

# **Leonardo 2 Industrial Plan Implications for Italian Regional Aircraft and Campania**

**The 2018 Regional Market Aircraft Status**

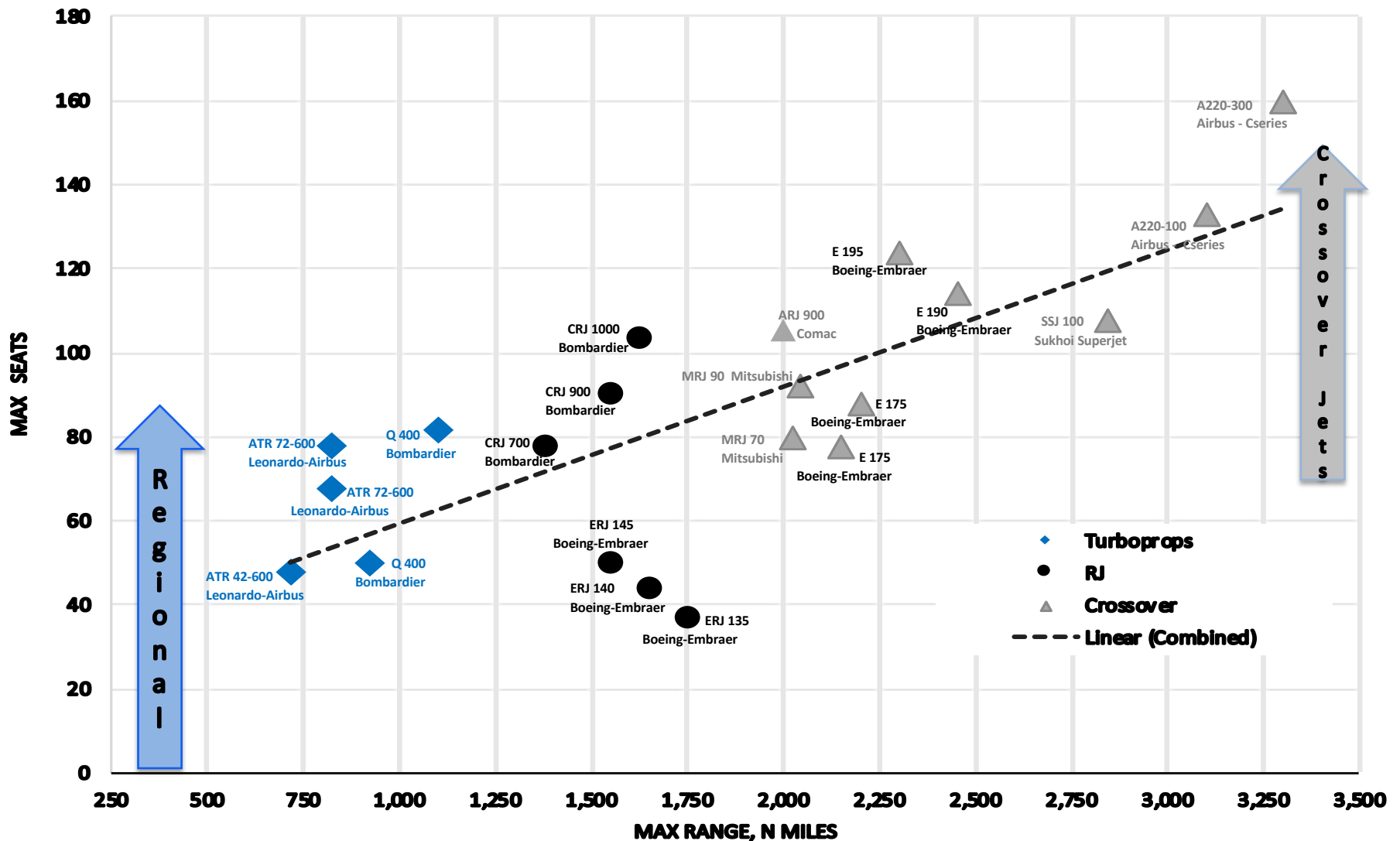
**Leonardo 2 abandons developing Next Generation ATR - 2018**

**More Electric Hybrid-electric Propulsion Regional Prop Vehicle(s)**

**The 2027-37 Regional Market: Aircraft**

**Leonardo 2; Long term Risk, Potential Losses**

# Turboprops, Regional Jets and Crossover Narrowbody Jets (70 to 150 seats) compose the 2018 Short-haul Regional Market



# Regional Jets Market Status: 2018 -2027

(Oliver Wyman GLOBAL FLEET & MRO MARKET FORECAST SUMMARY 2017-2027)

- **Regional jets** will play an interesting though less important role in the future fleets.

Operators, **up-sizing aircraft**, leaving smaller regional jet market.

**53% of 2027 RJ fleet will be New Generation (post 2000 designs)**

- **RJ's**, about **600 aircraft decrease** in fleet from **3,365 in 2017 to 3,181 in 2027 to 2,800 by 2027**, representing an average annual shrinkage rate of **-1.9%**.
- **Boeing-Embraer E-jet and E-jet E2 families will dominate** regional jet delivery schedule over the next decade with **920 deliveries**.

**Challenging Turboprops in larger markets**

- **Airbus C series**, A220-100 and -300 **successful**.
- **CRJ** order book falling dramatically.
- **Chinese-made ARJ-21** entered service, unlikely to draw orders outside China;
- **Mitsubishi MRJ** struggling.

# Turboprop Market: 2018 - 2027

(Oliver Wyman GLOBAL FLEET & MRO MARKET FORECAST SUMMARY 2017-2027)

- **Turboprops** fleet size **decline expected** from nearly **2,700** to about **2,200** aircraft in **2027**.

**Turboprops remaining niche player, losing head-to-head competition with RJs.**

**34% of 2027 TP fleet will be New Generation (post 2000 designs)**

- **Bombardier's Q Series**; uncompetitive, higher operating costs, deliver fewer aircraft next 10 years.
- **ATR** remaining niche player, fleet projected **average annual growth rate of 2.9%** (about 700 delivers) by **2027**.

**Leonardo 2 abandons developing 100 seat Next Generation ATR & technology, 2018**

**Extracting revenue from existing ATR models (2018- 2022).**

**Reinvesting into other Leonardo business.**

- **Next Generation Regional Aircraft Electrification emerging:**
  - More Electric Aircraft (MEA)**
  - Serial Hybrid Electric Prop-Propulsion Regional Vehicles**

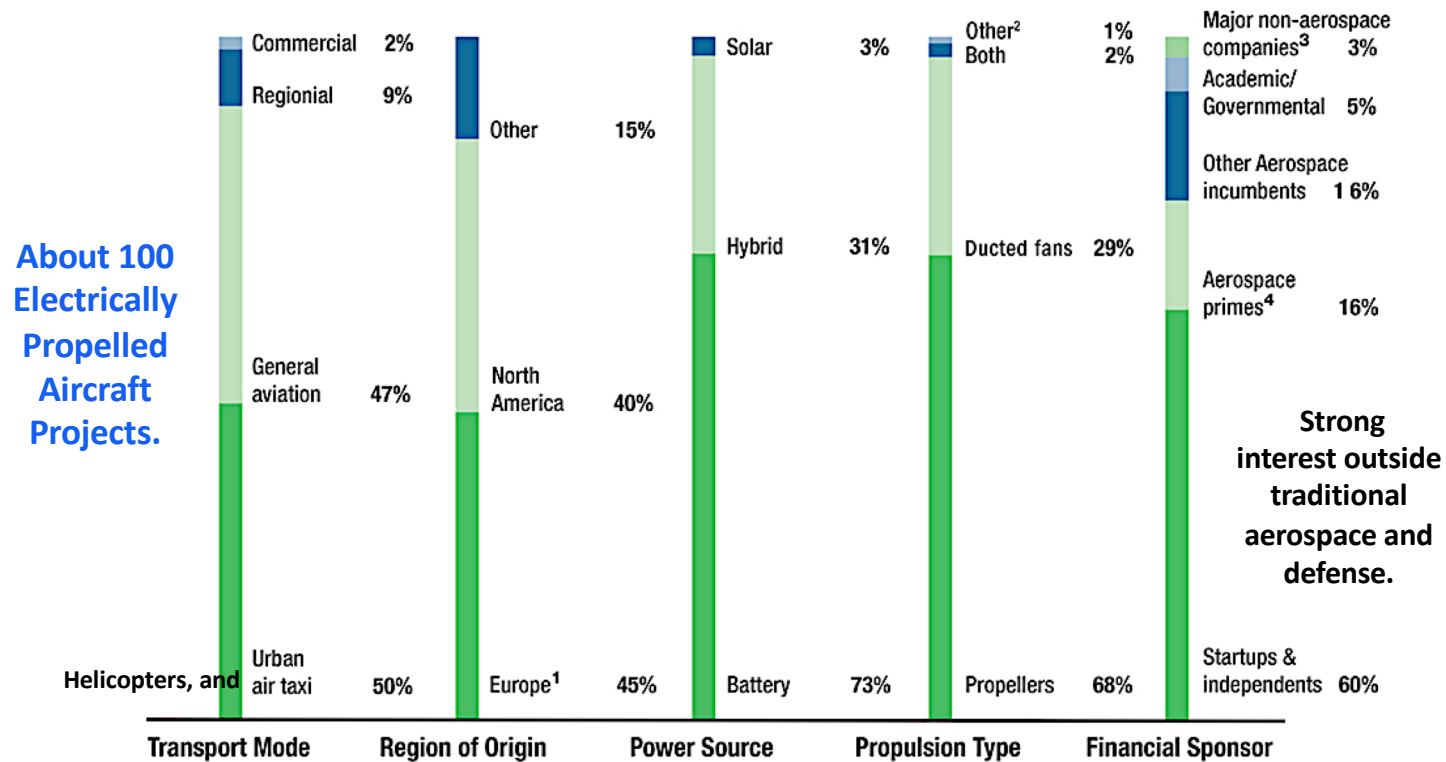


# A Disruption Technology Transition is Occurring

[http://aviationweek.com/future-aerospace/aerospace-sector-could-see-overhaul-electric-propulsion?utm\\_](http://aviationweek.com/future-aerospace/aerospace-sector-could-see-overhaul-electric-propulsion?utm_)

## Electrical Propulsion Projects as of May 2018

(First flights after 2010, excluding UAVs and purely recreational developments)



<sup>1</sup> Russia included in Other; <sup>2</sup> Thruster and fan; <sup>3</sup> Includes Kalashnikov, Siemens and Workhorse (public US company manufacturing electrically powered delivery and utility vehicles); <sup>4</sup> Includes Airbus, Cessna, Embraer and Boeing

# More Electric Hybrid-electric Propulsion Regional Prop Vehicles

- **The More Electric aircraft (MEA) vehicle systems utilize electric power for non-propulsive systems.**
  - Traditionally non-propulsive Vehicle Management Sub-systems are driven by a combination of different secondary power sources: such as hydraulic, pneumatic, mechanical and electrical.
- **Hybrid-electrical Propulsion concept**
  - Fuel burning engine drives a generator to produce electricity charging batteries and power the motor that drives a prop or ducted fan.
- **Integrated Hybrid Electrified Airplane**
  - “Small” gas turbine(s) to drive generator providing power for thrust and on-board functions: power electronics, fault-tolerant architecture, electro-hydrostatic actuators, flight control systems, high density electric motors, power generation, conversion systems, batteries, other hydraulic, pneumatic, mechanical subsystems.

**Propulsion may no longer be a Distinct System,  
separate from other power-consuming functions.**

# ATR 72-600 (2015/16) More/All-electric Systems Architecture 15 Hours Flight Test - Europe's Clean Sky Research Effort.



**Liebherr hybrid electro-pneumatic bleed-air systems for the A330neo, Embraer E2, and all-electric trials A320 and ATR test aircraft bleedless systems**



Alessandro Amendola  
ATR Senior Vice President Engineering

**Leonardo lead with Liebherr (for pressurization) and Thales (for the electric generator).**



**Often more efficient to generate pressurized air using an electric motor-driven compressor.**

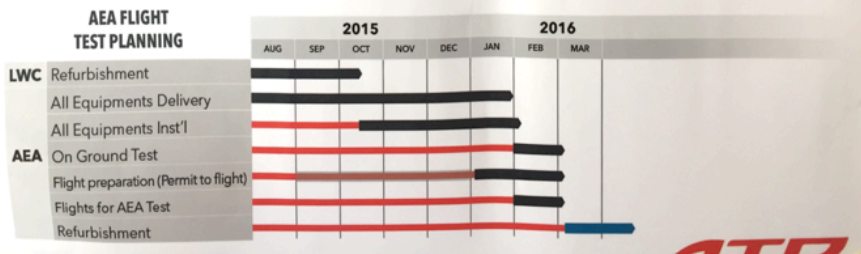
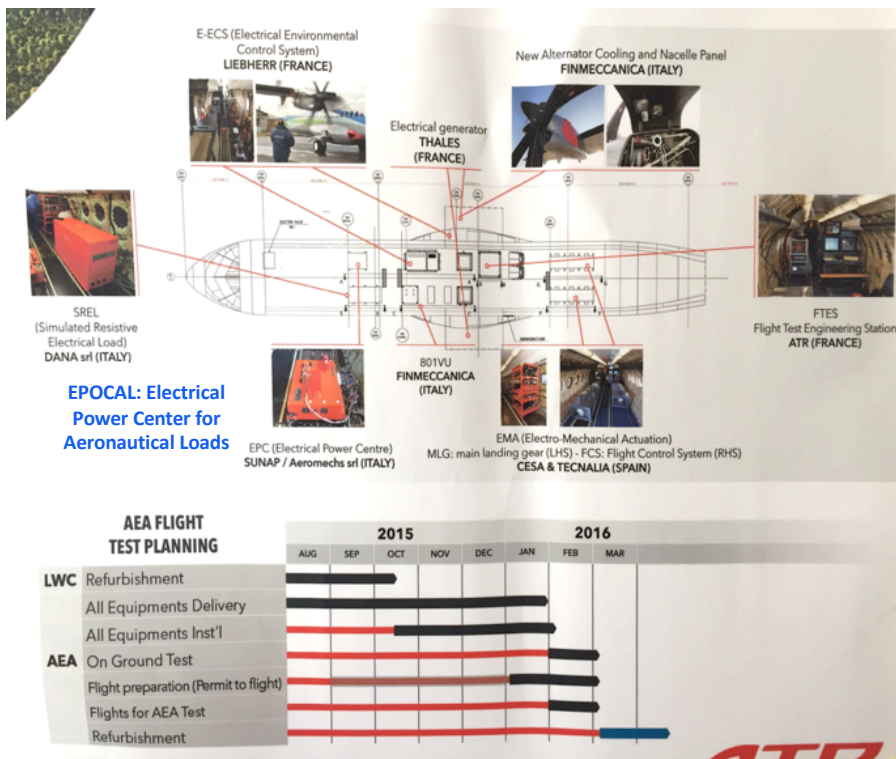
**Strong Italian Innovation Leadership. Preparing Leonardo and ATR for Next Generation Regional Aircraft.**

**The B787 & A350 are More Electric Aircraft  
HYBRID-ELECTRIC PROPULSION aircraft use More Electric Aircraft Technology**

# Suppliers and Video URL

## Europe's Clean Sky Research Effort

### ATR 72-600 (2015/16) More/All-electric Systems Architecture



**Strong Italian Innovation Leadership.  
Preparing Leonardo and ATR for Next  
Generation Regional Aircraft.  
(No Follow-up)**

# Will Aviation be Electrified?

(AvWeek & Space technology/August 20-Sept2, 2018, pps. 46-49)

- **The answer among industry executives is an overwhelming “Yes,” but in different ways, on different time frames, in different markets.**
  - Hybrid-electric propulsion looks viable in regional market
  - Megawatt-class electric technology could have wider use
  - Electrification is expected to affect all classes of aircraft
- **Mike Mekhiche**, global head of Rolls-Royce’s electric team.

“For us, electrification is real. In our mind, regional- and business-jet type of aircraft [flying 300-1,000 nm and carrying 1-4 or 20-100 passengers] represent the first opportunity to implement hybrid-electric propulsion systems,”
- **Rudiger Thomas**, hybrid-electric technology roadmap owner in the Airbus Corporate Technology Office.

“Airbus believes in electrification,  
**E-Fan X is a technology demonstrator.**

“We will run electric propulsion with the turbo-generator batteries and switch between them.  
We will test ultra-high voltage, high-altitude operations.”



# Technology Demonstrators, 2018-2021+

Retrofitting existing platform(s) to develop and integrate more electric and hybrid-propulsion systems.  
(involves several OEMs)

## ATR 72-600 (2015/16) More/All-electric Systems Architecture

The Airbus battery-powered E-Fan aircraft, crossed Channel in 2015  
© Bloomberg



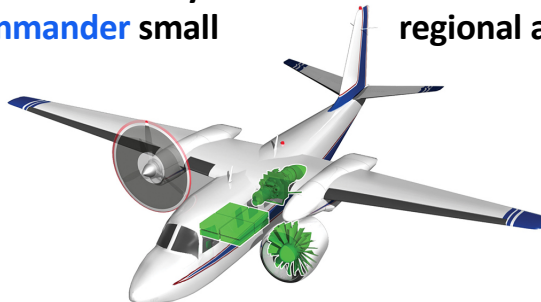
Flight demonstration Completed 2016.  
No follow-on.

NASA Pegasus Regional Hybrid-electrical Concept  
ATR 42-500 baseline  
X-57 electrification Technology



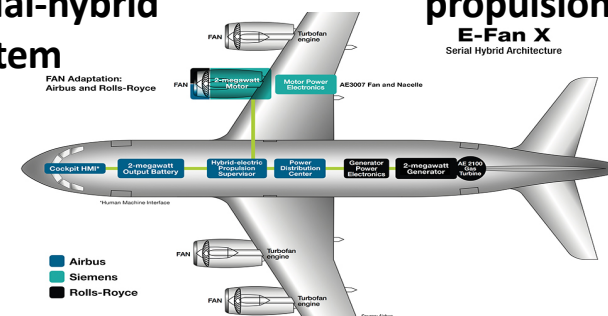
48-seater design, 600-nm concept range.  
parallel-hybrid electrification options. X-57  
(modified Tecnam P2006) Mod II Flight demonstration, Mid 2019

Zunum Aero's hybrid-electric Rockwell Turbo Commander small regional aircraft



Modified Safran Ardiden3 turboshaft engine coupled to Zunum selected electric generator. Bell providing hybrid-electric propulsion system. First flight 2020.

Airbus modified BAe 146 regional airliner, serial-hybrid propulsion system

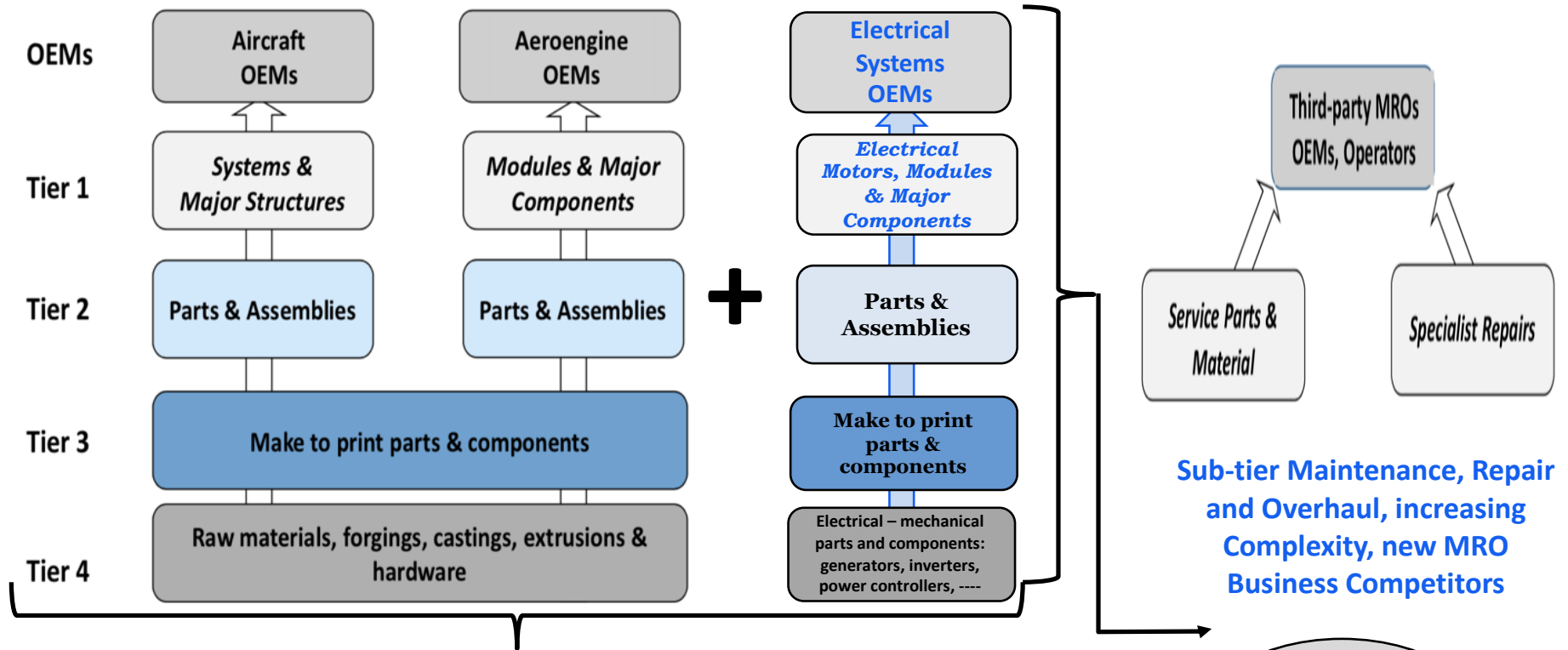


50-100-seat hybrid-electric regional aircraft  
Entry Into Service 2030+. First flight 2020

# Changing Aerospace Supply Chain Structure: 2020 - 2030

## More-electric and Hybrid-electric Prop Propulsion

### New OEMs & Repair and Maintenance of Electrical Subsystems



Sub-tier Maintenance, Repair and Overhaul, increasing Complexity, new MRO Business Competitors

Definitions of complete systems versus components changing Integration & MRO

3 Complex systems/Technologies

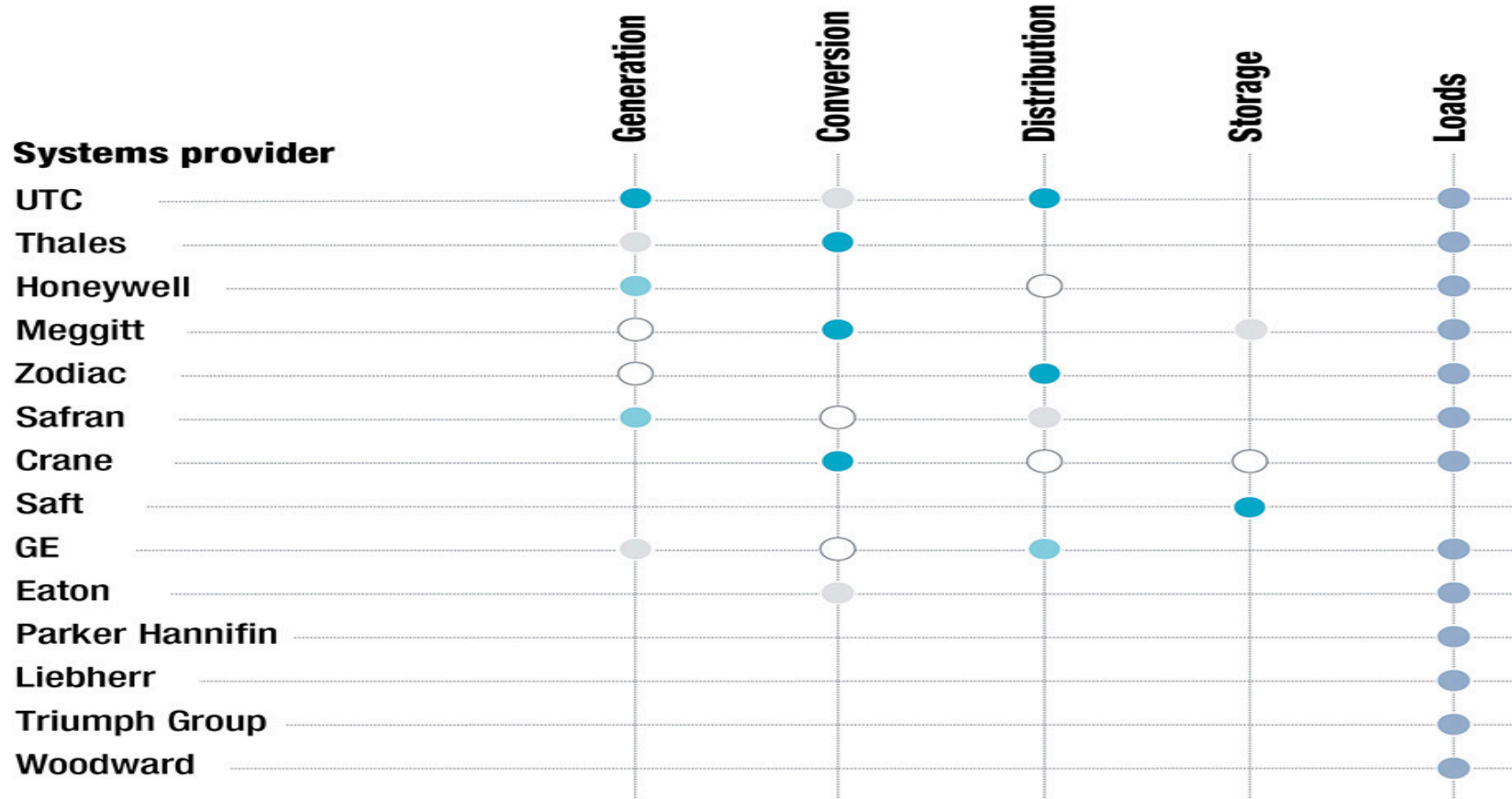
New System OEM?

Chief Integrator, Certification, and Support Requirements?

# Aircraft OEMs Collaborate With their Suppliers to Design New Systems and Implement New Electrical-intensive Architectures.

Top-tier suppliers don't Want to be Left Behind

How Will Italian Firms Participate In The Technology Transition?



Market shares (based on total estimated 2017-21 revenue):

- >20%
- >10% and <20%
- >1% and <10%
- >0% and <1%
- Tier 1 systems supplier
- No presence

Source: Roland Berger

## Electrical Systems OEM Candidates?

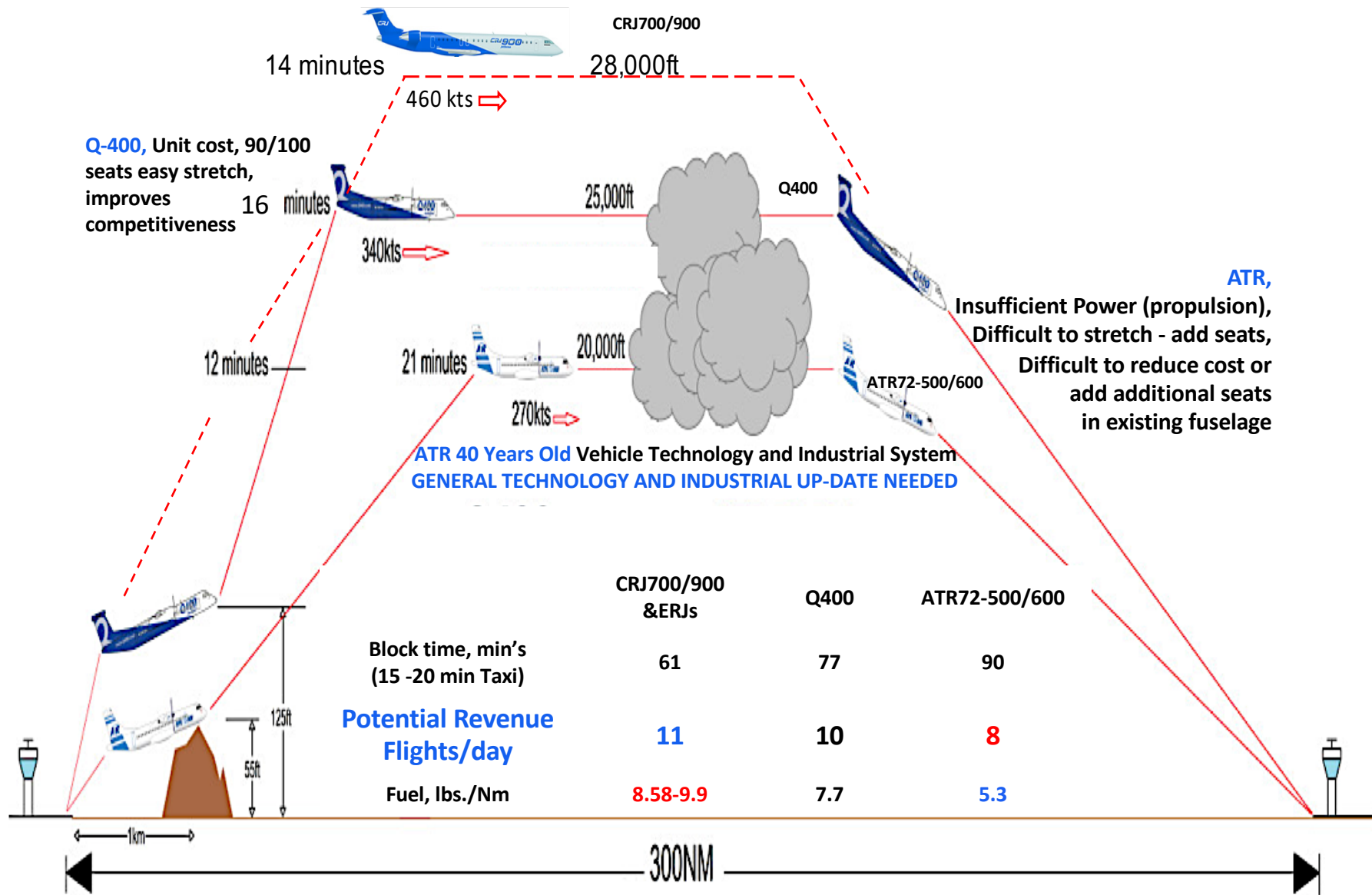


# Policy, Regulation and Technology Driving Transformation

- **Reduction of CO<sub>2</sub> per passenger kilometer**
  - Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA developed by the International Civil Aviation Organization (ICAO)  
and
  - Clean Sky technology objectives
    - “The EU’s Flight path 2050 program calls for a 75 per cent reduction in carbon emissions per passenger kilometer by 2050. But without electric technology those targets will be missed. You can argue that aviation can make up the gap by carbon trading . . . but that is just pushing the problem off somewhere else.”  
Ric Parker, Clean Sky chairman
- **Airline perspectives;**
  - “We see electric aviation as a matter of when it will happen, not if,”  
Chris Essex, EasyJet head of fleet procurement
  - EasyJet advising Seattle-based start-up Wright Electric on plan for an electric aircraft seating about 120 passengers. Israel’s Eviation also pursuing all-electric nine-seater fling routes of up to 650 miles by 2021.

# Relative RJ and TP Design Performance for a Notional City Pair

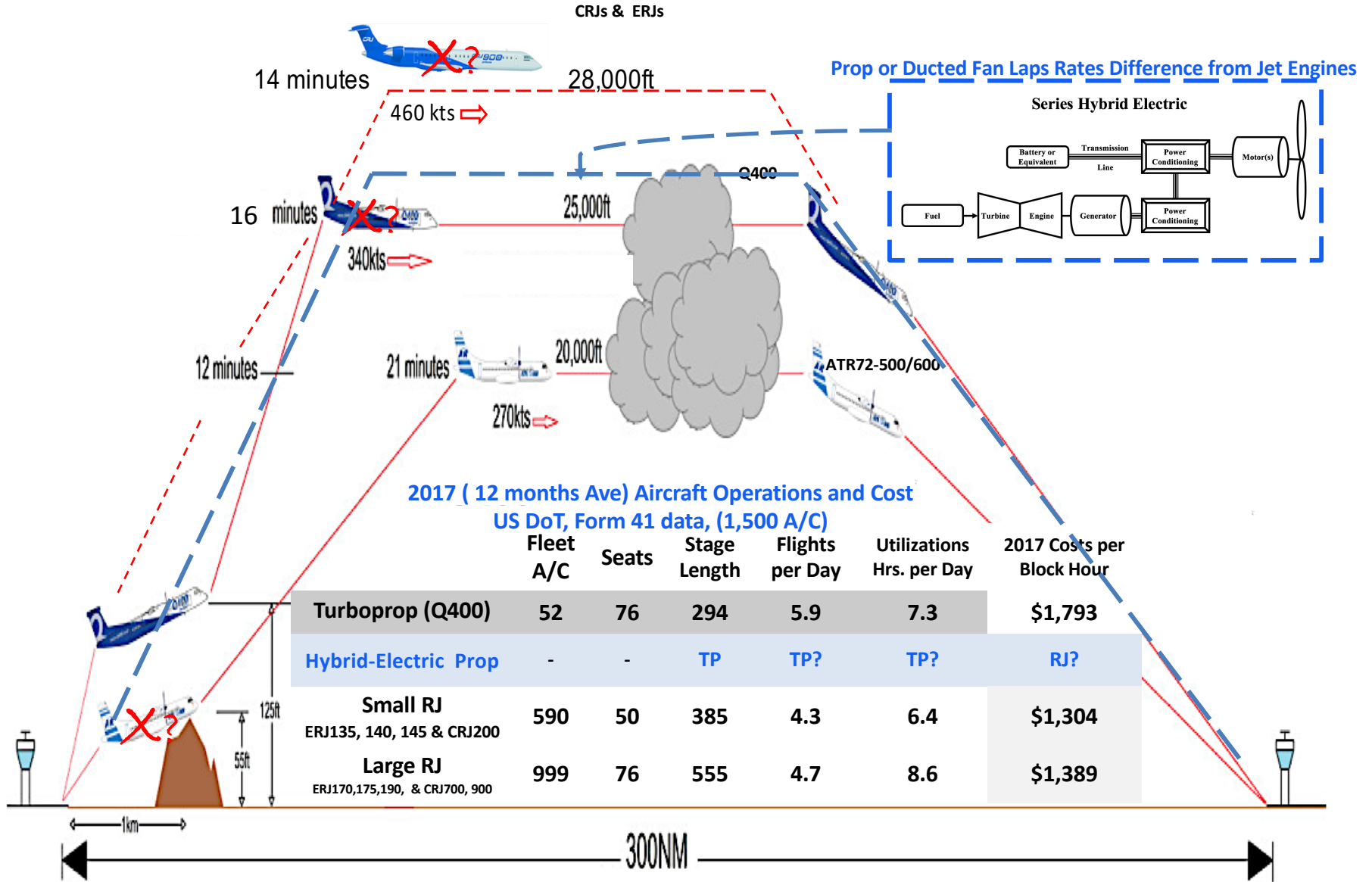
## Different TP Strategies; Minimum Fuel vs Revenue per Day (unit cost).



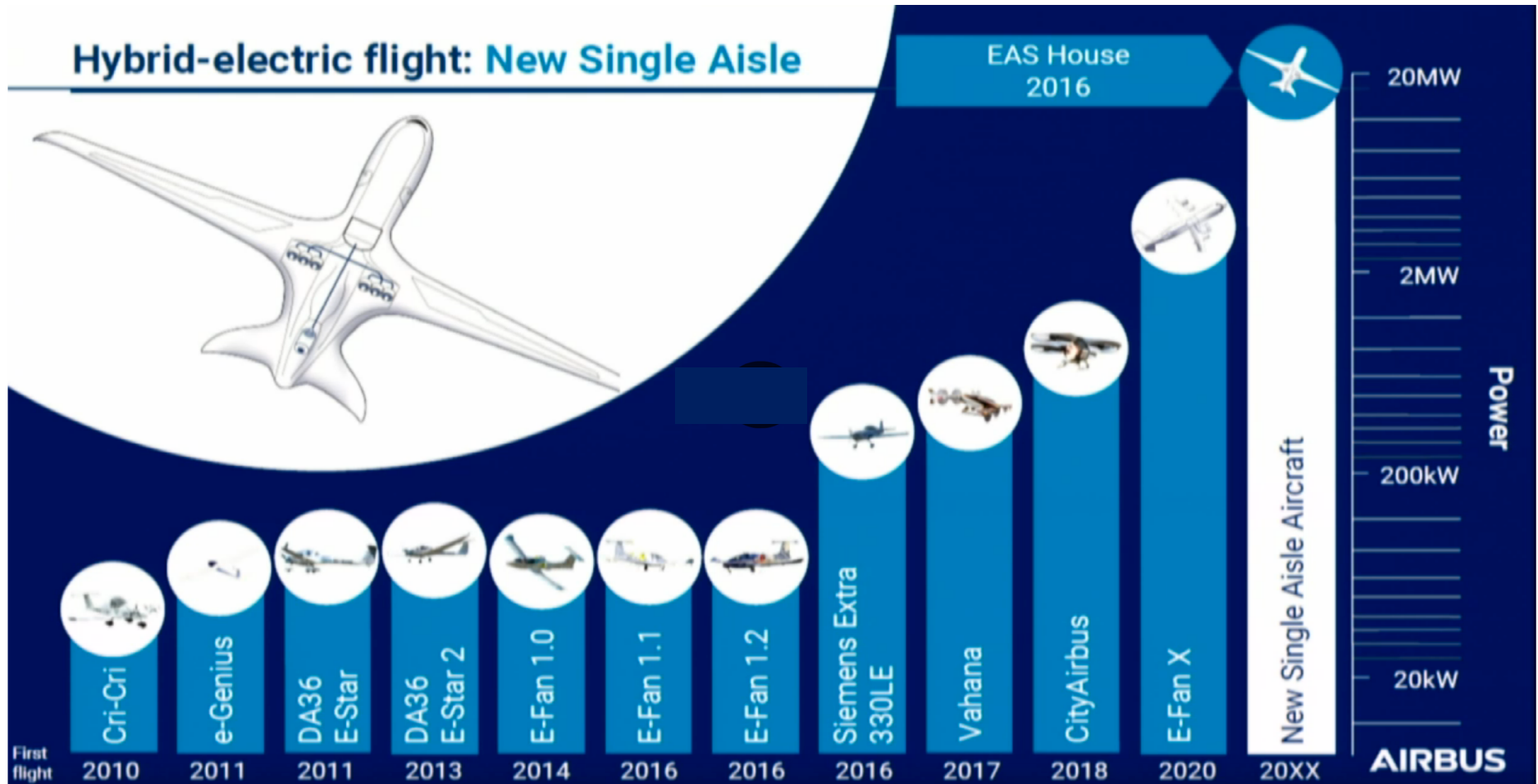
# Next Generation Electrification Design Optimization?

## Relative Hybrid-Electrified Regional Prop Performance vs Vintage RJs and TPs

### RJs converted to Prop or Ducted Fans



# Potential New Technology Option: 90+ passenger Regional jet: similar ATR72-600 performance?



**JOINTLY FUNDED** by **Siemens** supplying the electric motor and its power electronics; **Rolls-Royce** contributing the gas turbine, integrated electrical generator and its power electronics; and **Airbus** providing the power distribution, battery and control systems. **Airbus** will be the overall integrator.

# 2018-22 Leonardo 2 industrial Plan

Abandoned NGTP (ATR900 series)

Retain ATR600 series

Diverted Funding to AW609

AW609 VITOL Tiltrotor Prototype No 3



- **Troubled Development History**
  - 1996 start
  - 6-9 passengers
  - **Legacy Technology**
  - 1999 First flight
  - 2019 Certification expected, **20 years after first flight**
  - EIS expected 2020 or 2021
- **Approximately €500m+ Development Cost. 2016 to 2020**

Next-Generation Leonardo Tiltrotor



- **Technology Demonstrator**
  - Clean Sky 2
  - 20 passenger
  - **Refine Legacy technology;** Rotate Engines vs Wing box
  - Electrification, TBD?
  - 2021 Initial First Flt
  - 2023 First Flt. Goal
- **2030-35 Potential EIS Target?**

**Managing Director (2017) Gian Piero Cutillo says that Leonardo Helicopters needs to sell "quite significant numbers of units" in order to break even on the program. Daniele Romiti (Leonardo Helicopters 2016 CEO) "We have never said we would sell [the AW609] in large numbers,"**

# Production Decisions: New Platform and Systems

- Production partner(s) decision for new Regional Serial Hybrid Electric Propulsion Vehicles, **2021-2023**

- Two program options:

- 3 OEMs partnering for New Generation Electrified Vehicles program**

or

- Traditional 2 OEM program - Vintage Turboprop and RJs**

- Potential Next Generation Product Program Organizations

- NEW Airbus Hybrid-electric Regional Prop with electrification partner(s) (Toulouse, FR)

- Boeing with Zunum and Embraer as partners (US & ?)

- **Leonardo-Airbus for Vintage ATR's (Toulouse, FR),**

or

- **Separate Leonardo-Airbus program Office for Vintage ATR's.**

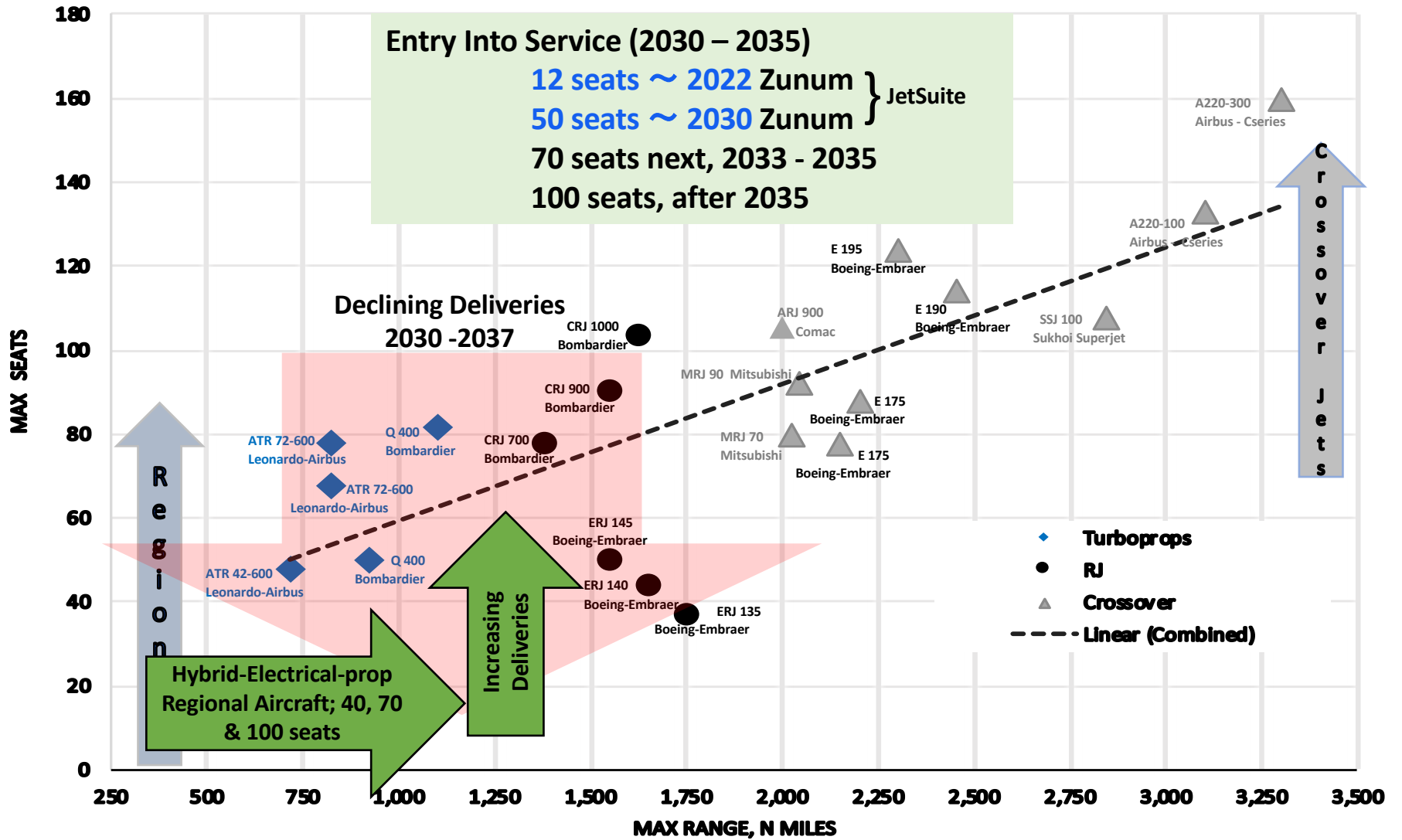
- Declining vintage ATR production about (2033-2035)**

- Relocate Production Northern Italy (Turin Caselle plant?)**

- (Pomigliano d'Arco, Nola and Pomigliano d'Arco Design Office?)**

**Italy's and Campania industrial base will be disrupted.**

# The 2027-37 Regional Aircraft Market: Beginning of the Electric Era in Aviation, a Paradigm Change.





# Summary

- **Short-haul Regional fleets – In Transition**
- **Leonardo 2 abandoned developing Next Generation ATR & technology**
  - Extracting revenue from existing ATR models (2018- 2022).
  - Reinvesting into other Leonardo business, Tiltrotor Focus.
- **NEW Airbus Program Office for Electrified Regional Vehicles**
  - Without Leonardo?
    - Toulouse, FR
  - Competing with legacy ATR (declining market)?
- **Not a Sustainable Longer Term Leonardo Business or Financial Strategy.**

**Go-out-of-business strategy for the  
Legacy Leonardo Reginal Civil Aircraft business sector?**

**If Leonardo Doesn't Invest in Modernizing the ATR,  
the ATR will Slowly Disappear from the Market  
as Consequence of Technological Transition**

**Companies NEED Senior Technical Leadership (+ people)  
and  
Innovation Projects to REMAIN COMPETITIVE.**



# Grazie e Forza Napoli

