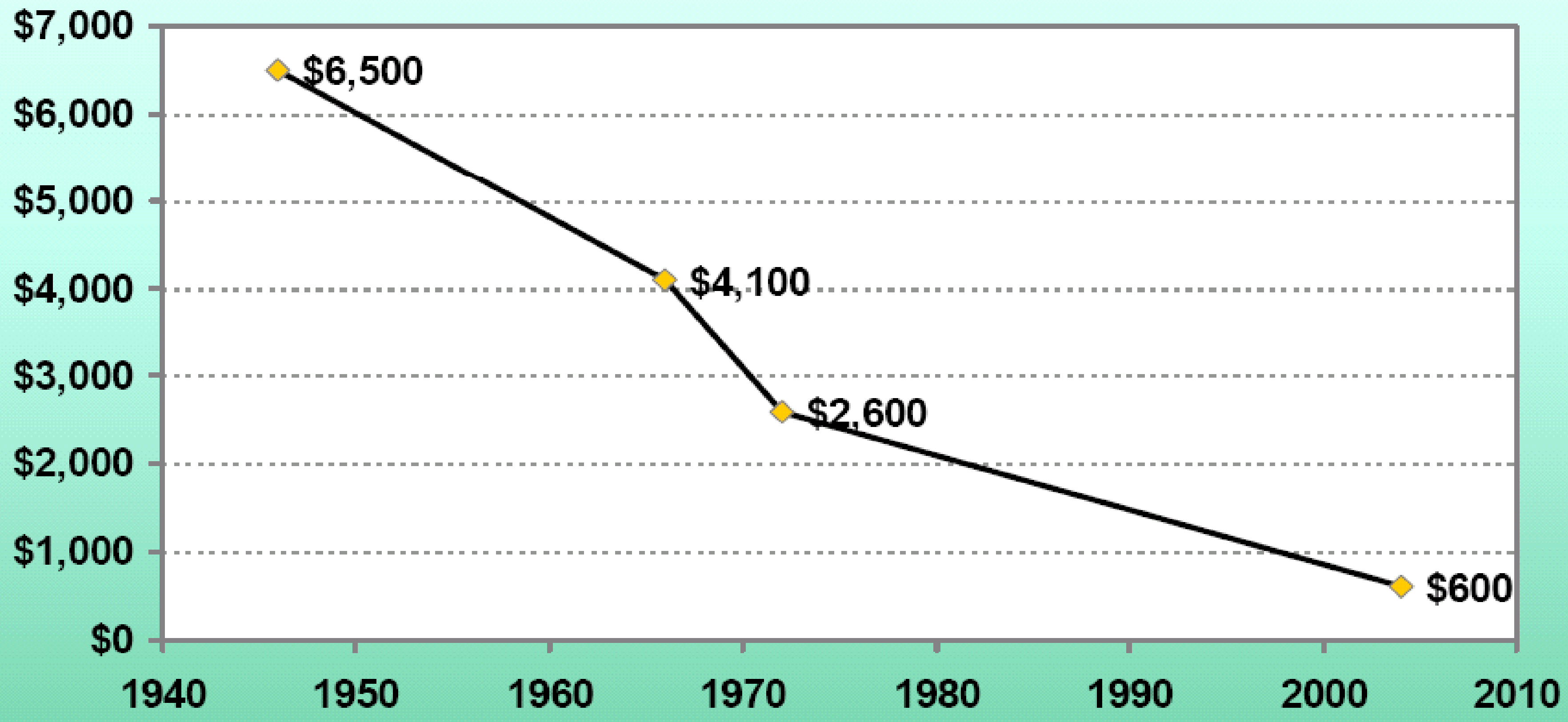
Main Commercial Passenger Aircraft, 1935-2008

Aircraft	Year of First Commercial Service	Speed (km/hr)	Maximum Range at Full Payload (km)	Seating Capacity
Douglas DC-3	1936	346	563	30
Douglas DC-7	1953	555	5,810	52
Boeing 707-100	1958	897	6,820	110
Boeing 727-100	1963	917	5,000	94
Boeing 747-100	1970	907	9,045	385
McDonnell Douglas DC-10	1971	908	7,415	260
Airbus A300	1974	847	3,420	269
Boeing 767-200	1982	954	5,855	216
Boeing 747-400	1989	939	13,444	416
Boeing 777-200ER	1995	1030	14,300	300
Airbus A340-500	2003	886	15,800	313
Airbus A380	2007	930	14,800	555
Boeing 787-8	2008	1040	15,700	250

Trend in Aircraft Fuel Efficiency (Fuel burned per Seat)

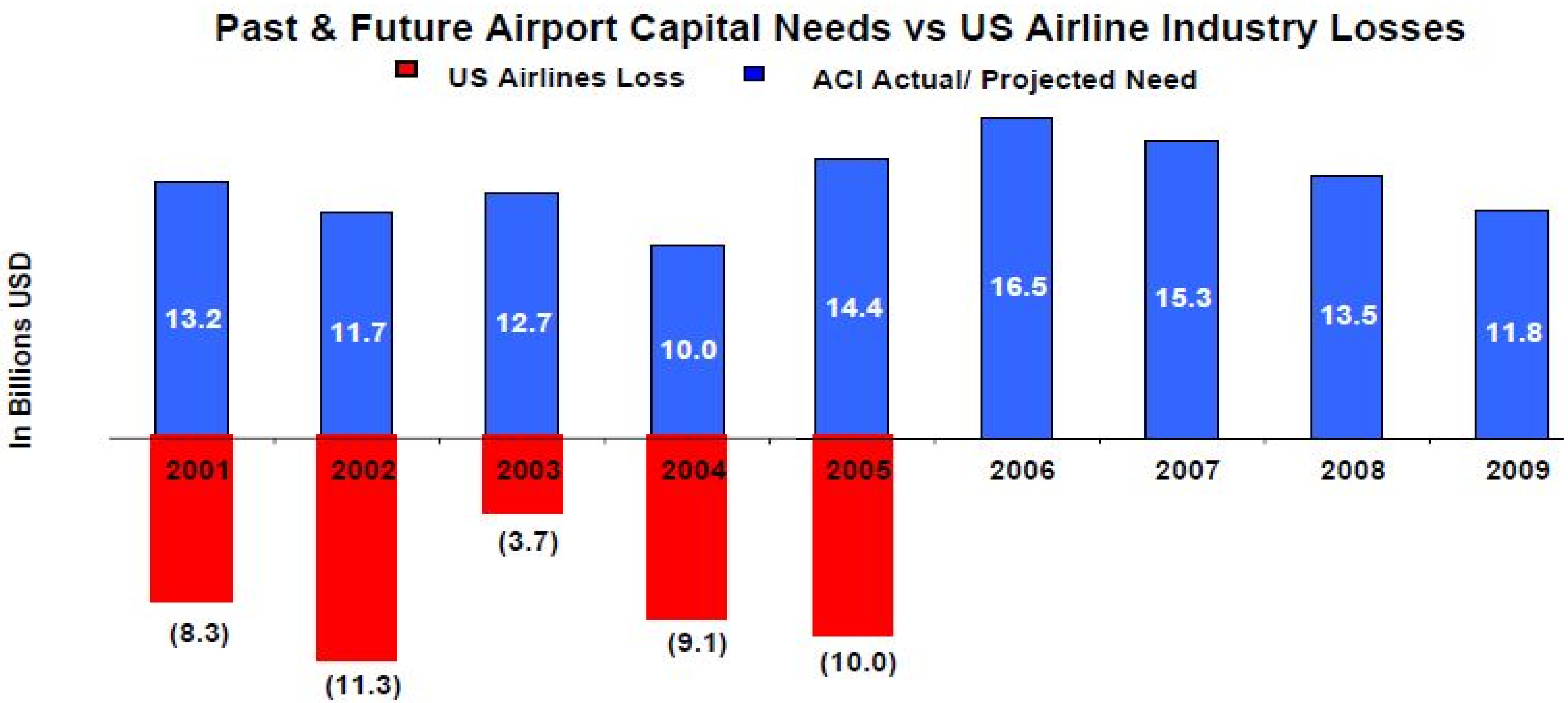


Average Airfare (roundtrip) between New York and London 1946-2004 (in 2004 dollars)



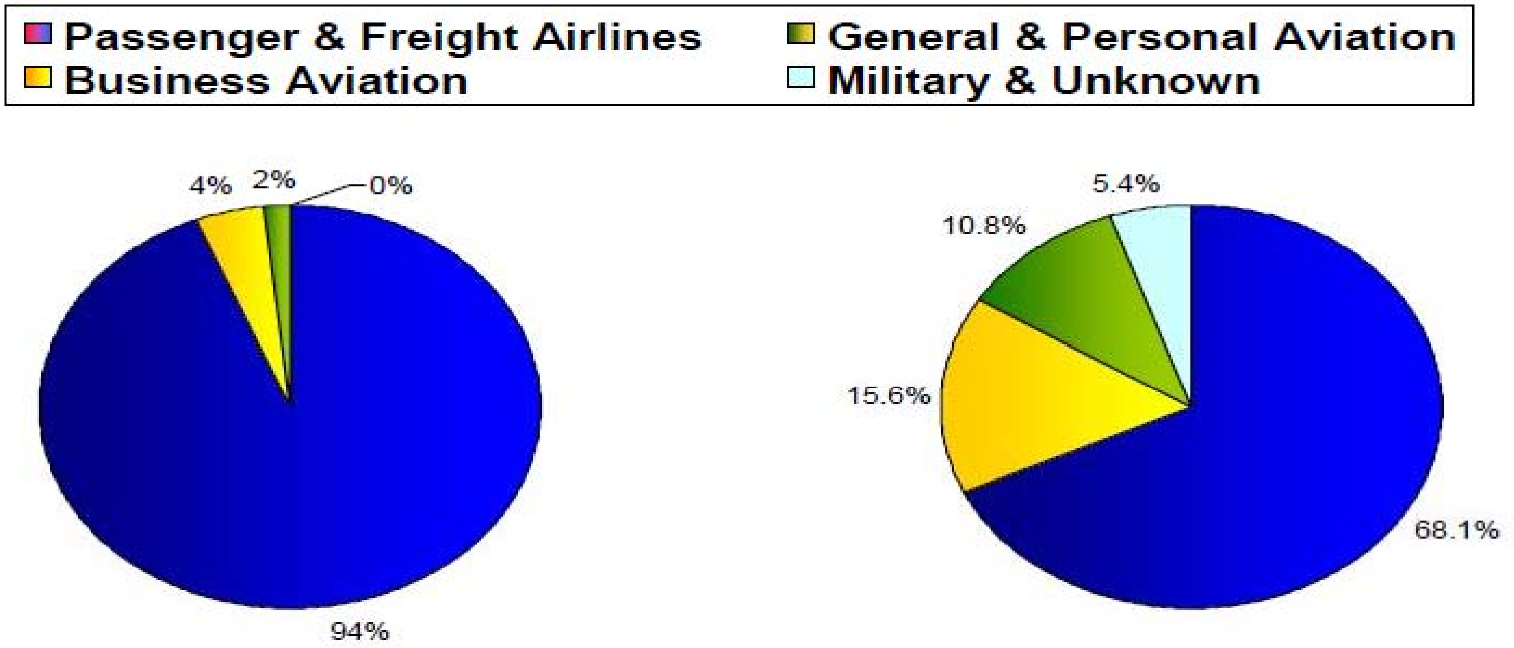
Airports Needs Capital

- US airports are estimated to need $71BB in infrastructure improvements through 2009
- Between 2001-2004, US airlines financed $47.5BB in airport improvements, while accumulating losses totaling $32BB



ATC Needs Money

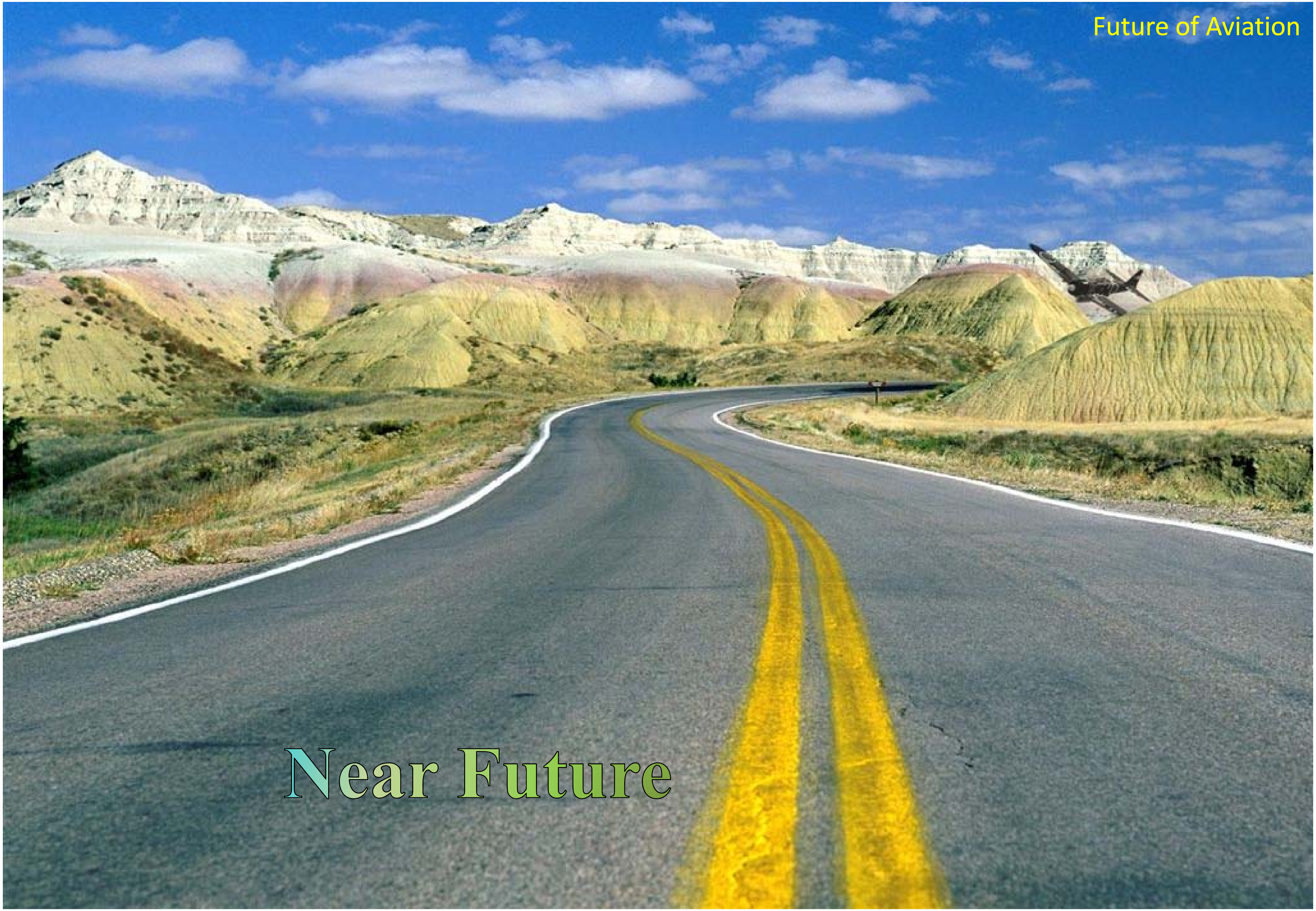
- The Air Traffic Control (ATC) system also requires re-investment
- Passenger airlines use less than 70% of the ATC system, but pay for over 90% of it



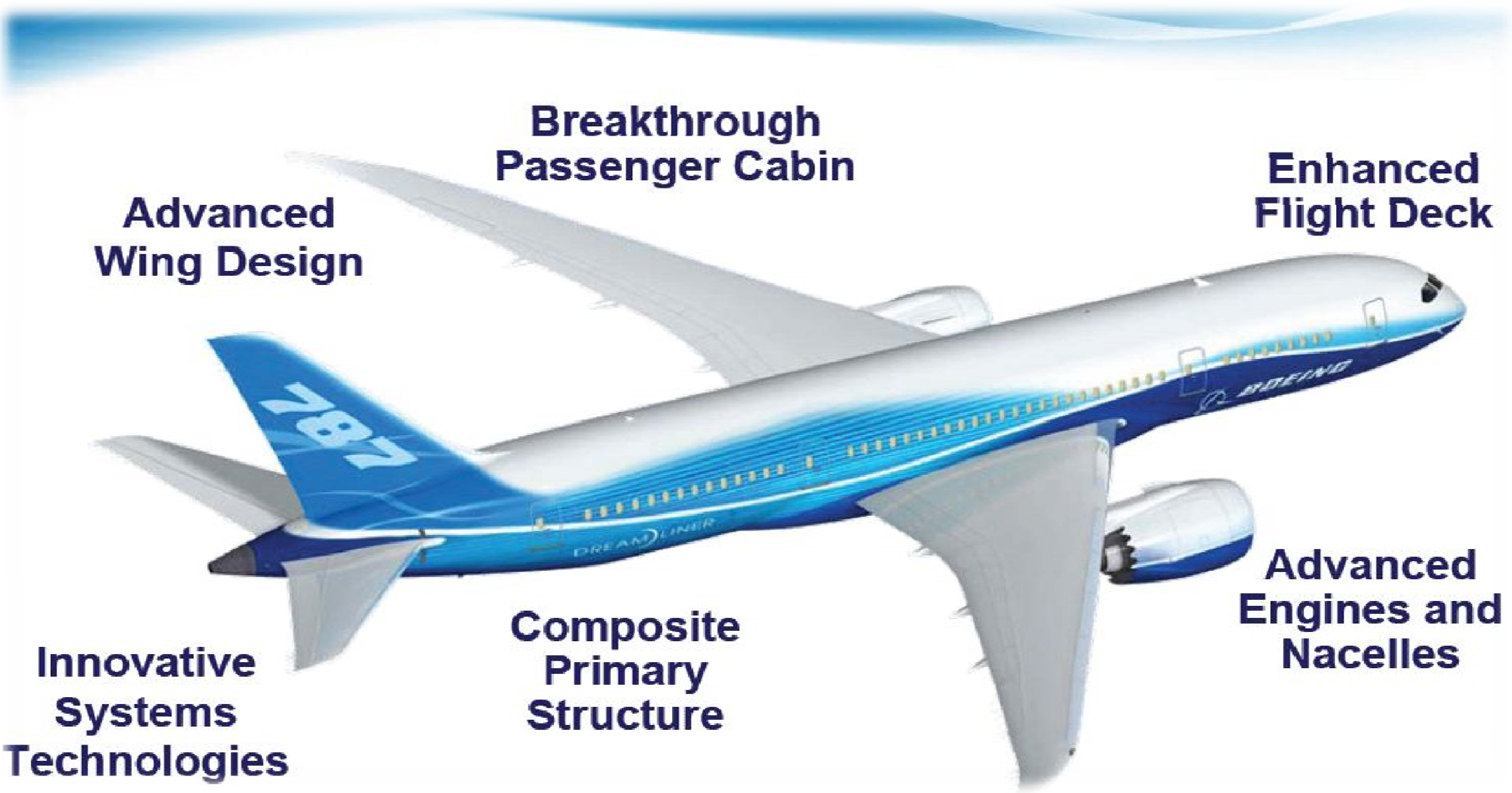
Who Pays for the ATC System?

Who uses the ATC System?

Source: FAA ETMS; FAA Estimates, FY 2004 Data


Future of Aviation
Near Future

Boeing 787


Breakthrough
Passenger Cabin
Advanced
Wing Design
Enhanced
Flight Deck
787
BOEING
DREAMLINER
Innovative
Systems
Technologies
Composite
Primary
Structure
Advanced
Engines and
Nacelles

Close relatives

Boeing 747-8

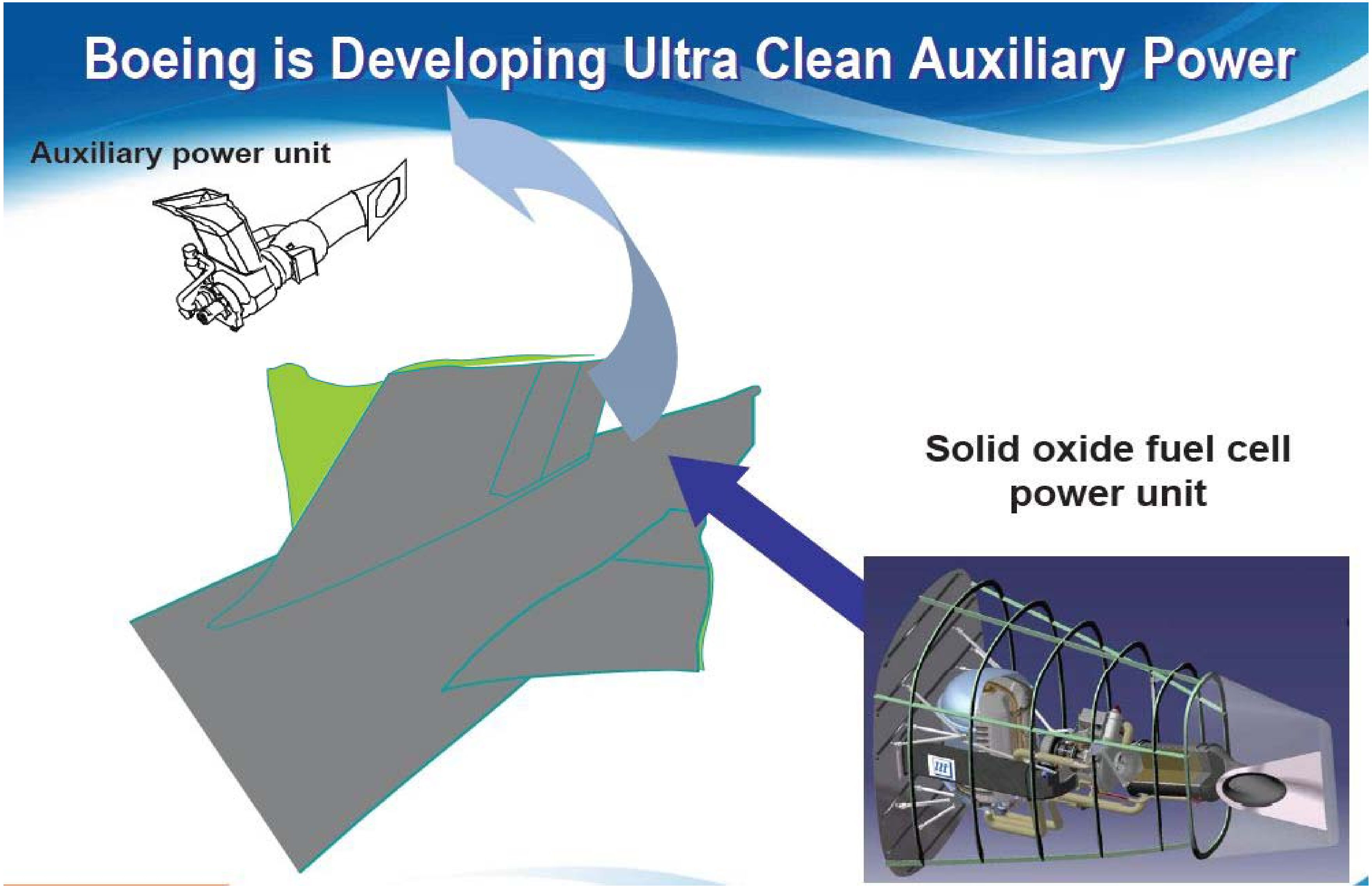
Airbus A350XWB

Fuel cells

Fuel Cells Offer Ultra Clean Power

- *Chemical Reaction Provides Electric Power*
- *Primary Emission is Water*

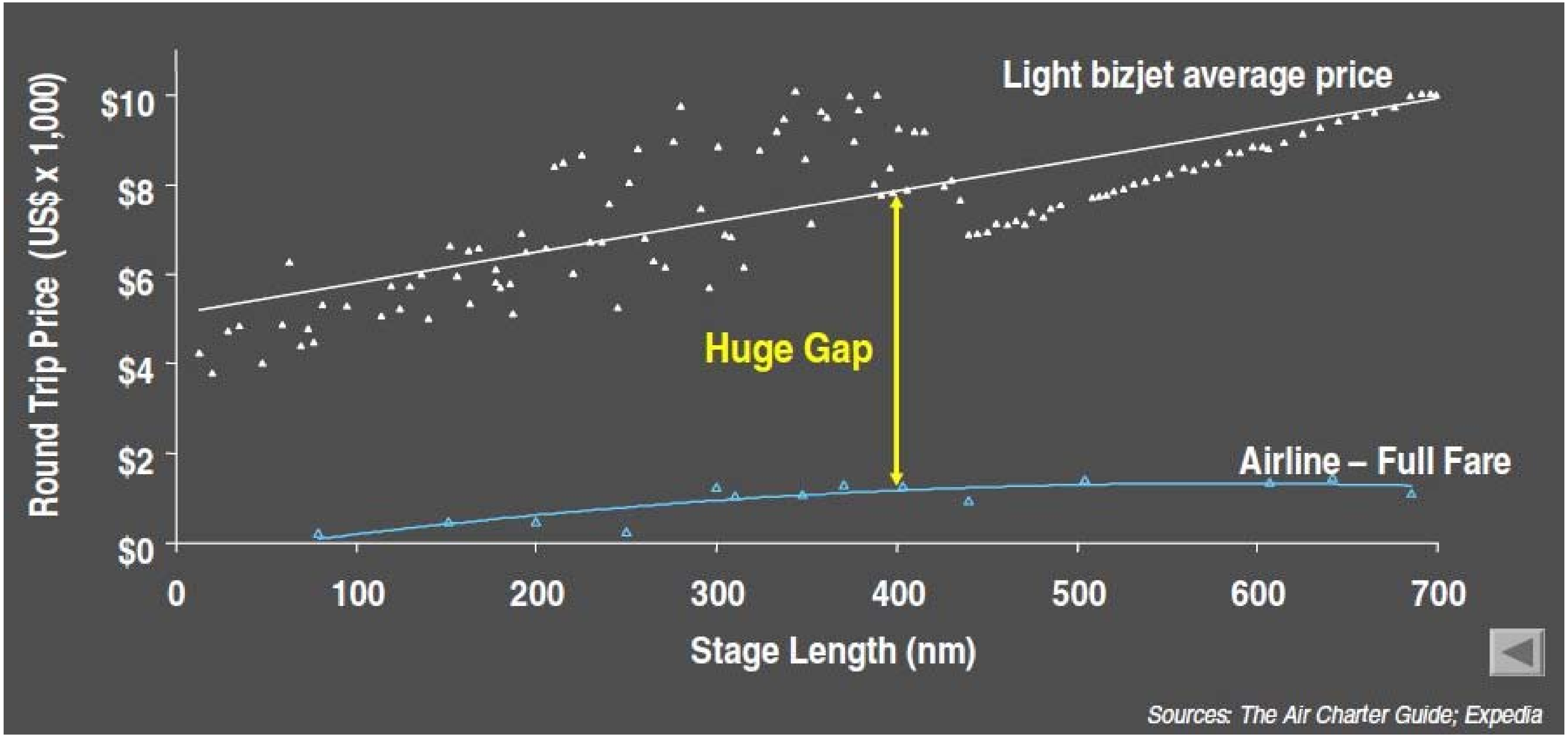
Fuel cells


Boeing is Developing Ultra Clean Auxiliary Power
Auxiliary power unit
Solid oxide fuel cell
power unit

Solar Impulse

- Solar powered plane
- Set to circumnavigate the globe with a person aboard
- Strong support (Deutsche Bank, Omega, Solvay)
- 2nd flight April 7th, 2010

Charter Flights vs. Airlines



Small planes (VLJs) may fill de gap and deliveries will increase significantly

2010 and Beyond

Electric and Hybrid Cars

MITSUBISHI TRON

GIUGIARO/FRAZER-NASH NAMIR

TESLA ROADSTER

FISKER KARMA

SWEDISH KOENIGSSEG QUANT (SOLAR)

2010 and Beyond

More Electric and Hybrid Cars

CADILLAC ESCALADE

GEM CAR

ZAP XEBRA

DINASTY IT SEDAN

ZENN

2010 and Beyond

More Electric and Hybrid Cars

CHEVROLET SILVERADO HYBRID

MERCURY MARINER HYBRID

TOYOTA PRIUS (HYBRID)

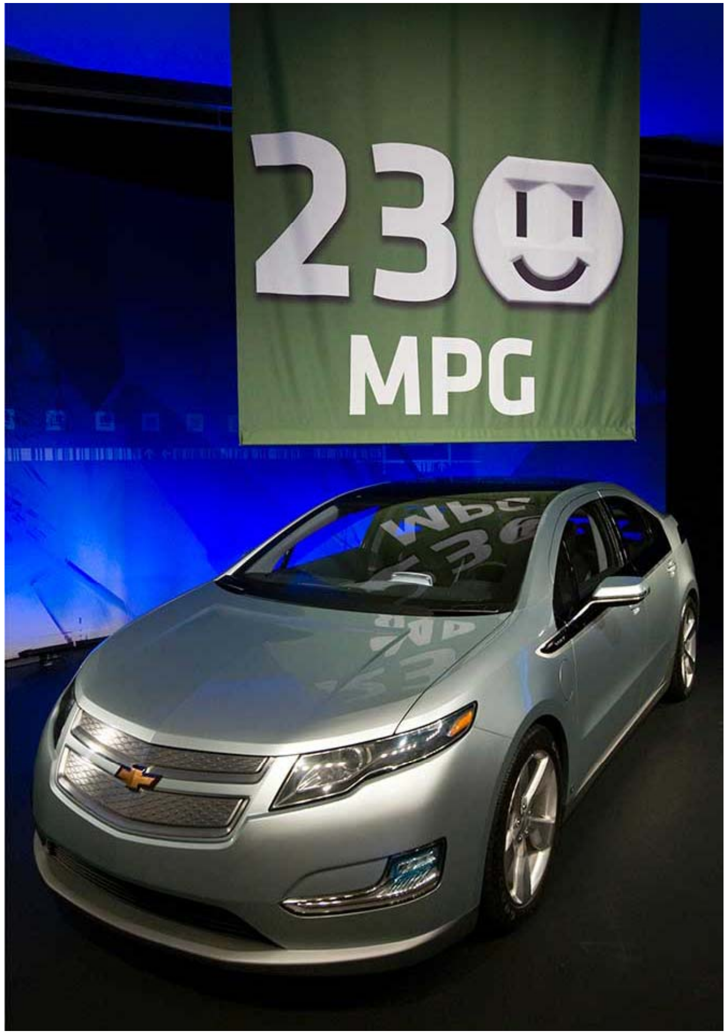
CADILLAC CONVERJ (HYBRID)

CHERY S18 (CHINA)

2010 and Beyond

More Electric and Hybrid Cars

General Motors claims the Chevrolet Volt range-extended electric vehicle will get at least 230 mpg in the city when it hits the road late 2009. That's more than four times higher than the Toyota Prius, the current EPA fuel-economy champ.



GM VOLT

2010 and Beyond

INSIDE VIEW OF CADILLAC CONVERJ

There's no mistaking the Converj for anything but a Cadillac. An aggressive, forward-leaning profile hints at a new, progressive theme and proportion in Cadillac's design evolution. The new proportion showcases a uniquely shaped, modern vision of a personal luxury 2+2.

The overall shape is reinforced by a prominent, sweeping body line with large, 21-inch (front) and 22-inch (rear) wheels pushed to the edges of the body. The Converj exterior is painted a dark silver tri-coat that GM designers dubbed "Reaction."

An all-glass roof incorporates solar panels that help offset power drain from the vehicle's accessories. Additionally, several aerodynamic and design efficiencies were incorporated to enhance the driving range, including:

* A full under-vehicle cover (belly pan)
* Minimal grille openings that reduce drag at the front of the vehicle
* Low-profile rearview cameras replace conventional outside mirrors to reduce drag
* Wheels are shaped to push air outward for smoother body side airflow

The Converj also incorporates vertical headlamp and taillamp elements, with light pipe technology.
"Vertical lamps are Cadillac signatures and the Converj builds on the brand's light pipe technology with bolder light emitting diode (LED) and high-intensity discharge elements front and rear," said Clay Dean, global design director for Cadillac. "There is also a unique daylight light 'spear' at the top of the headlamps."

The Converj's interior has advanced features and luxurious appointments blending efficiency and environmental consciousness. The 2+2 configuration is trimmed in contrasting Winter White synthetic suede – including the top of the instrument panel – and Midnight Black leather, with polished aluminum and wood grain accents. Renewable materials are used throughout such as wool-blend carpeting, a headliner made from silk, suede made from post-industrial content and more.

A technologically advanced driver center increases efficiency and reduces the draw on the battery. Features include:

* New, organic light-emitting diode technology used on reconfigurable instrument cluster
* Touch-screen navigation, climate, center-stack controls and audio systems
* Adjustable, overhead white ambient lighting
* Unique "power on" sequence featuring blue-lit console graphics
* Screen displays for features including regenerative braking, battery charge level and power output
* No inside rearview or outside mirrors; cameras provide surrounding images on a screen placed high on the instrument panel for a full, panoramic view
* Push-button ignition and power-folding front seats

2010 and Beyond

Electric Motorcycles and Scooters

AZHAR HUSSAIN TTX

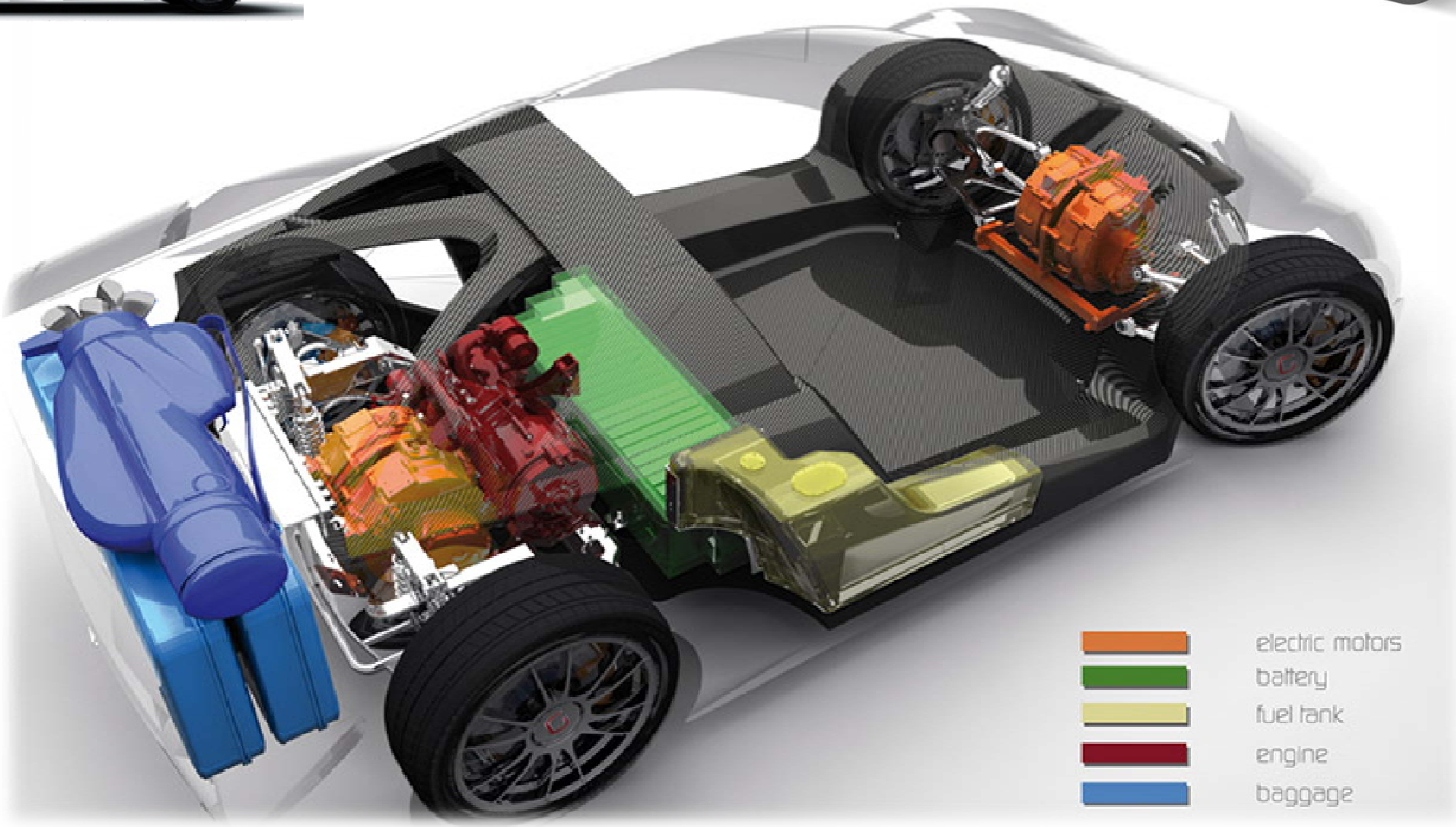
VECTRIX VX-1E

MISSION MOTORS

PIAGGIO MP3 (HYBRID)

2010 and Beyond

Namir Electric Car



Nissan Leaf Electric Car

2010 and Beyond

Early demand for the Nissan Leaf electric vehicle is strong, with 6,635 people reserving cars in just three days — a figure that represents more than 10 percent of the Leafs Nissan will build in its first year of production. Nissan started taking reservations for the four-door, five-passenger EV on Tuesday afternoon, and almost instantly people were signing up to get one. The Nissan Leaf, which will cost $25,280 after the $7,500 federal EV tax credit, rolls into showrooms in December.

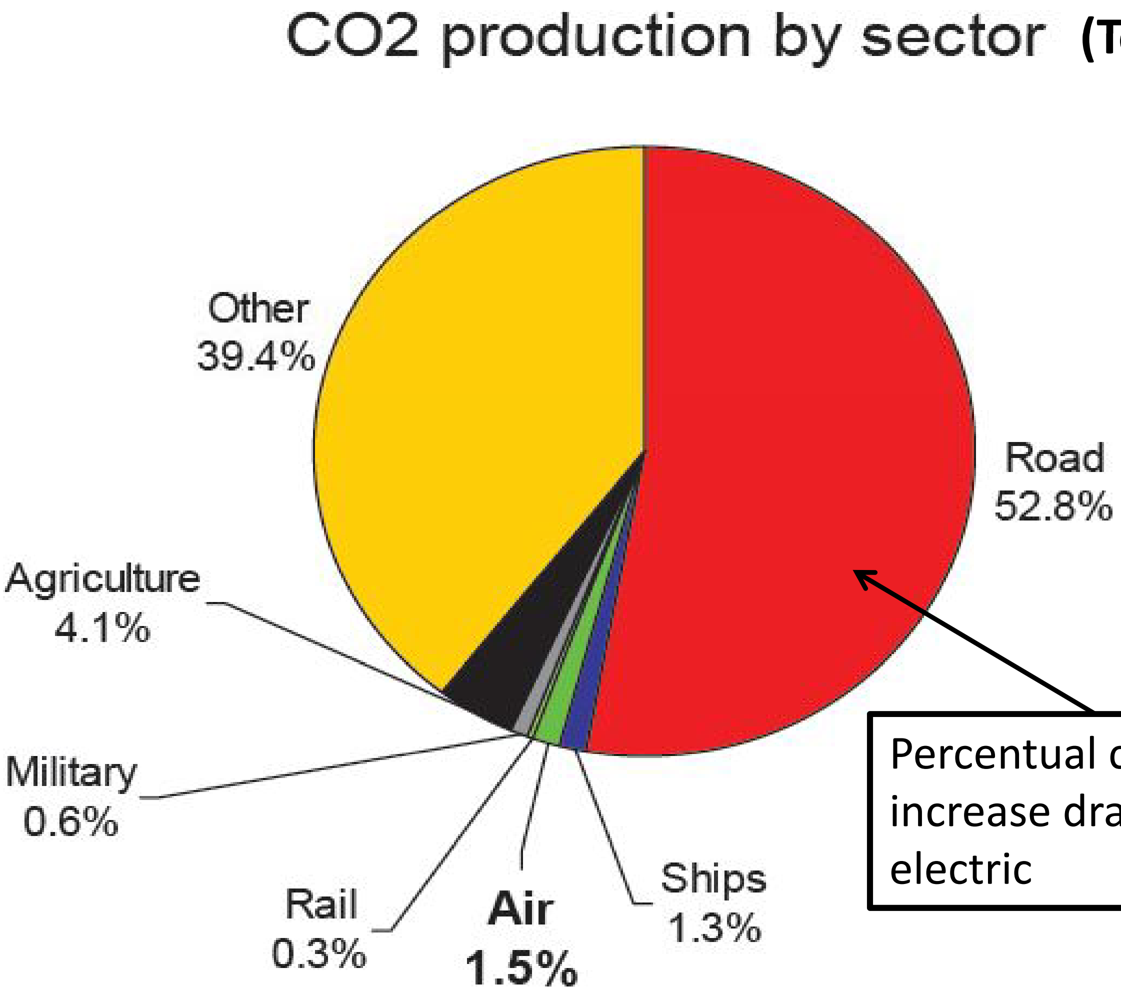
“We had 2,700 reservations in the first three hours,” said Dave Mingle, Nissan’s senior director for customer management and business strategy. “It exceeded what we expected, though we knew from what the hand-raisers were telling us this is an exceptionally passionate crowd.”

The hand-raisers he’s referring to are the 117,000 people who registered at the Leaf website to get a place in line once the reservation system opened. Those who have made reservations paid $99 to make sure they’re on the list when the Nissan Leaf starts appearing at dealerships.

Read More http://www.wired.com/autopia/#ixzz0lvfxV6Xb

2010 and Beyond

World with Electrical Cars and Trucks?



Percentual contribution of aviation will increase dramatically if road vehicles go electric

Source: EU Commission Study 2006

42 V Technology for Vehicles?

Benefits of 42 V in advanced automobiles

The principal benefits of a 42 V electrical system relative to today's (on the same basis 14 V) electrical system arise from the reduced current required to supply any stated level of power. The lower current means that electrical conductors in the wire harness can be smaller, lighter, and less expensive. It also allows a given electrical power to be switched by solid-state elements that are smaller and less expensive. These benefits accrue to all elements of the electrical system. The benefit of reduced wire size is important, but probably not sufficient to result in selection of a new operating voltage. The reduction in the cost of solid-state switching is more important. The reduction in silicon area per watt of load can be between 67 and 89%, depending on how switch losses are allowed to vary. Since silicon area is a major determinant of semiconductor cost, this difference can be great enough to make the difference between feasibility and impracticality of a proposed new electric feature.

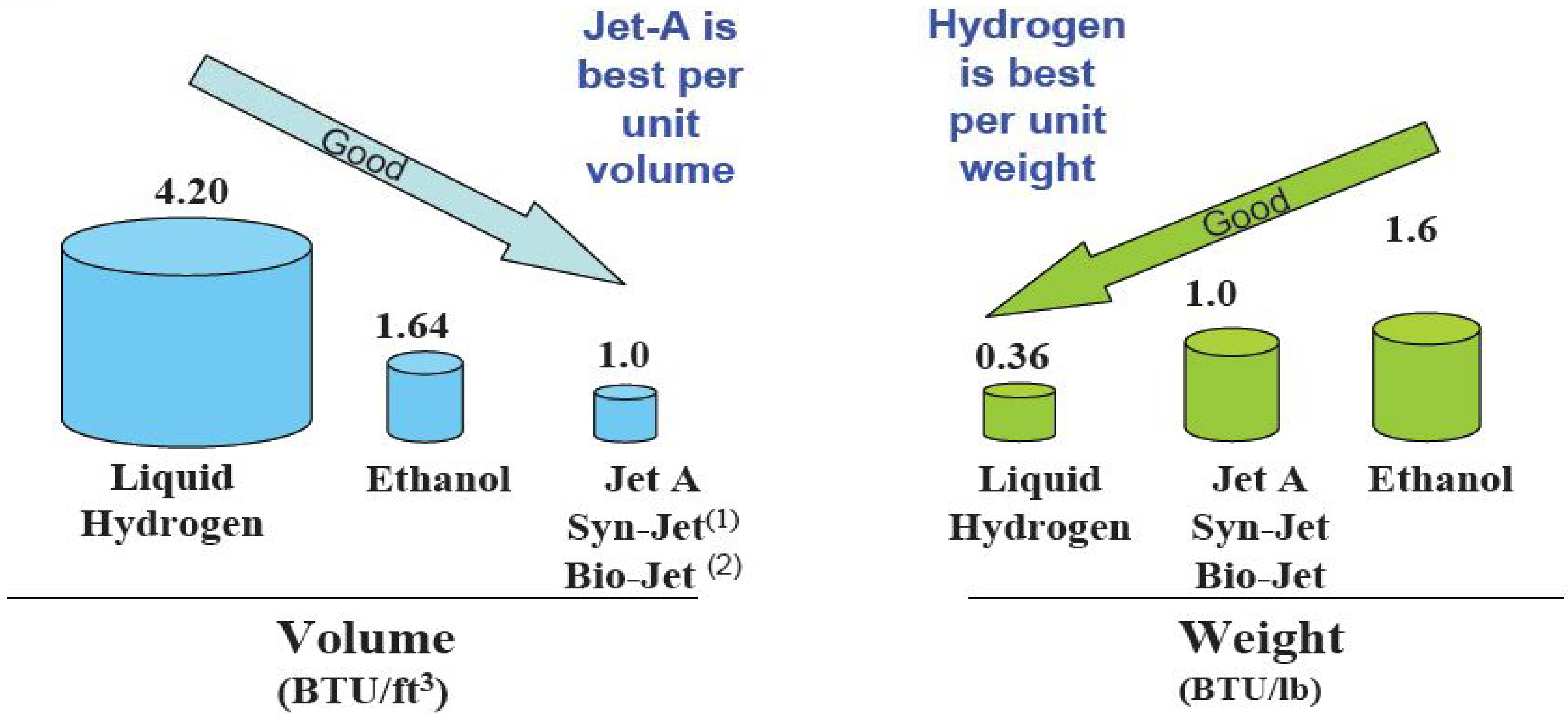
42 V Technology for Vehicles?

Although there was lots of serious talk of cars transitioning to 42V supplies, either in addition to, or to replace, the venerable 12V system they have used for decades, no progress has been made. The reasons for going to a supply potential that was three times the present supply rail were clear: the increased power requirements of today's cars could not be met efficiently by a lower-voltage system; the wire diameters needed to keep IR losses down were too big, and thus costly while consuming precious space; connectors were having problems handling the current; and the entire alternator charging/battery storage subsystem was, so to speak, running out of gas. Although some car vendors did install dual-supply dc systems in a few models, and key component vendors produced relays and other parts for 42V, the reality is that no one is talking about 42V systems breaking out any time soon—and many industry experts now say "it isn’t going to happen."

So, how did conventional wisdom go wrong? After all, many of the predictions came not from the usual crew of quick-with-the-quote analysts, but from insiders who were very knowledgeable about the technology and markets.
As is often the case in these situations, there is no single reason for the 42V systems not taking off as anticipated. Among the aspects cited are technical, business, and aftermarket issues, including:

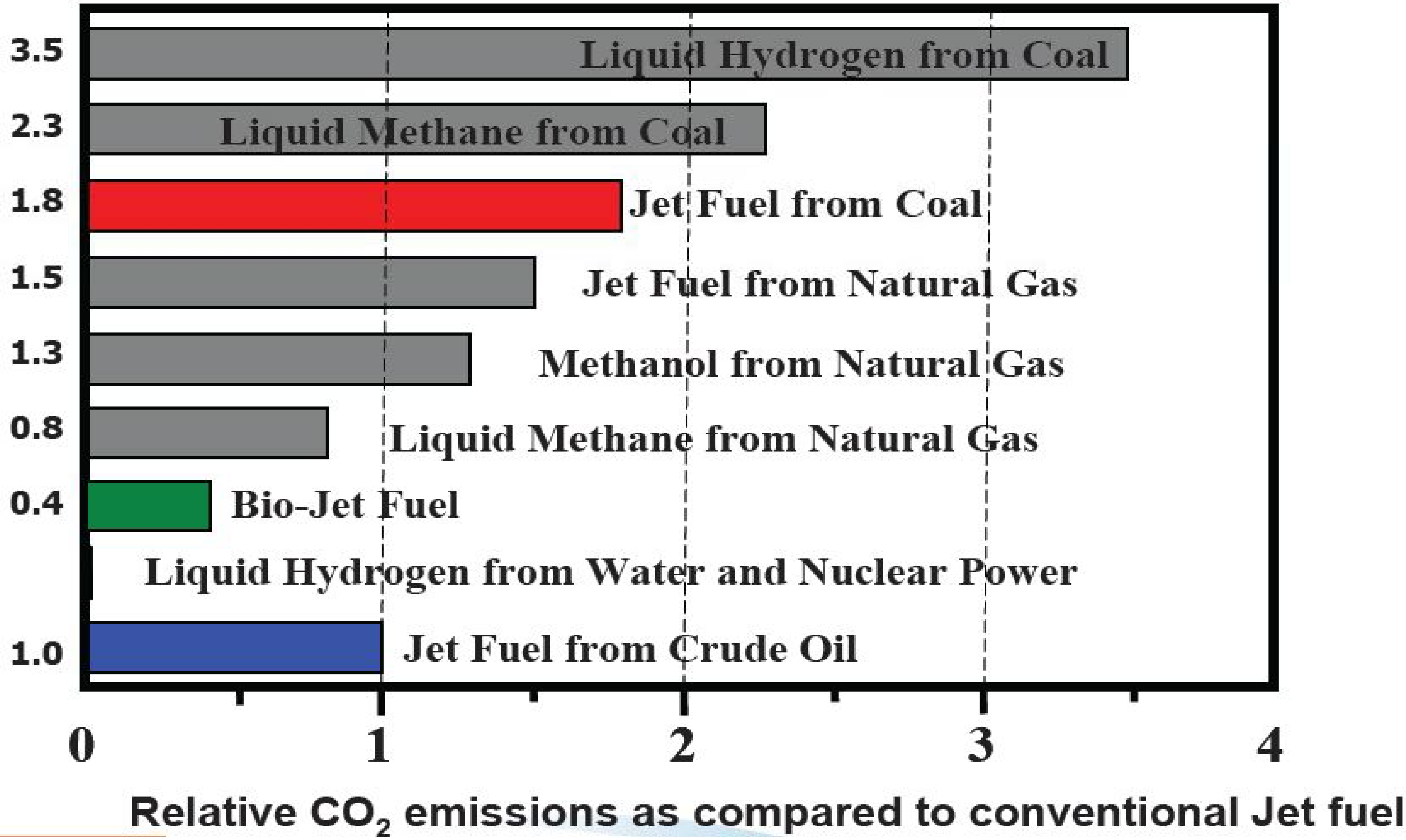
- The immense and well-tuned 12V infrastructure
- The familiarity, with 12V systems, of the service industry that keeps cars going
- The industry's decision to instead invest in developing components for hybrid and alternative vehicles squeezed out investment in 42V R&D; plus the desire to not make too many major automotive changes in the same time window
- The technical dilemma of designing-in a single 42V bus system versus dual 12/42V bus system
- Problems with long-reliability: at 12V DC loads, a relay's contacts don't arc or corrode; at 42V DC, the relay contacts can arc and pit as they open (unlike AC relays which self-extinguish when their contacts open)
- Sizing, keying, and standards for 42V connectors—not elegant, but critical practical factors
- Safety issues in the field, during test and repair, with 42V systems

Finding an Alternative Fuel is Difficult



Equivalent Energy Comparison

Carbon Emissions Should be an Important Consideration in Selection of Alternative Fuels




The Shape of the Things to Come

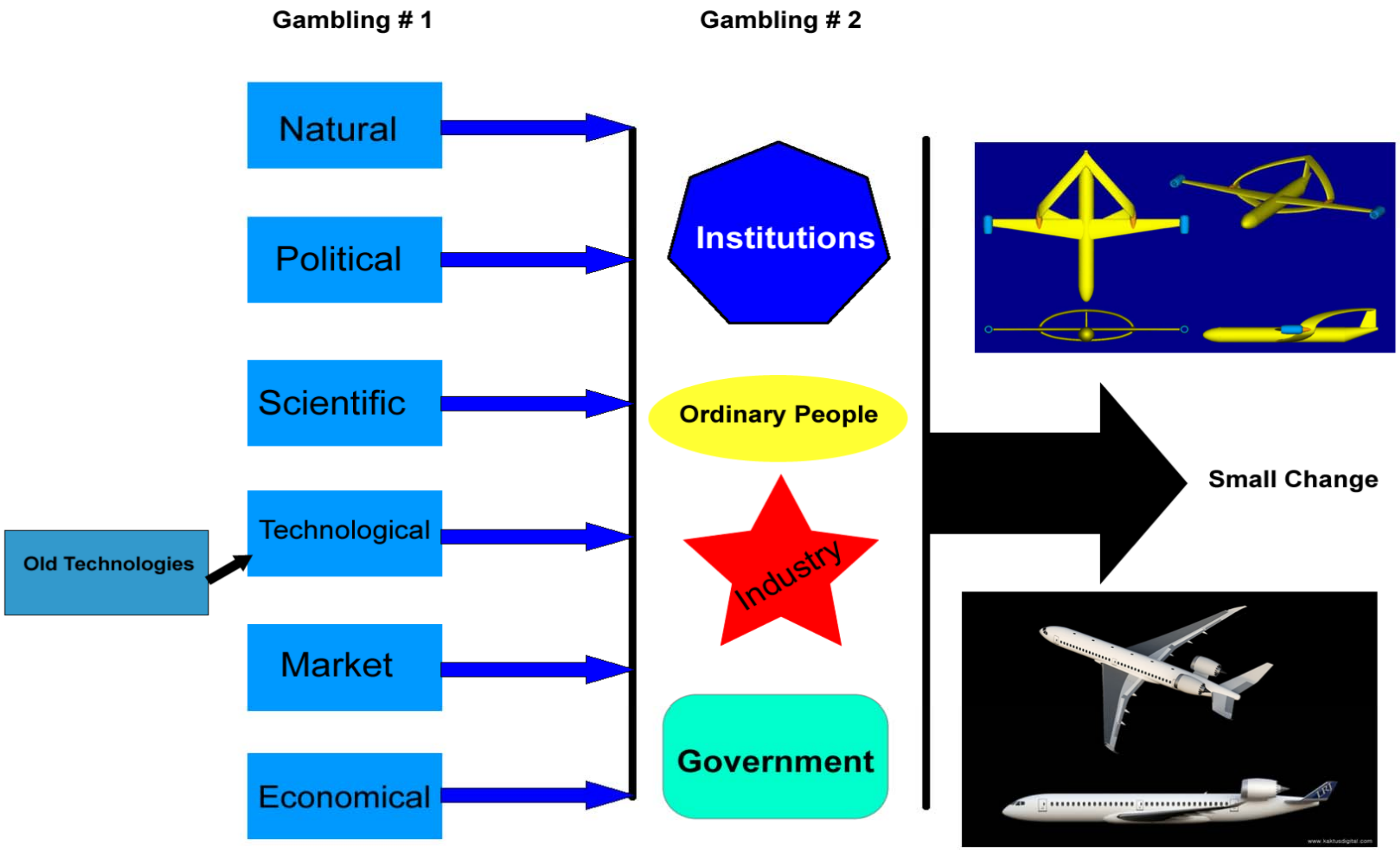
Forecasting...

Drivers of Change are major forces of transformation that will shape our efforts to remake learning. They represent the convergence of several trends into emerging ideas and phenomena that will disrupt traditional narratives and assumptions about learning. The questions under each driver serve as useful starting points for discussion.

Trends are distinct directions of change that point to new concepts or new patterns of behavior that will shape the future of learning.

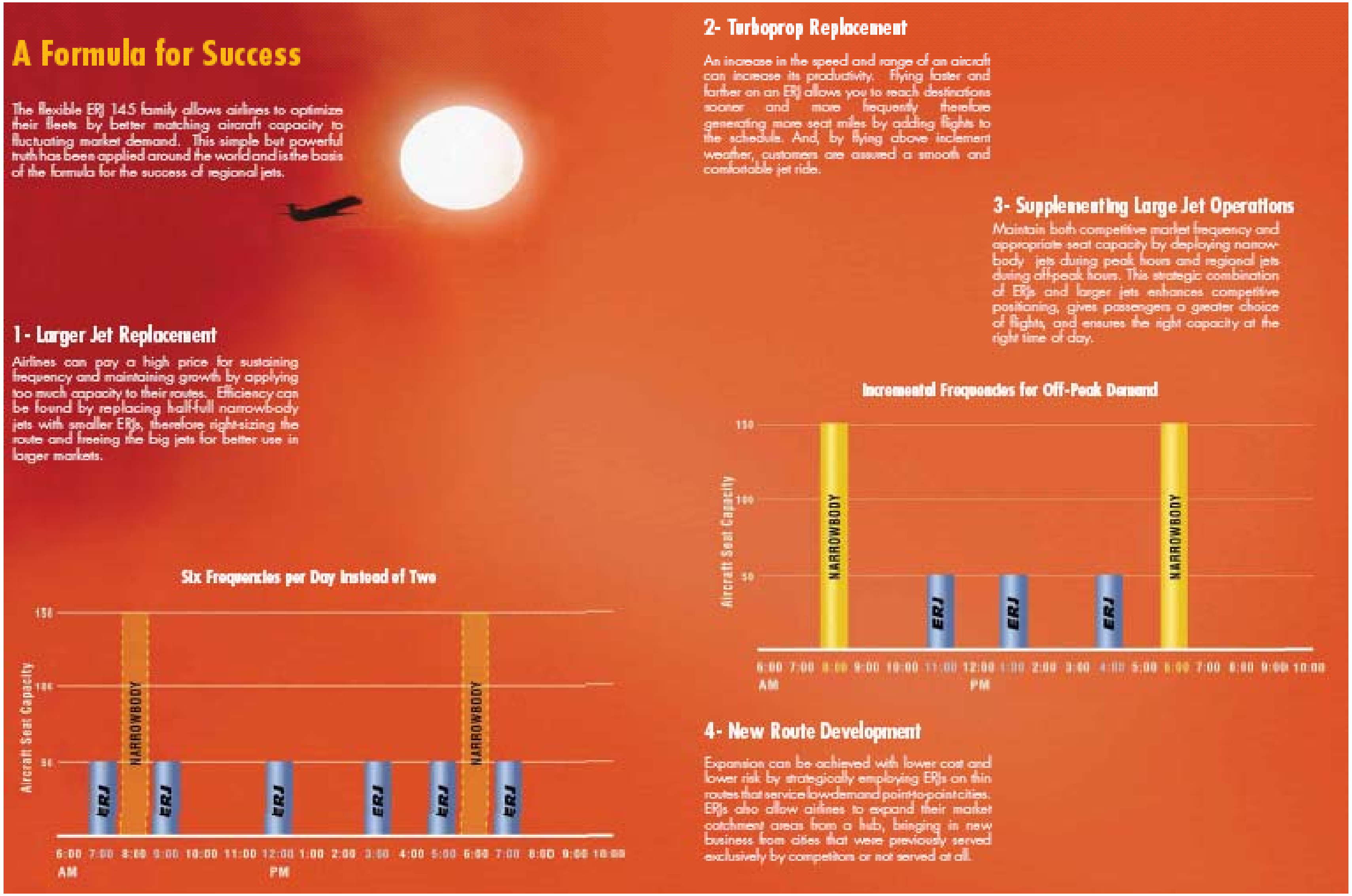
Signals are examples, or early indicators, of the changes described by the trends and the drivers of change. By providing analogies, data, and explicit stories, signals help make the future seem more concrete.

Drivers of Change



Drivers of Change

Case Study of Regional Jets



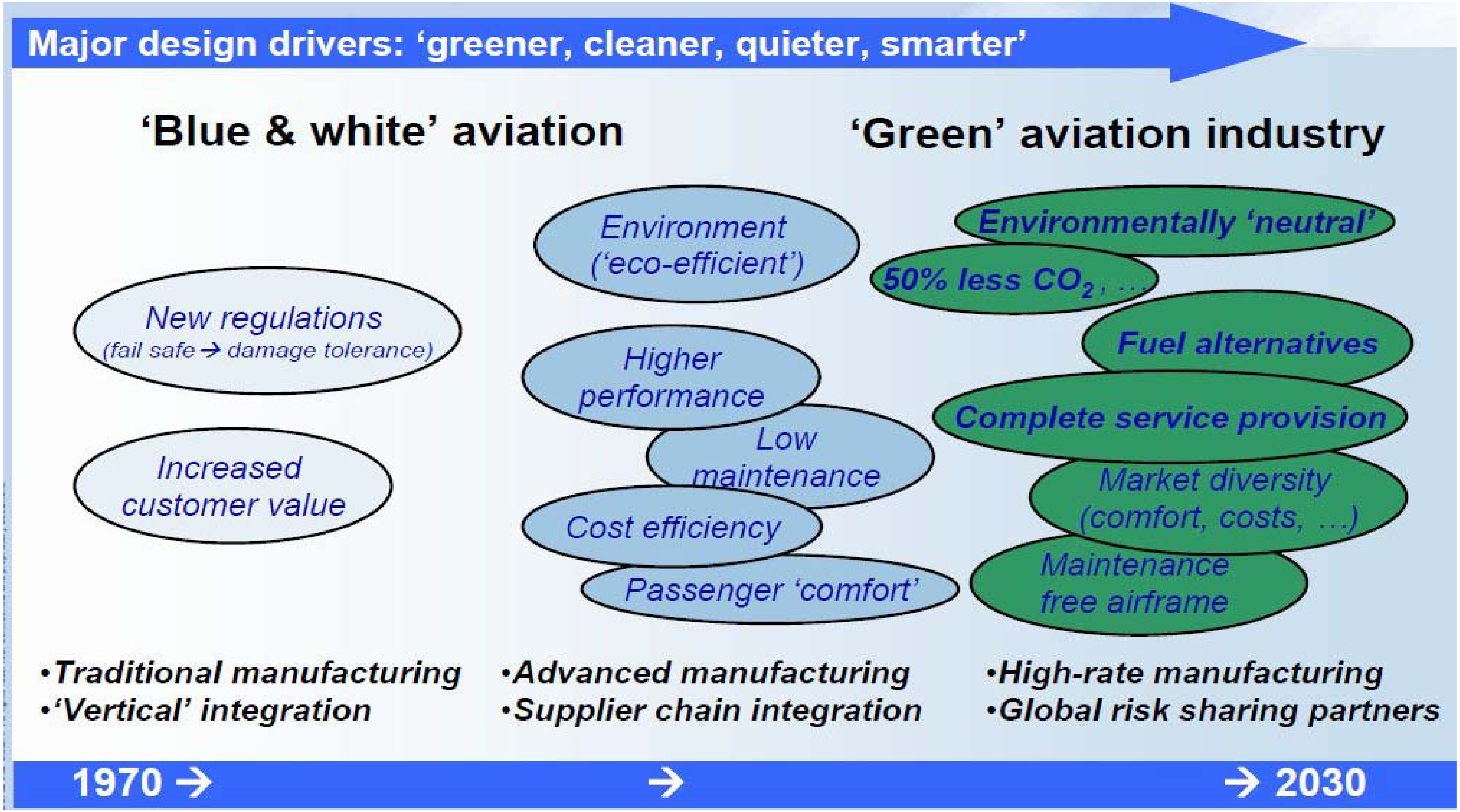
Drivers of Change

Case Study of Regional Jets

- **Governmental** : Deregulation Act 1978
- **Market**: Traditional airlines intended to expand business and there were new entrants to explore new markets and were keen on competing with the existing ones
- **Technological**: low-consumption turbofan engine for commuter aircraft
- **Political**: none
- **Natural**: none
- **Industry**: failed to introduce small turbojet airplanes in the 60s and 70s
- **Economical**: none
- **Scientific**: none

A 70s regional airliner fitted with turbojet engines

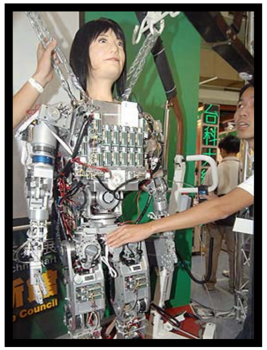
Evolution of Airbus Airframe Design -Drivers



Source: Airbus. 44th John Player Memorial Lecture, IMechE, March 2009

Drivers for the World of Tomorrow

- **Governmental** : Heavy investment in technology (Europe Technological Framework s); actions to stop global warming and lower emissions (Noticeably in Europe)
- **Market**: Traditional airlines intended to expand business and there were new entrants to explore new markets and were keen on competing with the existing ones. New business models will emerge.
- **Technological**: more efficient jet and prop engines; fuel cell; carbon nanotubes; all- composite aircraft; alternative fuels; morphing wings;
- **Political**: Cold war come back; Iranian technological advances; China increasing political influence
- **Natural**: global warming; volcanism; cosmic menace (gamma rays; asteroid impact, etc...)
- **Industry**: still slow reacting to faces new challenges but some are active in research and innovation
- **Economical**: increasing fuel prices; Asian economical growth; increase in world population
- **Scientific**: robotics; research on gravitational waves; possible new particle physics



Trends for the World of Tomorrow

• Towards more environmental friendly vehicles (electrical cars within 5 years).

• Towards a interconnected network for road vehicles.

• Asia economies will stay booming.

• Internet will continue to register on increased presence in everyday life (collaborative work, vehicles will be online all the time).

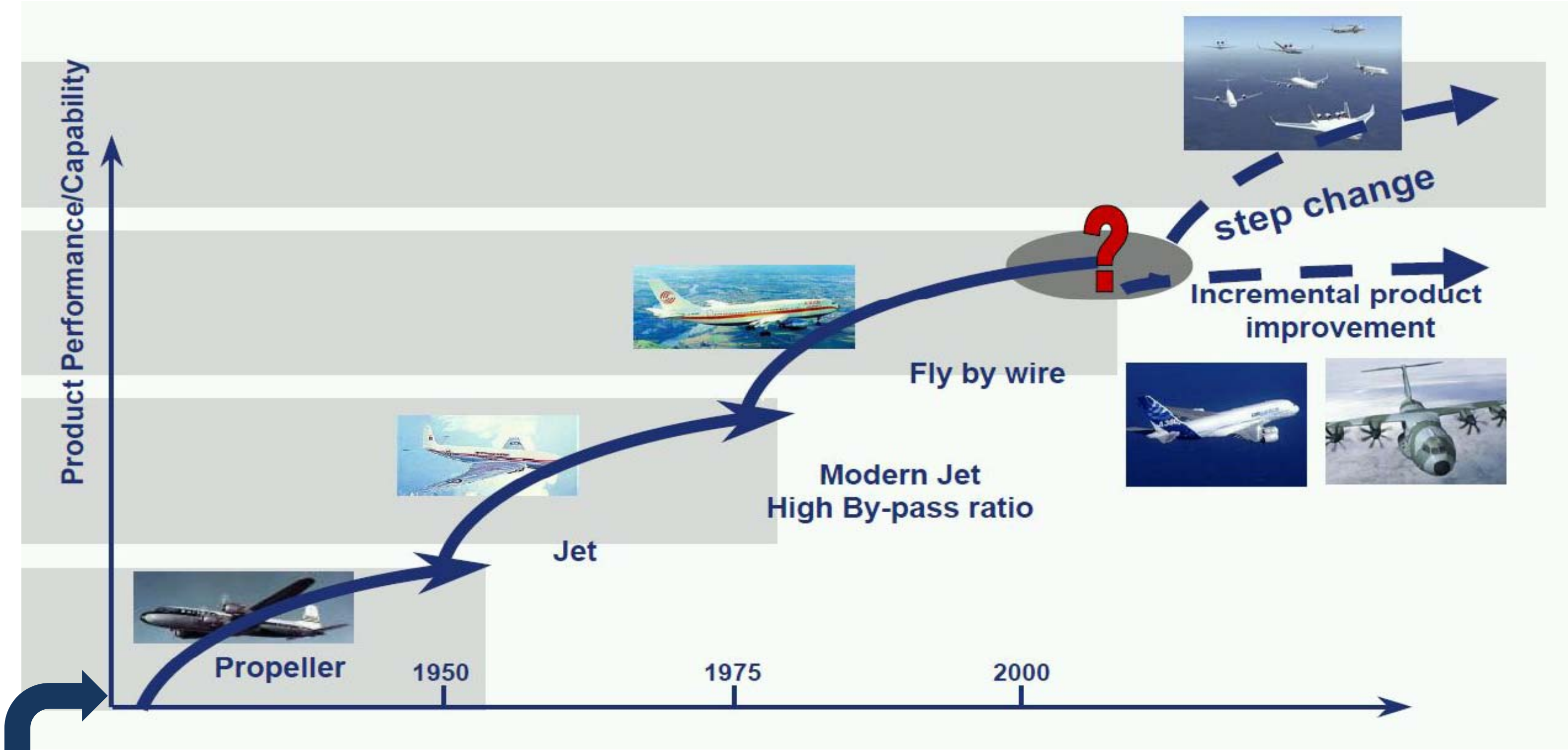
• Space race between the United States and China. To footprint the Mars surface, the USA will probably have to ask collaboration from China and Russia. Private money will not be enough.

• Generalized use of UAVs.
• Global warming and public attitude against pollution will exercise increased pressures on new aircraft designs.
• Personal androids will become reality in 15-20 years.
• Research for supersonic small business jet. Here, besides the technological challenges, environmental concerns poses a serious barrier.

Some Signals for the World of Tomorrow

- Large Hardron Collider can rewrite particle physics.
- Although the F-35 fighter program will bring new insights and standards in VTOL aircraft technology, this technology will not be sufficiently evolved and mature to be implemented in commercial planes in the next 20 years.
- Research into 3D Fax capabilities.
- High evolved automata under development.
- Generalized applications of nanotechnology.

Evolution or Revolution ?



Time Zero=1906

European Aeronautics - Vision 2020

Challenges	and associated goals
Quality and Affordability	Reduced passenger charges Increased passenger choice Transformed freight operations Reduced time to market by 50%
The environment	Reduction of CO_2 by 50% Reduction of NO_x by 80% Reduce perceived external noise by 50% Substantial progress towards 'Green MMD'
Safety	Reduction of accidents rate by 80% Drastic reduction in human error and its consequences
The Efficiency of the Air Transport System	3X capacity increase 99% of flights within 15' of schedule Less than 15' in airport before short flights
Security	Airborne - zero hazard from hostile action Airport - zero access by unauthorised persons or products Air navigation - No misuse. Safe control of hijacked aircraft

addresses the full scope of customer expectations

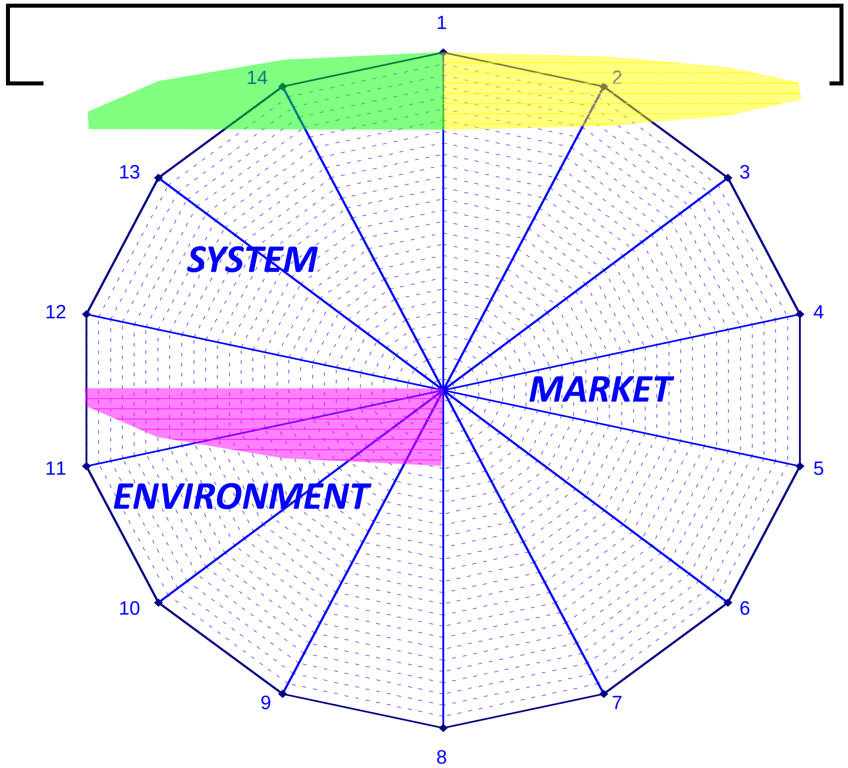
Understand the challenges

SAFETY and SECURITY

MARKET REQUIREMENTS
1. *High Productivity*
2. *Low cost of operation*
3. *Superior reliability/maintainability*
4. *Comfort / health driven cabin design*
5. *Low cost of acquisition / high residual value*
6. *High flexibility/updatability*
7. *Family Concept design*
8. *Market specialisation*

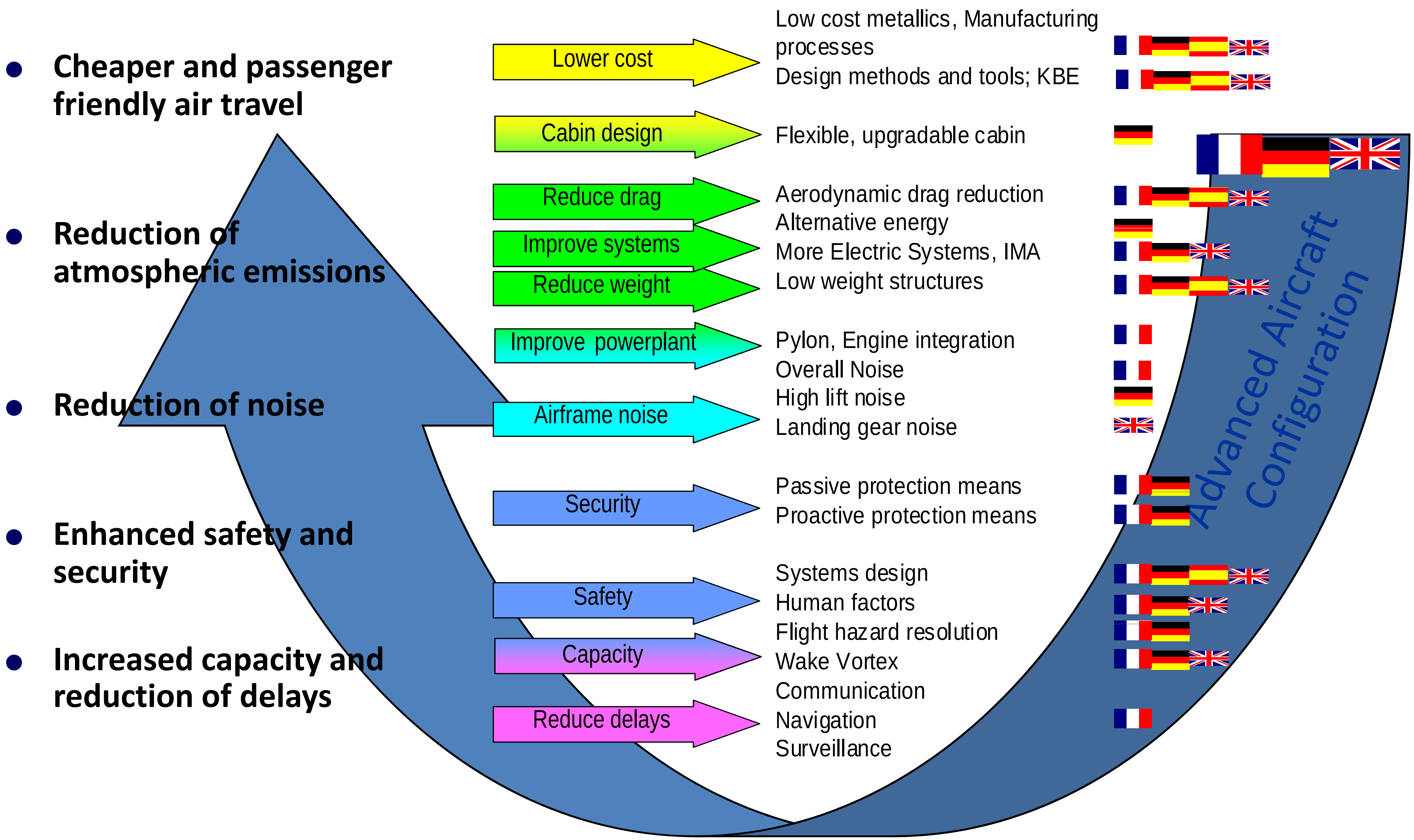
ENVIRONMENTAL PRESSURE
9. *Low noise*
10. *Reduced emissions*
11. *Low manufacturing and life cycle impact*

INTEGRATION IN THE SYSTEM
12. *Solution to airport congestion*
13. *Good airport compatibility*
14. *Exploiting new ATM opportunities*

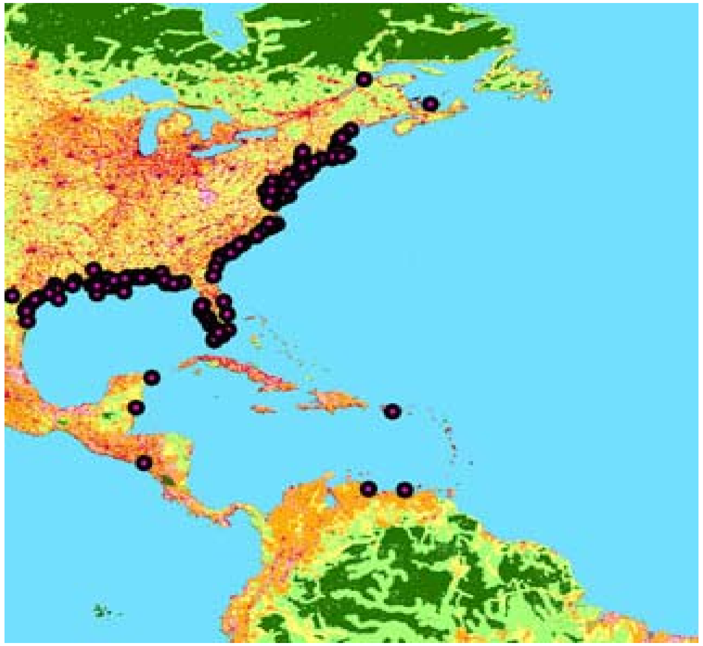


Key driving requirements for the future air transport system have been captured and analysed

How Airbus will Implement the ACARE Vision

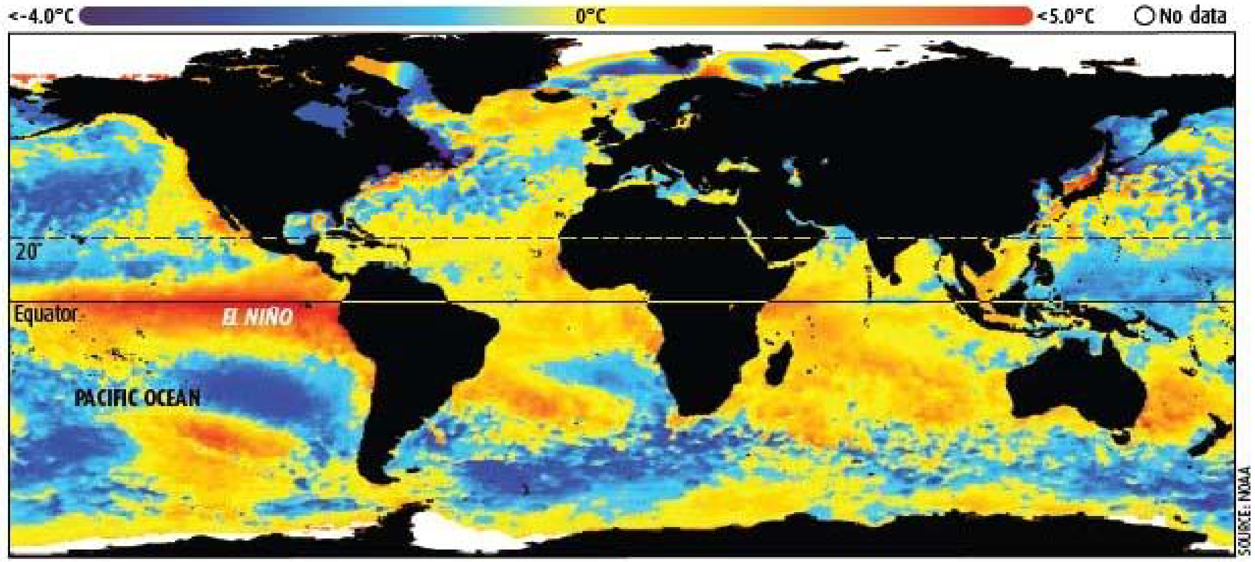


Catastrophic Climate Changes



***Above* - DEAD ZONE:** Waters with little or no oxygen continue to form in coastal areas worldwide thanks to fertilizer washing off agricultural fields and fossil fuel burning.

***Below* –** Global Warming



Catastrophic Climate Changes

What is being done?

On Feb. 24, 2008, Virgin Atlantic Airways completed the first flight of a commercial aircraft powered by biofuel when it flew a Boeing 747-400 partially fueled with a mix of coconut oil and babassu oil from London Heathrow to Amsterdam Schiphol.

The Ipanema is the first factory series production aircraft in the world certified for the use of ethanol as a fuel alternative.

Crowded Skies

Sequence of photographs of Boeing 747 on landing approach as industrial smoke dramatically defines one of trailing vortices. Photo ©Bob Stoyles.

Crowded Skies

What is being done?

NASA conducting flight assessments of wake-alleviation concepts at Dryden with NASA Boeing 747, T-37, and Learjet aircraft.

Model of Boeing 747 during wake-vortex testing in Langley 14- by 22-Foot Tunnel
with traversing rig mounted downstream to permit measurements of trailing wake.

Crowded Skies

What is being done?

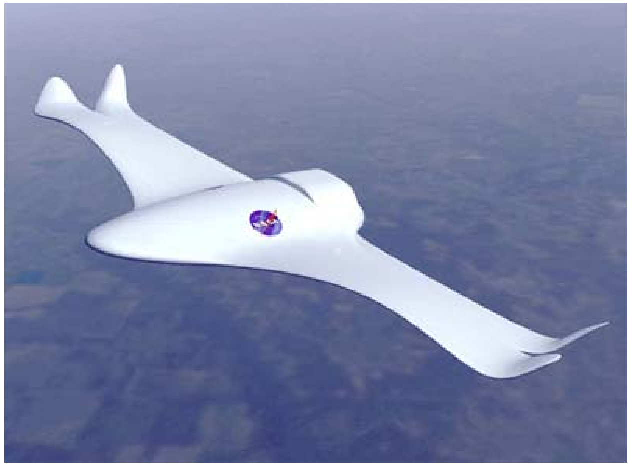
The **Small Aircraft Transportation System** (**SATS**) is a joint research project between the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA), along with local airports and aviation authorities. It is designed to facilitate transportation between small General Aviation airports using small aircraft as an alternative to traditional airline travel.

Airframe Technology

What is being done?

Morphing aircraft wings

- Increase lift
- Reduce drag
- Enhance maneuverability

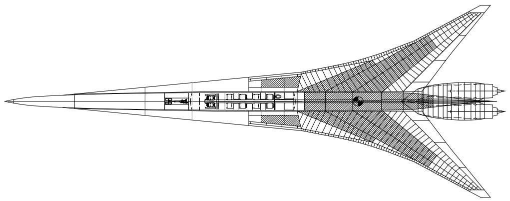


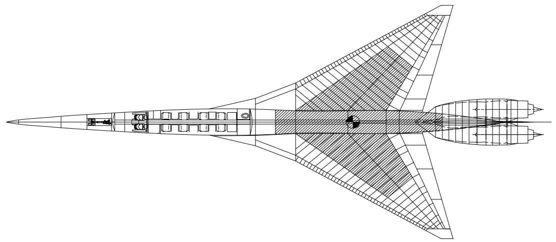
NASA morphing aircraft concept

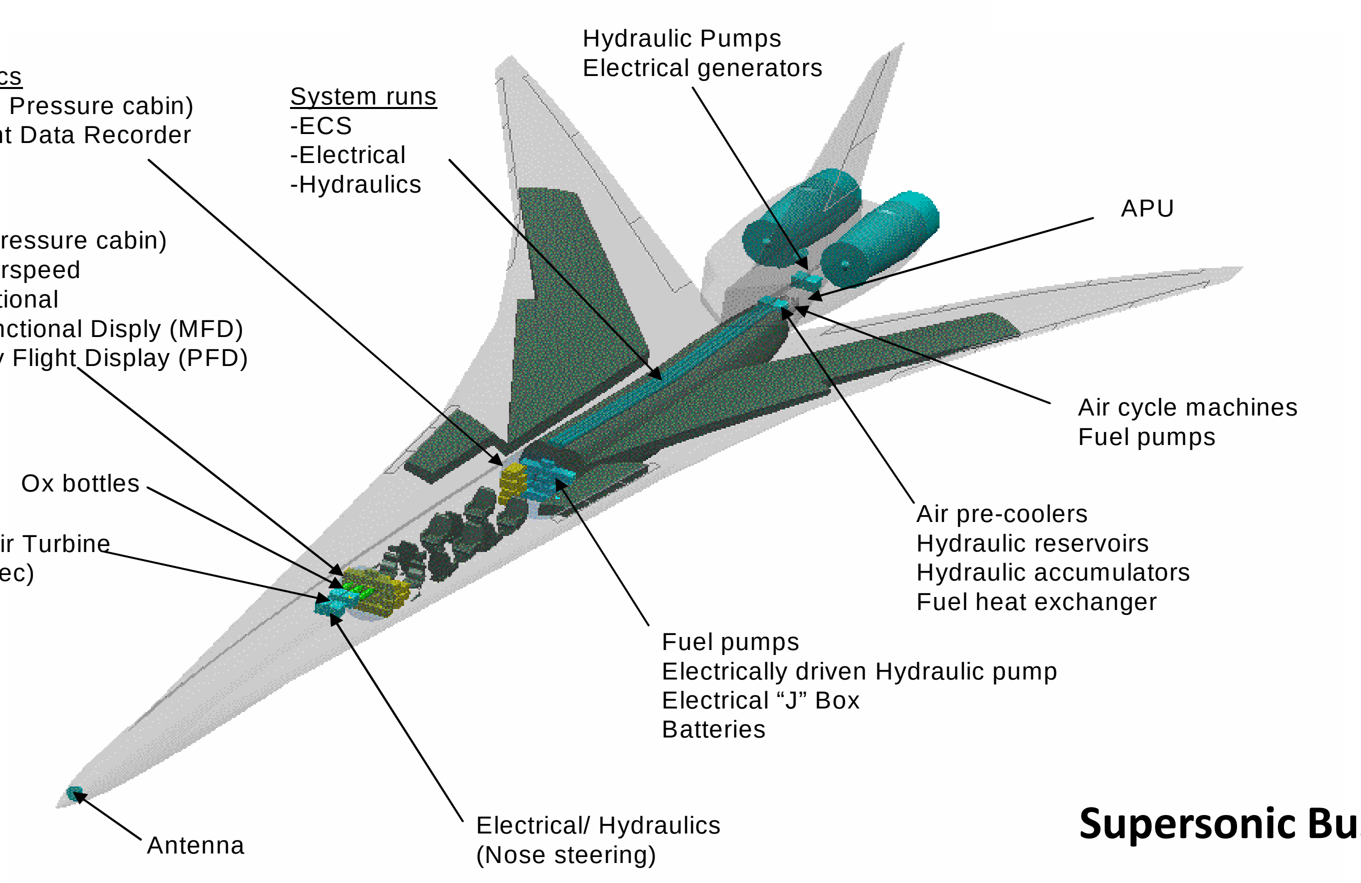
← BMW Gina

Airframe Technology

What is being done?

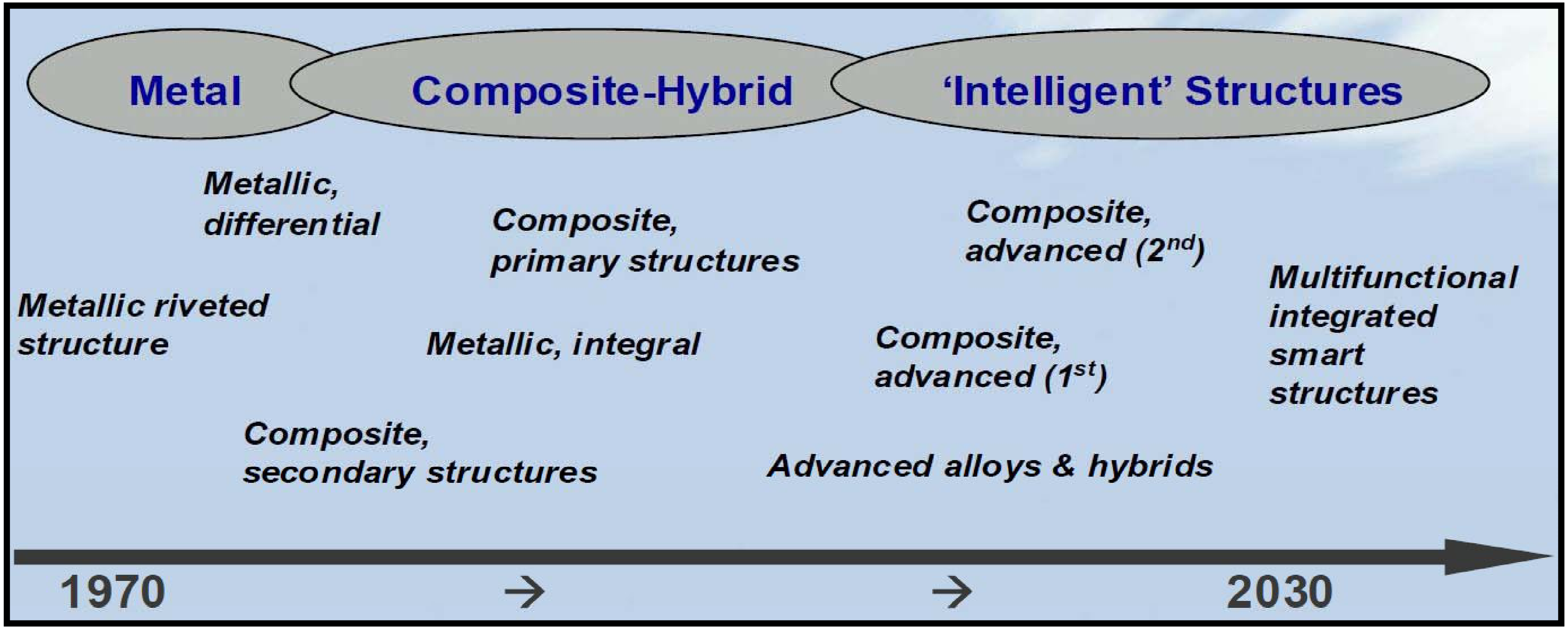






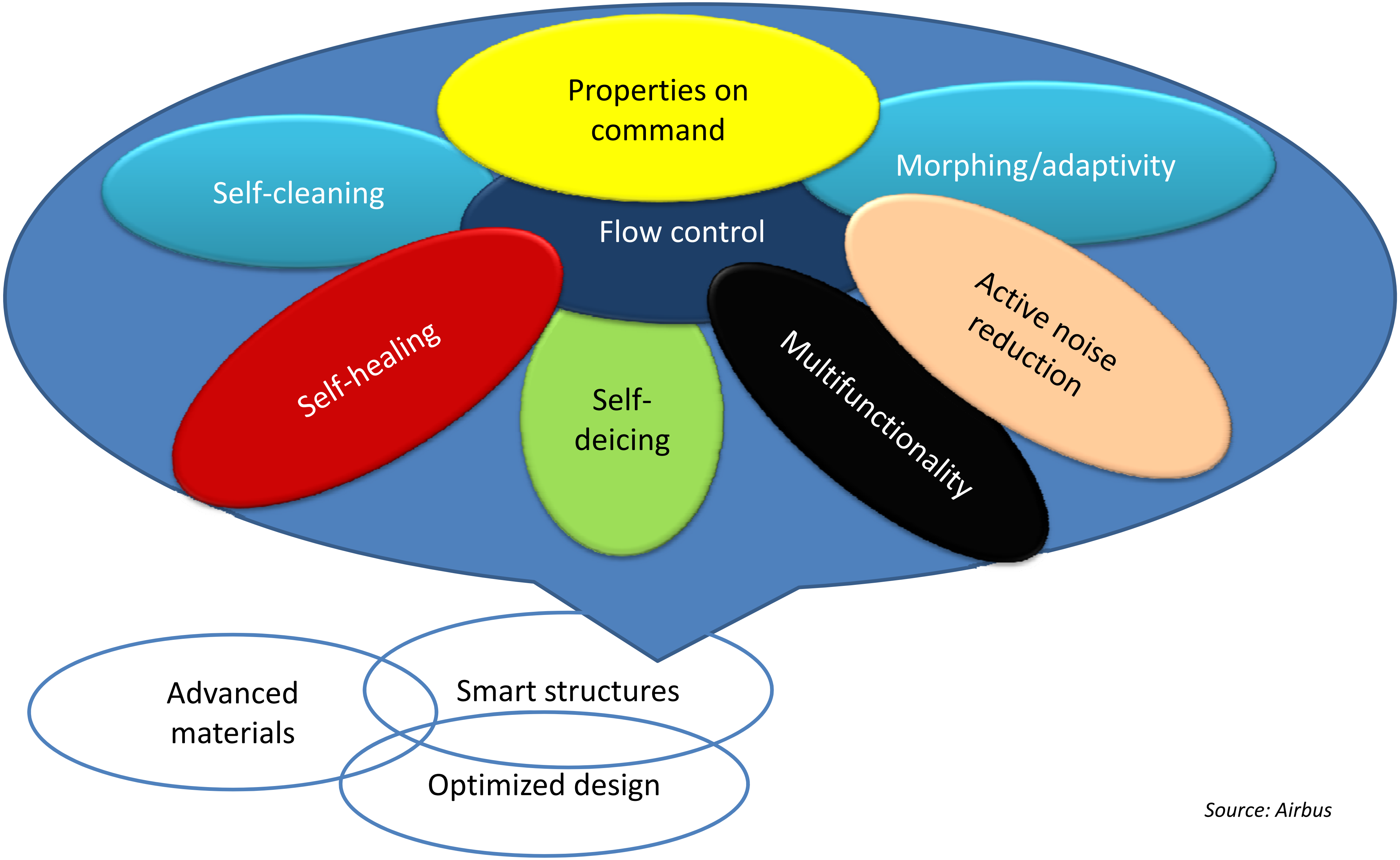
Supersonic Business Jet

Airframe Technology
Evolution of Airbus Airframe Design



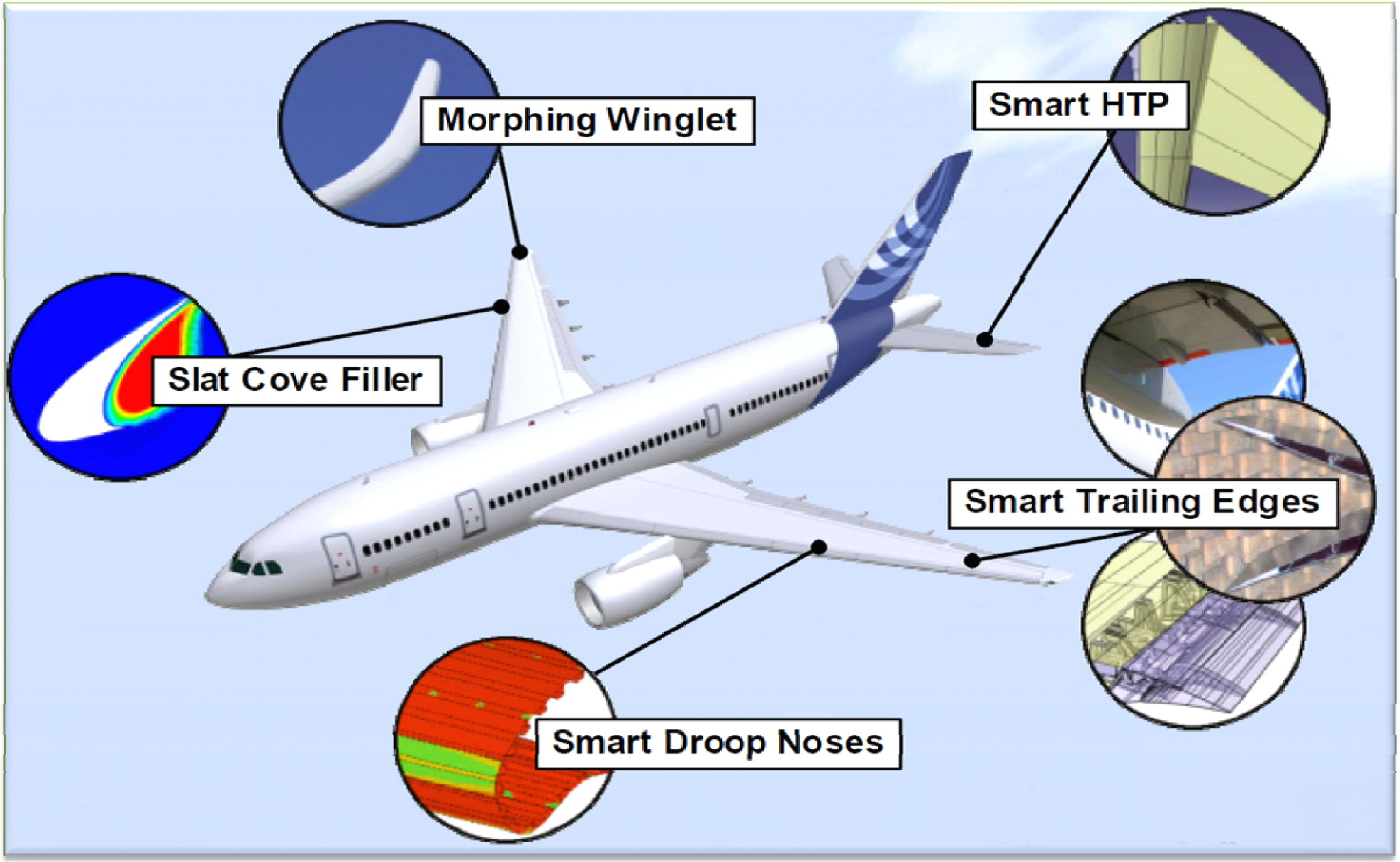
Material and design innovation increased structural performance, in future step changes are expected from multifunctional *intelligent* structures

Airframe Technology
Airbus "Intelligent" Airframe



Source: Airbus

Airframe Technology
Morphing and Adaptative Structures



Airframe Technology
Structural Health Monitoring

Generation 0
- Structure testing application (TR: 2003)
- Benefit: structure analysis & testing

Generation 1
- In-service aircraft, off-line sensor (TR: 2008)
- Benefit: maintenance

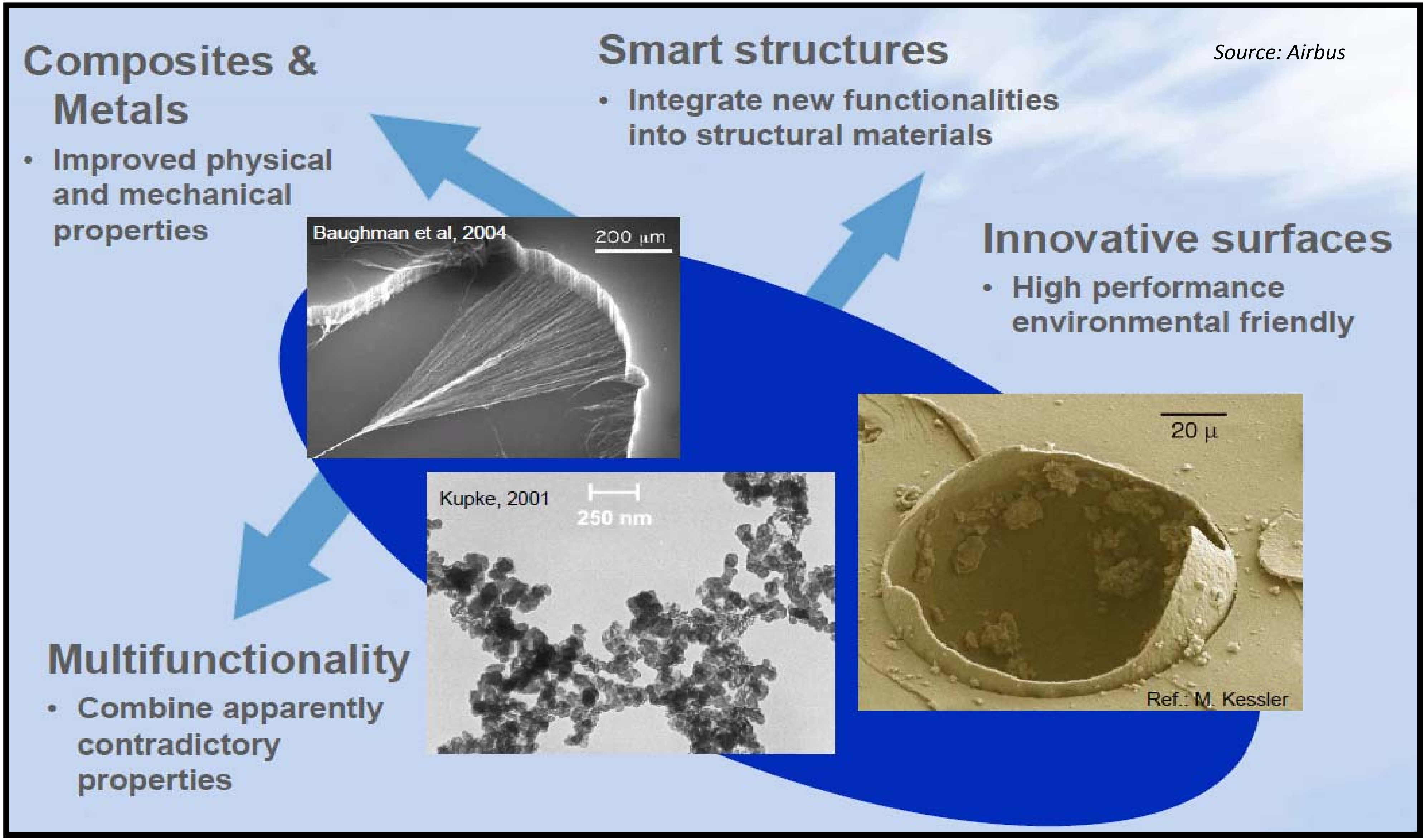
Generation 2
- In-service aircraft, on-line sensor (TR: 2013)
- Benefit:
  -weight saving component level
  -maintenance

Generation 3
- In-service aircraft, fully integrated sensor (TR: 2018)
- Benefit:
  -weight saving aircraft level
  -maintenance

Stepwise approach towards SHM application is essential

Source: Airbus

Airframe Technology
Nanotechnology



Airframe Technology
Self Repairing Structures

Researchers at the Engineering and Sciences Research Council are developing composite materials that "bleed" resin when stressed or damaged, effectively creating a "scab" that fixes the damage. It's an innovation that could drastically improve air safety, foster the development of lighter aircraft and bring biomimicry to aviation.

"This project represents just the first step", says Dr. Ian Bond, the aerospace professor leading the research. "We're also developing systems where the healing agent isn't contained in individual glass fibers but actually moves around as part of a fully integrated vascular network, just like the circulatory systems found in animals and plants. Such a system could have its healing agent refilled or replaced and could repeatedly heal a structure throughout its lifetime. Furthermore, it offers potential for developing other biological-type functions in man-made structures, such as controlling temperature or distributing energy sources."

Think about the body's healing process and the technology behind self-healing plastics is easy to grasp.

When we cut ourselves, sticky cells called platelets clump together near the wound to create a plug that stops the bleeding and begins the healing. The principle behind the self-healing plastic Bond has developed at University of Bristol technique is remarkably similar.

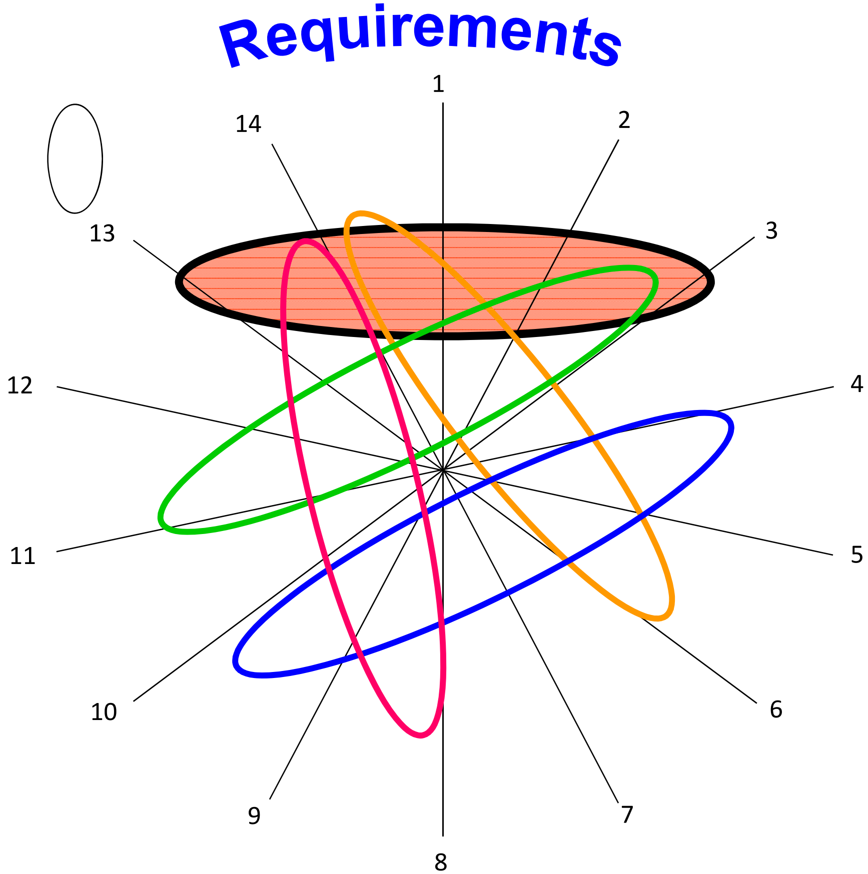
Read More http://www.wired.com/autopia/2008/05/airplane-heal-t/#ixzz0ldwilIXI

Configuration Choice

Think out of the box

Existing products : based on one single concept to best meet all requirements

Future capabilities : driven by a family of concepts tailored to fit specific sets of requirements



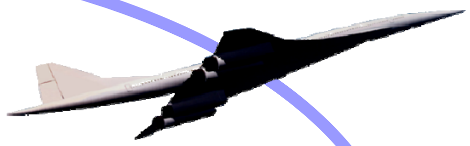
The idea is to select concepts to explore the most relevant capabilities and meet the widest range of challenges

Source: Airbus

Configuration Choice

Select the champions

From the foreseen range of requirements, typical concepts have been selected as most able to drive the innovations in their respective field of difficulty :



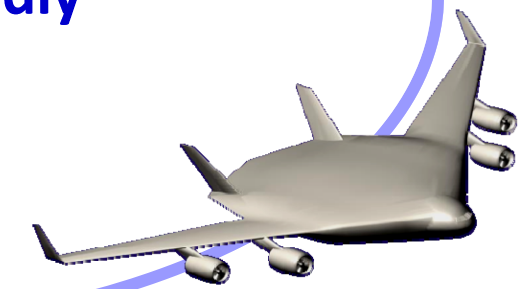
1 - The Money Buster

2 - The Proactive Green

3 - The Passenger Friendly

4 - The Value of Speed

5 - The Flying Truck



**Irrespective of final future product configurations,
the champions will act as basic vectors, scoping the whole set of future capability development**

Configuration Choice

Shape the champions

1 - The Money Buster

2 - The Proactive Green

3 - The Passenger Friendly

4 - The value of Speed

5 - The Flying Truck


Configuration Choice
The Money Buster
Putting maximum bias on return on investment over the life of the aircraft
Source: Airbus

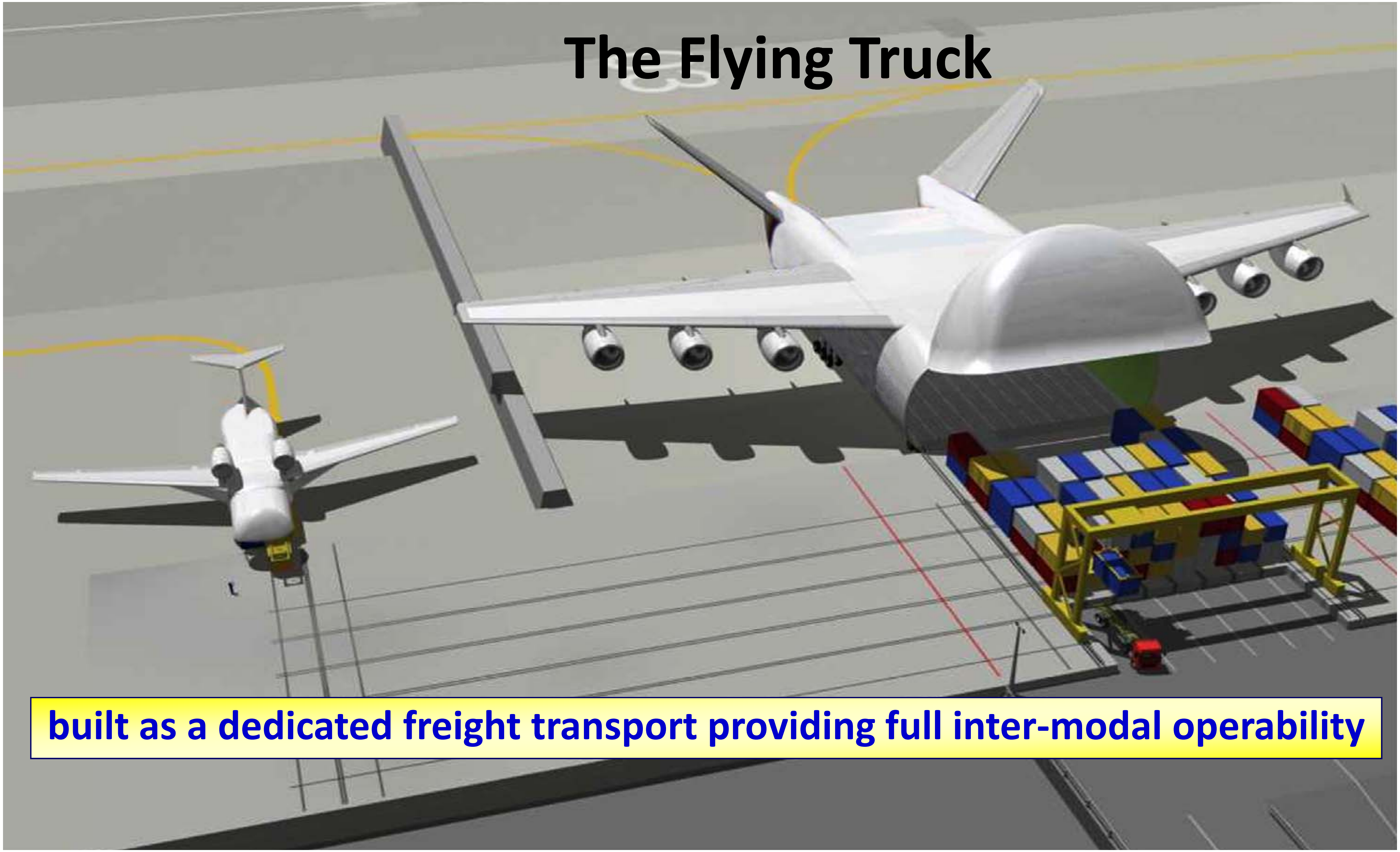
Configuration Choice

The Proactive Green

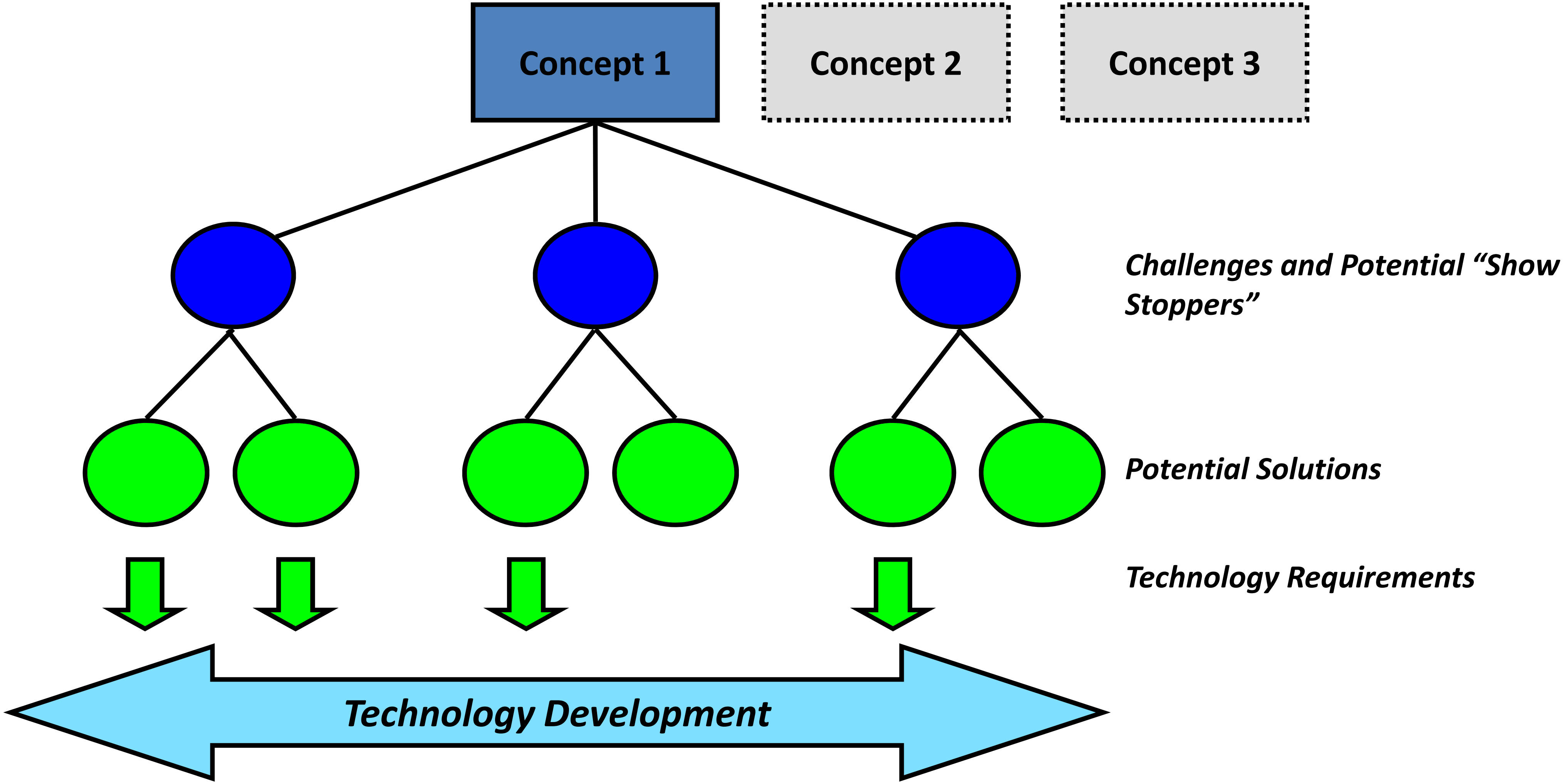
Giving minimum affordable impact of aviation operations and manufacturing on the environment

Configuration Choice

Configuration Choice



Capture the Champions Technology Needs



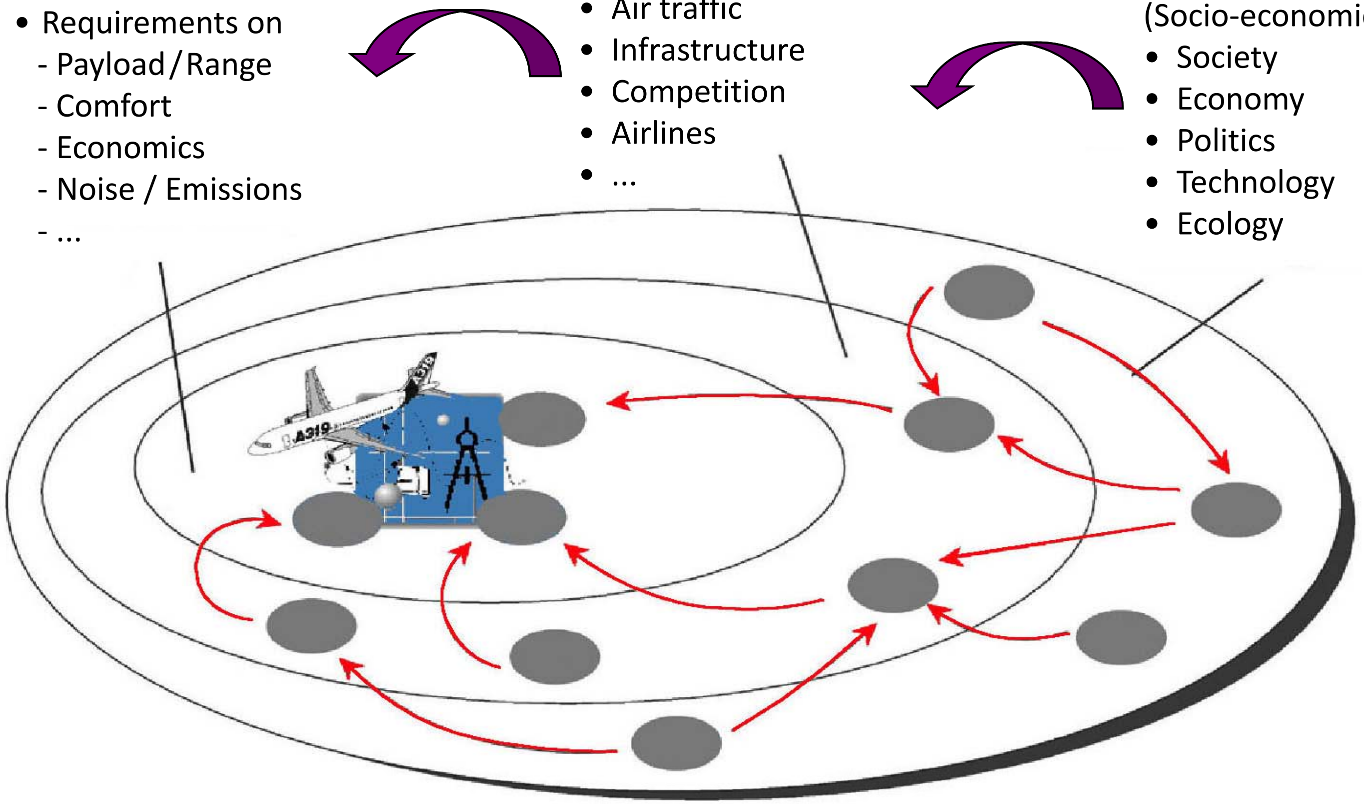
and bring focus to the complete research network

Rank the champions

Micro Environment
(aircraft specific)
- Requirements on
  - Payload/Range
  - Comfort
  - Economics
  - Noise / Emissions
  - ...

Meso Environment
(air transport related)
- Air traffic
- Infrastructure
- Competition
- Airlines
- ...

Macro Environment
(Socio-economic)
- Society
- Economy
- Politics
- Technology
- Ecology



Modelling of the world context will provide insight and rationale to prioritise the different concepts for the benefit of the end customer as well as aircraft manufacturer

More Ideas...

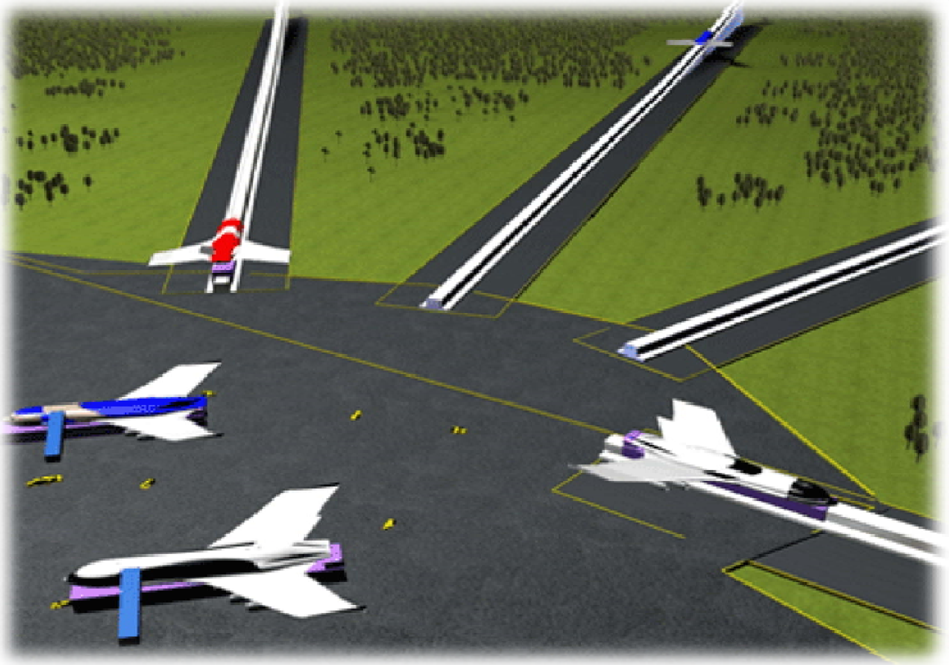
The Cruiser/Feeder concept including mid-air refueling

The concept envisages very large - possibly nuclear-powered - aircraft flying on stable circuitous routes that connect major centers of population. These large cruisers remain airborne for very long periods so that they could be considered to be permanently cycling around their designated route. They would fly at an economical altitude and speed which would not vary substantially. Linking these cruisers to fixed bases near the population centers would be short range shuttle aircraft designed only to travel from the ground to the an interception with the cruiser and back again. The feeder airliners would be able to land on or dock with the cruiser for the transfer of passengers and freight, possibly via a kind of pallet system. New methods of air refueling would need to be safer and easer to handle than the current system and automation would be required. The design of the feeder aircraft would also need attention – possibly an advanced super quiet VSTOL aircraft with pre-loaded passenger containers.

Source: Flight Global and ACARE

More Ideas...

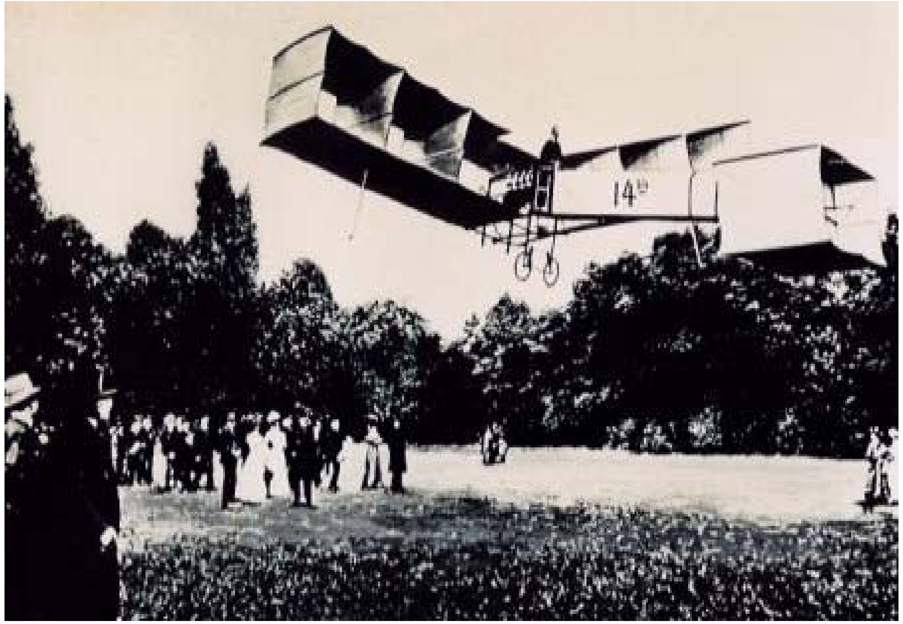
Ground-based power sources for take-off and landing



The objective here is to reduce the installed power and systems on the aircraft as a means to reduce weight and fuel consumption. For take-off, electrical, steam or magnetic devices using oil based, nuclear or solar energy sources could be used. Aircraft ramps, MAGLEV or catapults could be used, using supplementary rocket power. For landing aircraft weight could be reduced by eliminating the undercarriage with landings on water or on small cars using electro-magnetic fields to position the aircraft, para-foil landings etc.

Source: Flight Global and ACARE

Acknowledgement: Alberto Santos-Dumont



14*Bis* flew publicly in France in 1906.

Calassa’s replica flown sucessfully in Brazil in 2006

On the Web

http://www2.ita.br/~bmattos

Thank You!

Prof. Bento Silva de Mattos