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Present and Future aircraft technologies to reduce CO2 emissions

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Towards aviation decarbonization

Air transport system will take its part in the mitigation of climate change: industry is preparing for the future through unprecedented efforts in research and innovation towards aviation decarbonization.
Synchronized launch of ambitious R&T programs / national / European levels

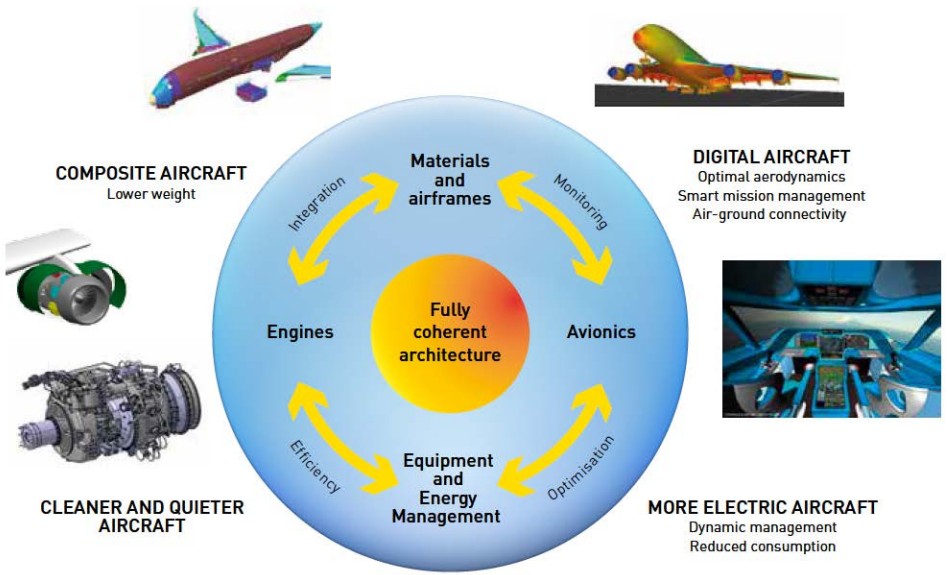
- Improve energy efficiency of air transport (aircrafts and operations)
- Use of alternate energies:

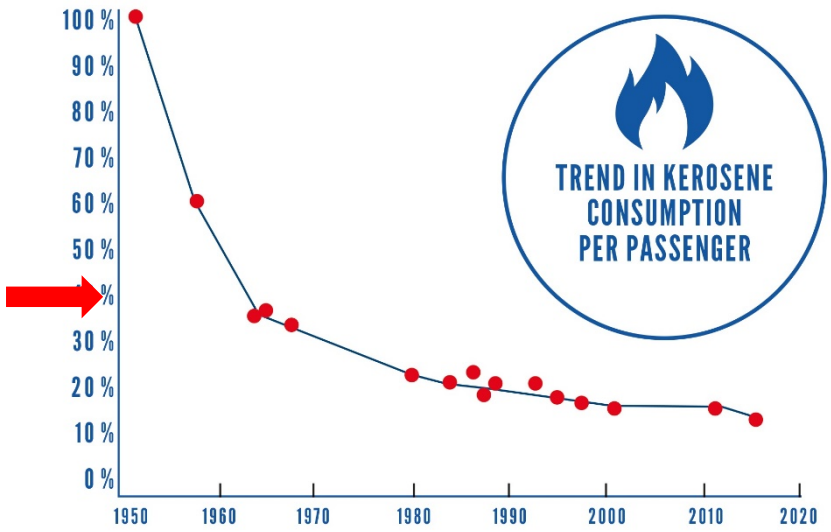
« Drop in » / classical aircraft design: Replacement of fossil fuels by biofuels or synthetic fuel (Power to liquid)

« Non Drop in » / non conventional –disruptive aircraft design:

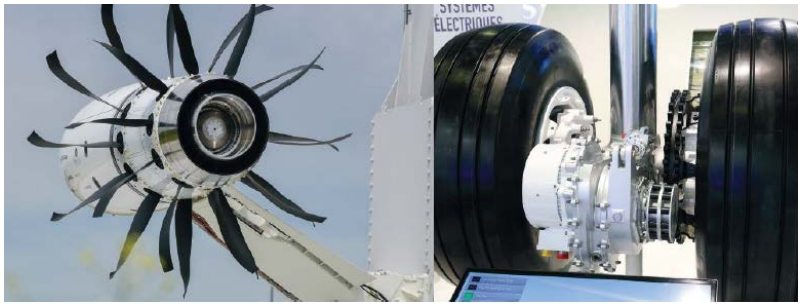
- ❑ Development of electrical/hybrid aircrafts
- ❑ Cryogenic energies (hydrogen, natural gas)

Improve energy efficiency: a continuous pathway





- Continue and increase the innovation effort
- Replace old aircraft with new models whose fuel consumption per passenger and per kilometre has been reduced **fivefold over 60 years** (15 to 20% less fuel consumption between 2 consecutive aircraft generations)
- Improve Air Traffic Management (continuous descent, more direct flights, etc.)



Open rotor, green taxiing : innovations for reduction of fuel consumption

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Alternate Energies

Electrical/ Hybrid aircrafts

DESIGNING HYBRID/ELECTRIC PROPULSION AIRCRAFT:

Optimize performances (gain in mass, fuel)

Get more robust architectures / less maintenance

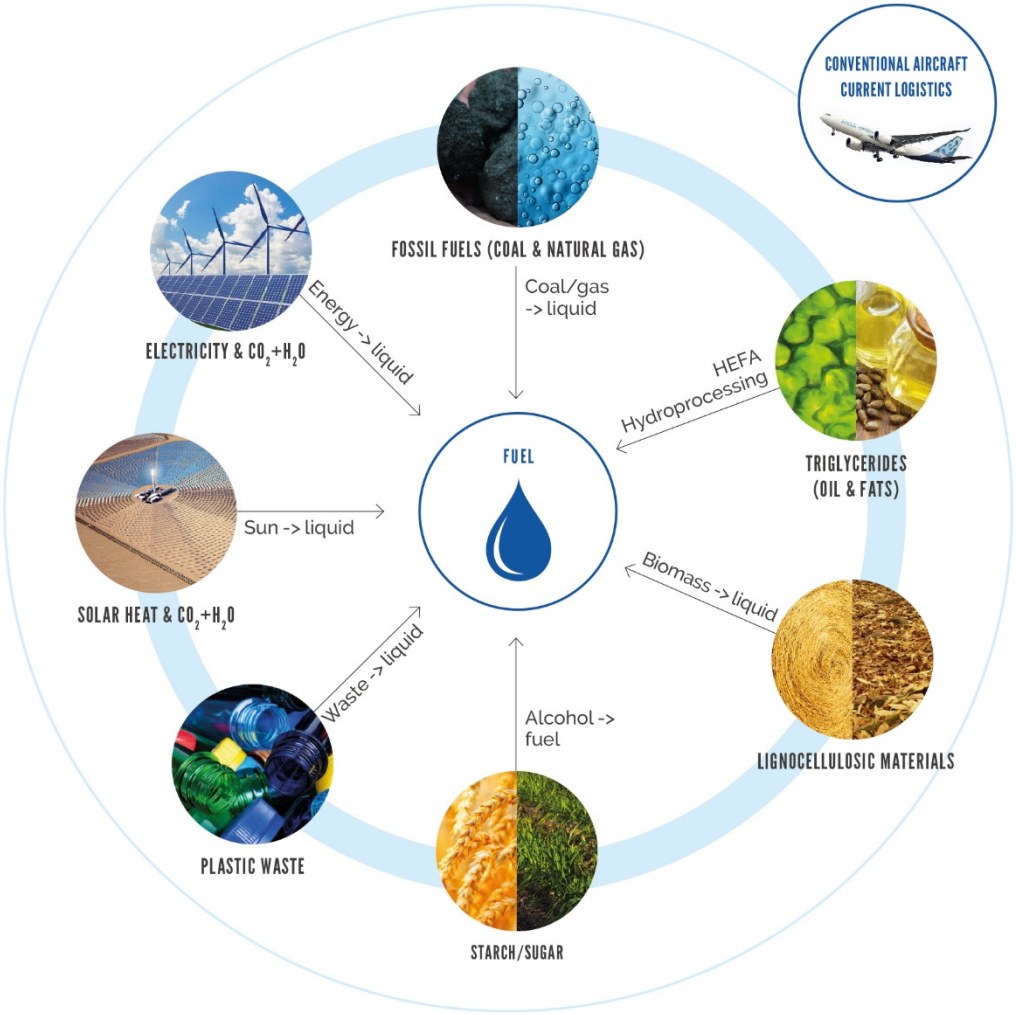
Develop new uses (flying taxis, drones) and leisure aviation.

But technological barriers for carbon-free aircraft >50 seats have to be considered (performance /weight of batteries, managing high voltage / high power on board)

Ottawan/EcoPulse project hybrid plane (Daher, Safran, Airbus)

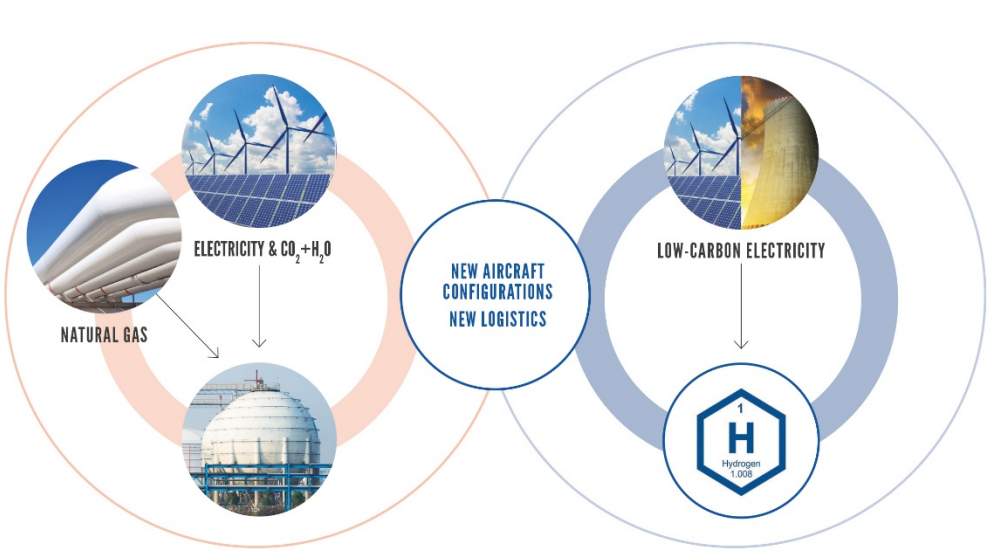
Ampere Project: ONERA concept of distributed electric propulsion aircraft

Alternate Energies
Sustainable biofuels



Several processes have been studied in association with engine and aircraft manufacturers to ensure compatibility and safety
These processes do not require changes in aircraft/engine configuration ("**drop-in**")

Alternate Energies
Cryogenic fuels



Cryogenic fuels (very low temperatures to remain liquid) : natural gas (methane) or hydrogen. "Non drop-in" solutions : need new aircraft configurations

- The combustion of **natural gas** reduces CO_2 emissions at the engine outlet by more than 20% and generates only low pollutant emissions (e.g. particulate matter).
- **Liquid hydrogen** is an attractive alternative because its combustion does not emit any CO_2 at the outlet side of the turbine. Its energy density per unit of mass is also three times higher than that of hydrocarbons.

Technological / operational barriers :

- development and deployment of storage, transport and distribution solutions (ground and on-board).
- Safety requirements, which imply new design rules based on practices in the space sector or chemical industry.

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THANK YOU