



ASTRID - aircraft on board systems sizing and trade-off analysis in initial design

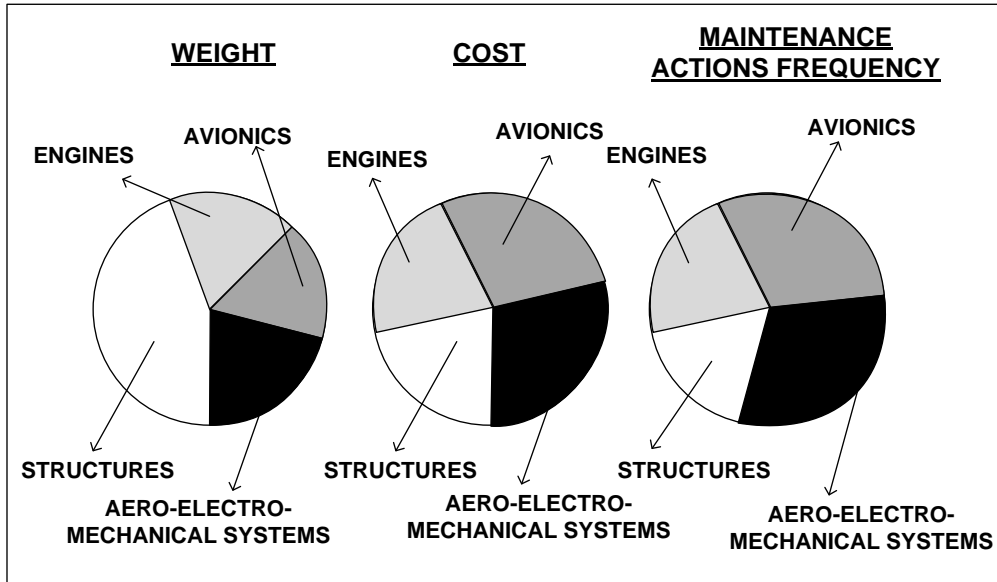
Marco Fioriti, Luca Boggero

marco.fioriti@polito.it , luca.boggero@polito.it



**POLITECNICO
DI TORINO**

The On-board systems should be designed starting from the conceptual design

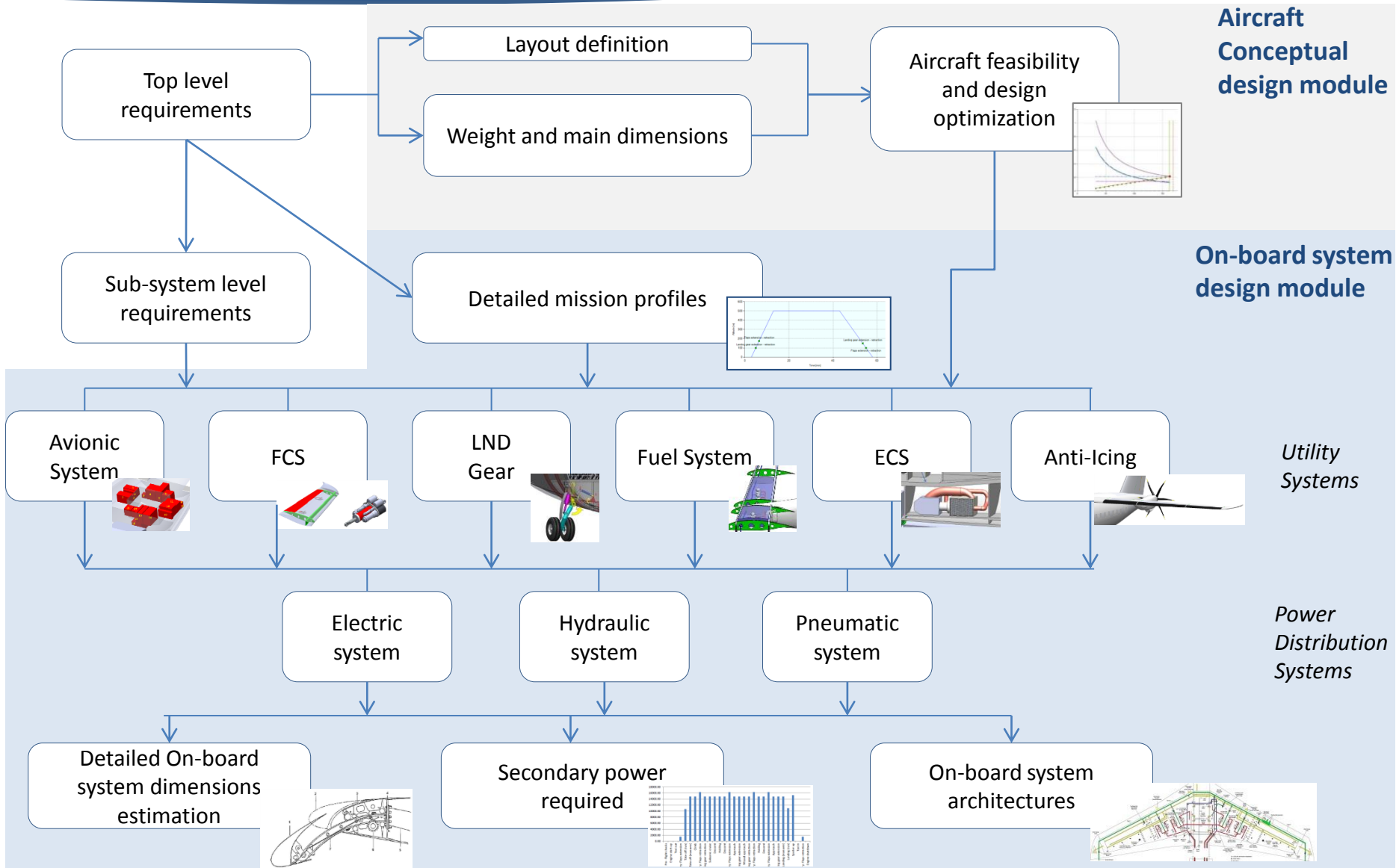


Figures for military aircraft

Aircraft On-board systems represent:

- 15% (regional transport) ÷ 30% (fighter) of aircraft empty weight
- 30% ÷ 50% of aircraft cost

ATA 21	AIR CONDITIONING AND PRESSURIZATION
ATA 22	AUTO FLIGHT
ATA 23	COMMUNICATIONS
ATA 24	ELECTRICAL POWER
ATA 25	EQUIPMENT/FURNISHINGS
ATA 26	FIRE PROTECTION
ATA 27	FLIGHT CONTROLS
ATA 28	FUEL
ATA 29	HYDRAULIC POWER
ATA 30	ICE AND RAIN PROTECTION
ATA 31	INDICATING / RECORDING SYSTEM
ATA 32	LANDING GEAR
ATA 33	LIGHTS
ATA 34	NAVIGATION
ATA 35	OXYGEN
ATA 36	PNEUMATIC
ATA 37	VACUUM
ATA 38	WATER/WASTE
ATA 39	ELECTRICAL - ELECTRONIC PANELS AND MULTIPURPOSE COMPONENTS
ATA 40	MULTISYSTEM
ATA 41	WATER BALLAST
ATA 42	INTEGRATED MODULAR AVIONICS
ATA 44	CABIN SYSTEMS
ATA 45	DIAGNOSTIC AND MAINTENANCE SYSTEM
ATA 46	INFORMATION SYSTEMS
ATA 47	NITROGEN GENERATION SYSTEM
ATA 48	IN FLIGHT FUEL DISPENSING
ATA 49	AIRBORNE AUXILIARY POWER
ATA 50	CARGO AND ACCESSORY COMPARTMENTS

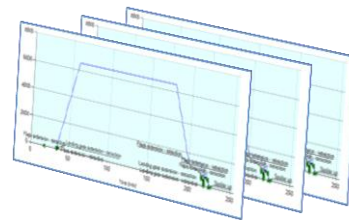


1° approach (only for avionics)

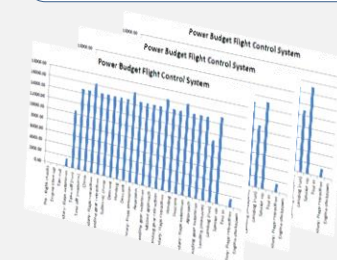
Selection from database



Equipment utilization within the mission profile

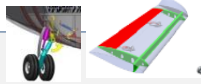


Power budget
Mass budget



2° approach (for all other systems)

Users definition



Main equipment design



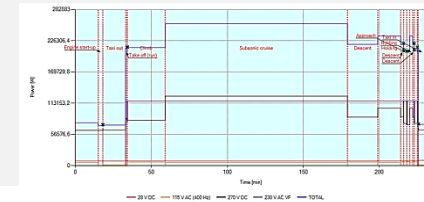
When is it used?

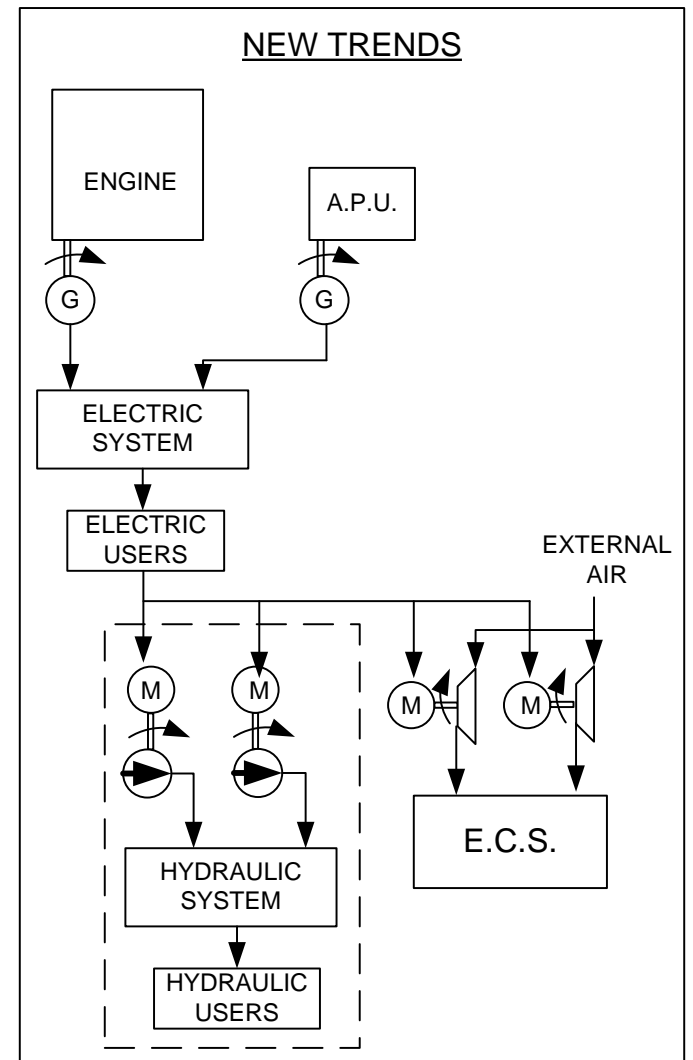
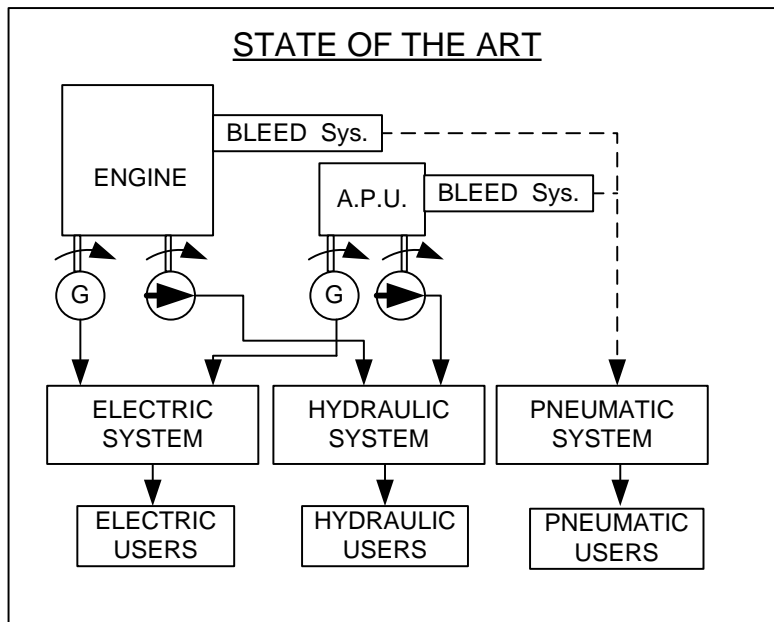
Main equipment definition

Total power required

Global power required to the engine

Design of power distribution systems





New trends:

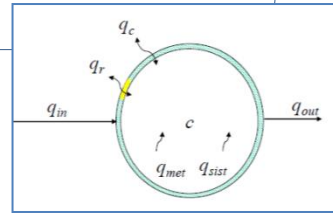
- All On-board power is electrical
- To power pneumatic and hydraulic users, electric motor driven hydraulic pump and air compressor are necessary
- Replace FCS and LNDG hydraulic actuators with electric ones
- New electric standards (230 VAC, 270 VDC)

INPUT

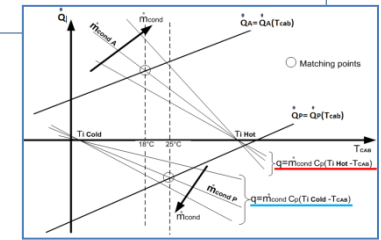
- Fuselage wet area
- Windows area
- Fuselage material
- External air temperature
- Aircraft N.Mach
- Air density
- N. passengers and crew
- Avionics power required

Thermal loads estimation

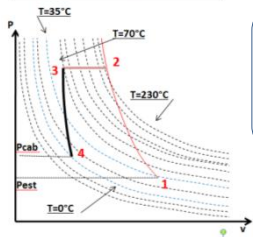
- Heat flow through the fuselage
- Solar heating
- Physiological heating
- Cabin equipment heating



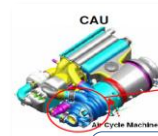
Conditioning Airflow estimation



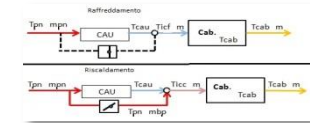
Z=0, Test=35°C, Tbleed=200°C



Bleed from the engine



Air cycle

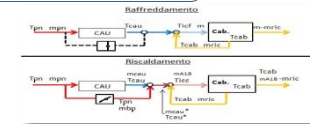
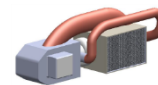


CAU no Sub-freezing

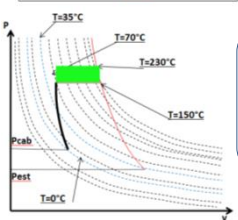
Airflow, cau weight,
n. cau redundancy,
minimum airflow

Vapour cycle

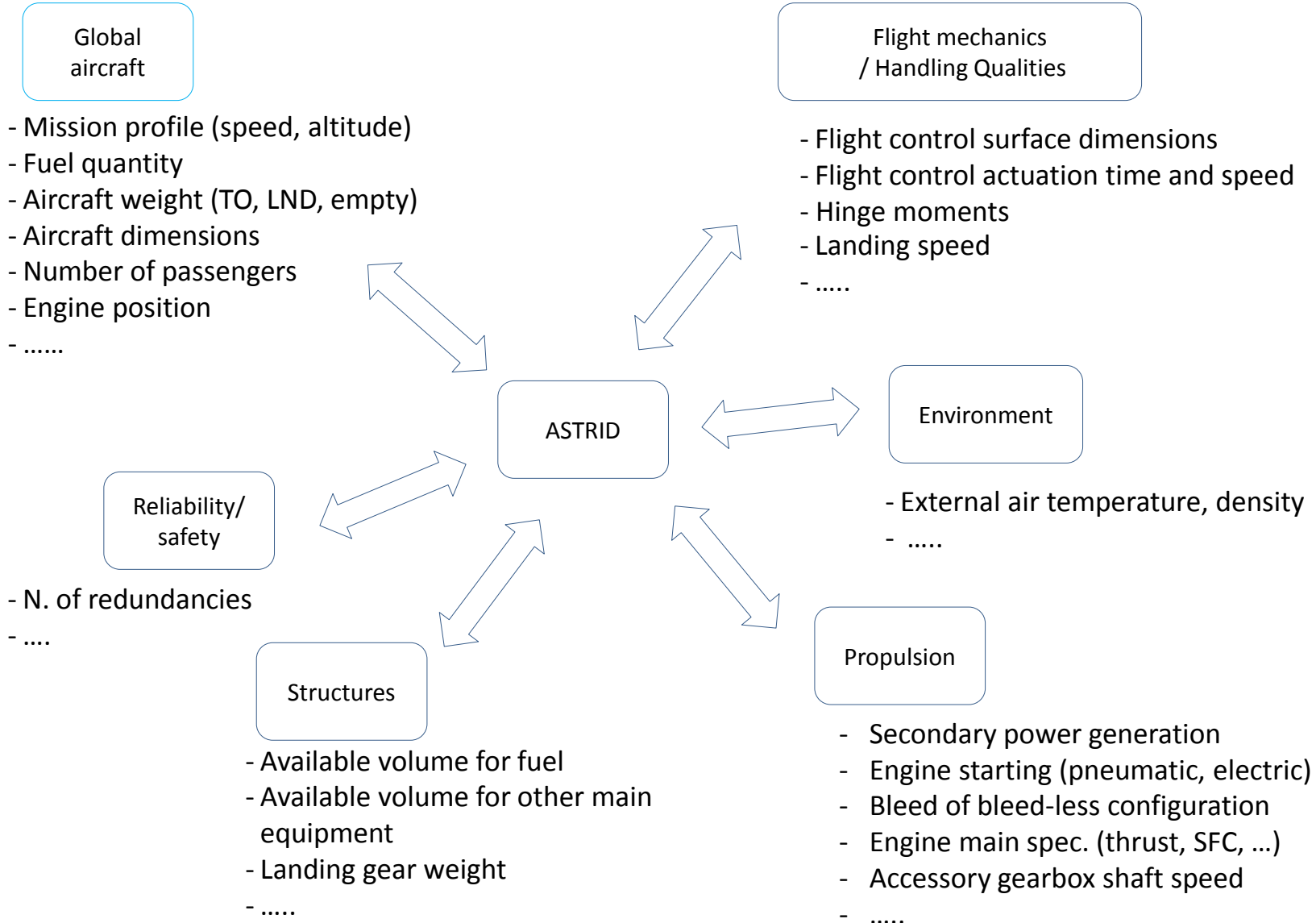
CAU Sub-freezing



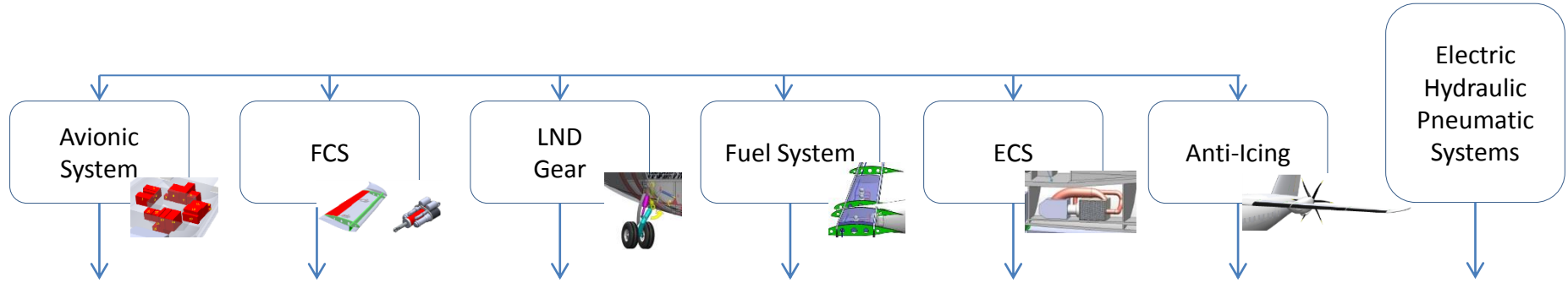
Z=0, Test=35°C, Tcomp=150°C



Dedicated compressors



ASTRID output



- Navigation eq. (dimensions, weight, power)
- Flight ctrl eq. (dimensions, weight, power)
- Comm eq. (dimensions, weight, power)
- Equipment list
- Redundancy
- Electric voltage

- N. actuators
- Redundancy
- Actuators (dimensions, weight, power)
- Electric voltage
- Hydraulic pressure

- N. actuators
- Redundancy
- Retraction, steering, breaking Actuators (dimensions, weight, power)
- Electric voltage
- Hydraulic pressure

- N. feed, transfer pumps (dimensions, weight, power)
- Redundancy
- Pressure drops
- Fuel pipes diameter
- Tanks configuration
- Electric voltage

- CAU design (typology, dimensions, weight, power)
- Redundancy
- Electric voltage/ pneumatic pressure

- Anti-ice design (typology, dimensions)
- Electric power/ pneumatic airflow required

- Generator/power converter (typology, dimensions, weight, voltage)
- Hydraulic pumps (typology, dimensions, weight, pressure)
- Pneumatic air flow



Thank you for your attention