



ULTRA-EFFICIENT AIRCRAFT AND PROPULSION ARCHITECTURES FOR LOW-EMISSION SHORT/MEDIUM RANGE [SMR] AIRCRAFT

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Clean Aviation Joint Undertaking

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2022
SWEDEN 



CLEAN AVIATION

SHORT MEDIUM RANGE AIRCRAFT



**Co-funded by
the European Union**

TOWARDS CLIMATE NEUTRAL AVIATION

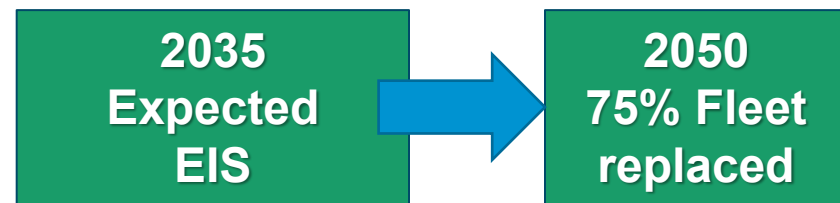
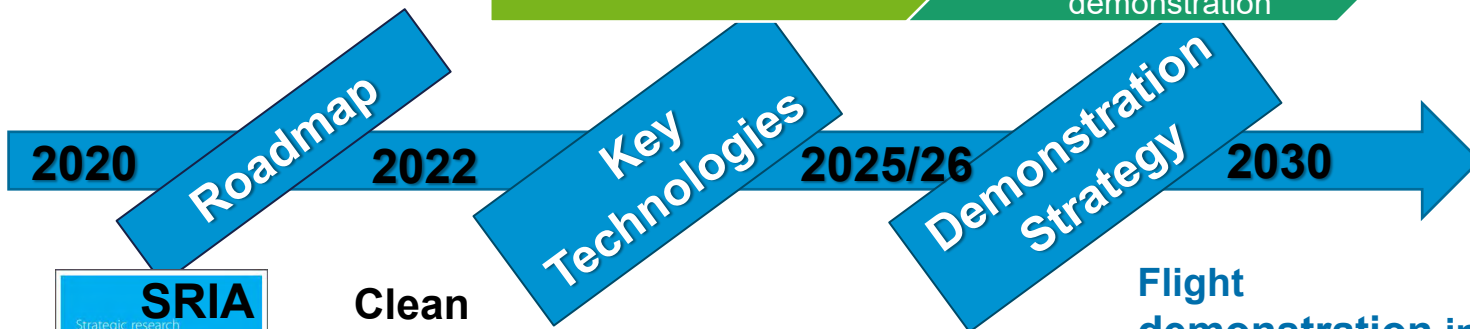
A European Green Deal

Striving to be the first climate-neutral continent



The ambition of the Clean Aviation Partnership is to ensure that advances in breakthrough technologies will allow new aircraft developments by 2030

CLEAN AVIATION THREE THRUSTS



Clean Aviation First Call Launch

Flight demonstration in Clean Aviation and Impact by 2035



IMPROVE NO LESS
THAN
30%
ENERGY
EFFICIENCY
ON A TYPICAL
MISSION
COMPARED
TO 2020
STATE-OF-
THE-ART

ULTRA-EFFICIENT AIRCRAFT

Low Emission **Short / Medium Range** Commercial Aircraft:

- Segment Capacity: from 100 up to 250 seats
- Up to 3700km range



2/3 of
global
emissions
from
flights
<4000km

Ultra-Efficient Concepts based on drop-in fuel:

- Essential for the **transition** to low/zero emission energy sources (synthetic fuels and non-drop in fuels such as hydrogen).
- Target to improve no less than **30% energy efficiency at aircraft level**, with at least 20% fuel burn reduction
- **EIS 2035** and **75% Fleet replaced by 2050**
- Aligned **Innovation Architecture** and **strong links throughout the innovation chain** from academia and research organizations via SMEs to large industrial enterprises.

The roadmap also includes to consider the **demonstration of a more disruptive concepts using hydrogen**, linked to the Clean Aviation technologies to enable Hydrogen-powered aircraft, with at least 15% reduction target in aircraft energy demand.

SHORT MEDIUM RANGE (SMR) CHALLENGES

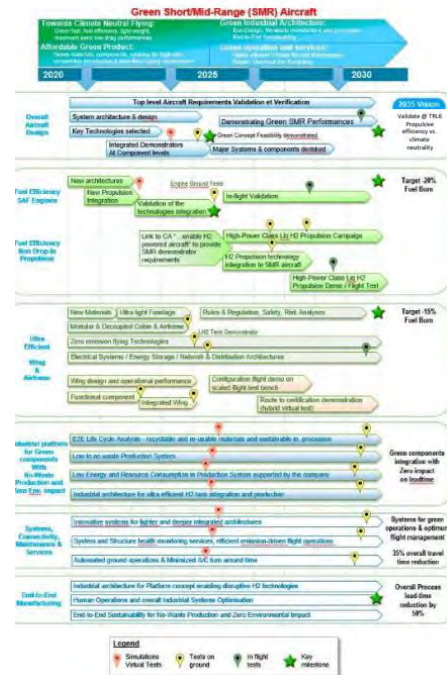
AMBITION

Flight Demonstration
in 2030

Entry Into Service
2035

75% Fleet in 2050

Overall Aircraft Concept
+
Greener Industrial Backbone
+
Novel Certification Methods



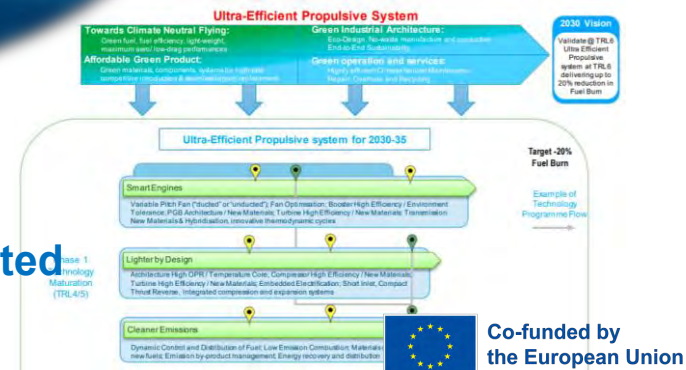
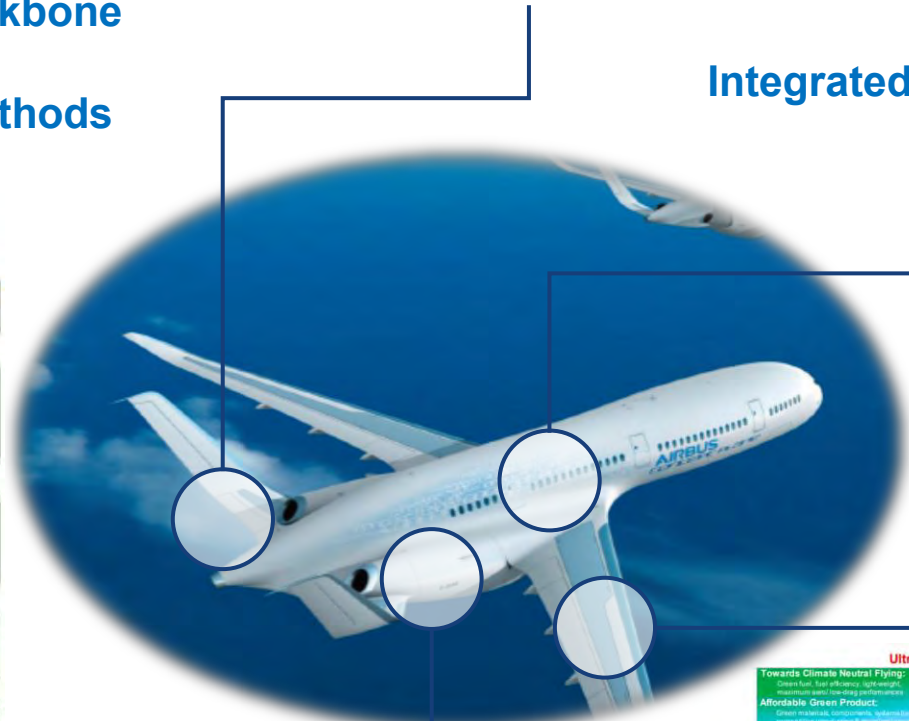
SRIA:
Strategic Research and Innovation Agenda

Ultra efficient Empennage

Integrated Airframe Fuselage

Ultra efficient Wing

Efficient Integrated Propulsion





- Ultra-efficient SMR
- H₂ Enabled Aircraft
- Hybrid-Electric REG

CALL 1 Launched Q1-2022

| Identification Code | Topic ID | Title | Max Number of projects selected for funding | Ind. Value (Funding in M€) |
|-------------------------------------|----------|---|---|----------------------------|
| Hydrogen Powered Aircraft | HPA-01 | Direct Combustion of Hydrogen in Aero-engines | 2 | 115 |
| | HPA-02 | Multi-MW Fuel Cell Propulsion System for Hydrogen-Powered Aircraft | 2 | 50 |
| | HPA-03 | Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions | 1 | 10 |
| | HPA-04 | Near Term Disruptive Technologies for Hydrogen-Powered Aircraft | 2 | 7 |
| Hybrid Electric Regional | HER-01 | Multi-MW Hybrid-Electric Propulsion System for Regional Aircraft | 2 | 75 |
| | HER-02 | Thermal Management Solutions for Hybrid-Electric Regional Aircraft | 1 | 40 |
| | HER-03 | Electrical Distribution Solutions for Hybrid-Electric Regional Aircraft | 1 | 40 |
| | HER-04 | Innovative Wing Design for Hybrid-Electric Regional Aircraft | 1 | 20 |
| Short & Medium Range 270M | SMR-01 | Ultra Efficient Propulsion Systems for Short and Short-Medium Range Aircraft | 3 | 175 |
| | SMR-02 | Ultra Performance Wing for Short and Short-medium Range Aircraft | 2 | 55 |
| | SMR-03 | Advanced Low Weight Integrated Fuselage and Empennage for Short Range and Short-Medium Range Aircraft | 1 | 40 |
| Transversal Areas 108M | TRA-01 | Aircraft concepts for regional, short and short-medium range aircraft enabling 30 to 50% reduction in emissions | 3 | 90 |
| | TRA-02 | Novel Certification Methods and Means of Compliance for Disruptive Technologies | 1 | 18 |
| CSA | CSA-01 | Developing a European Clean Aviation Regional Ecosystem (ECARE) | 1 | 0.72 |
| TOTAL | | 14 topics | up to 23 projects | 735.72 M€ |

Clean Aviation
CALL1
735M€ EU
Indicative
Funding

2023-2025/26

SHORT MEDIUM RANGE (SMR) ULTRA EFFICIENT PROPULSION SYSTEMS

SMR-01: ULTRA EFFICIENT PROPULSION SYSTEMS

Proposed solutions and technologies are expected to have TRL 3 at subsystem or component level as minimum entry point. Expected to achieve TRL 5 at system level (ducted or unducted engine architectures) or TRL4 for core engine and combustion technologies.

SMR-01 PROPULSION SYSTEMS

Variable geometry

(f.e. pitch multi-blade devices (ducted or unducted))

Optimum condition at multi-flight modes

Electrical machines

Innovative thermodynamic cycles

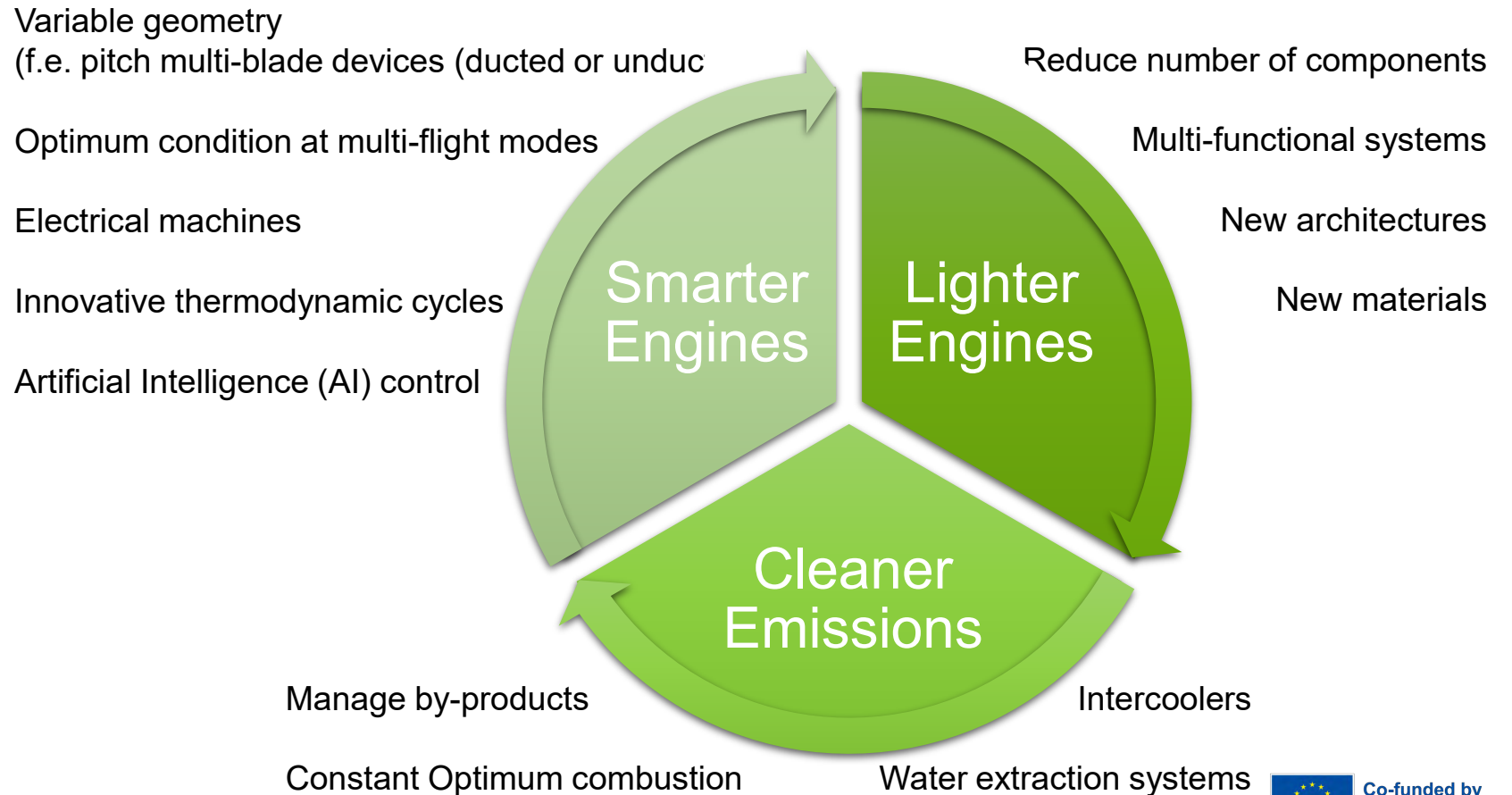
Artificial Intelligence (AI) control

Reduce number of components

Multi-functional systems

New architectures

New materials



SHORT MEDIUM RANGE (SMR) ULTRA EFFICIENT AIRFRAME

SMR-02: ULTRA PERFORMANCE WING

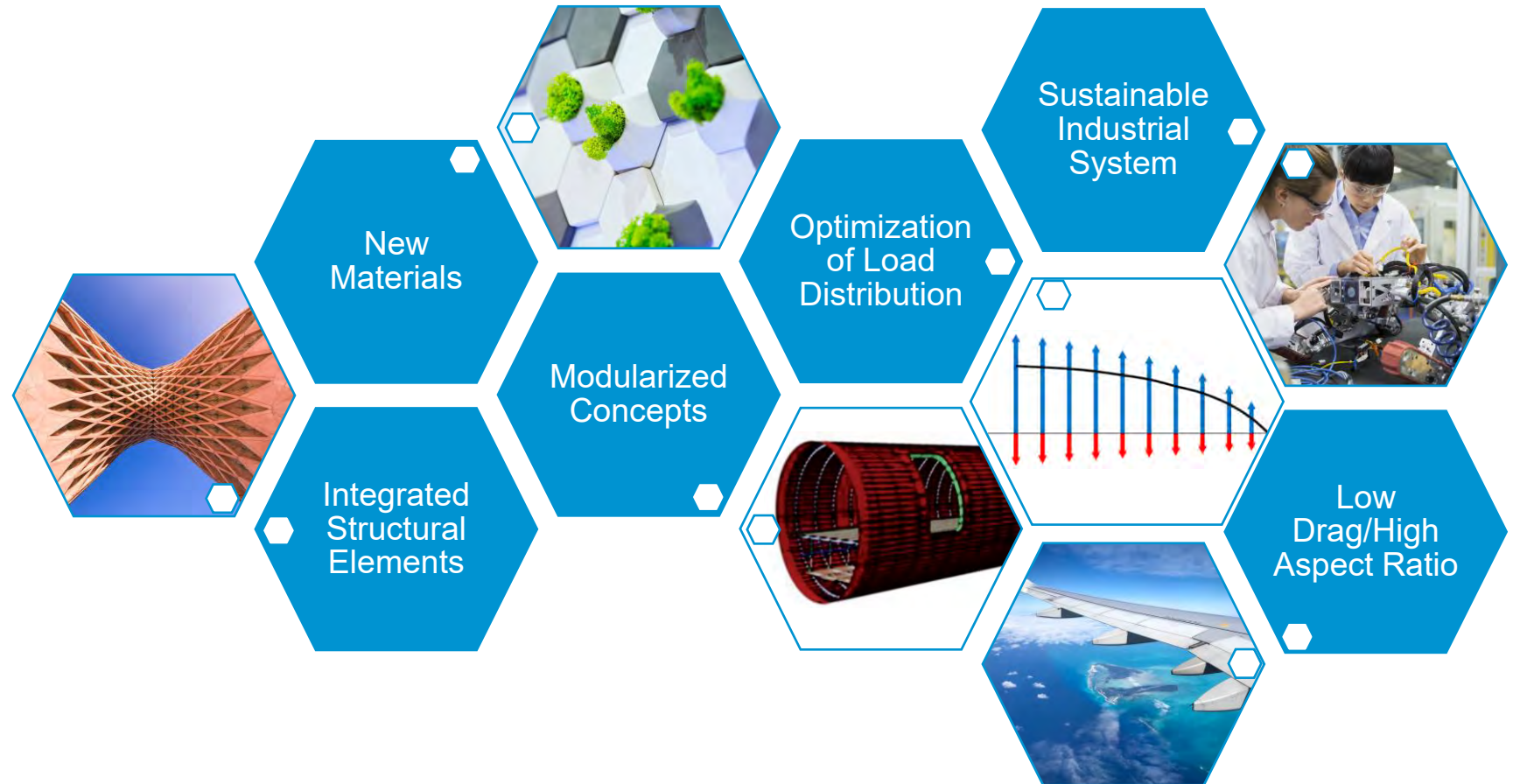
SMR-03: ADVANCED LOW WEIGHT INTEGRATED FUSELAGE AND EMPENNAGE

Maturation at TRL4 or higher via ground and scaled-flight tests demonstration

SMR-02
WING

+

SMR-03
FUSELAGE AND
EMPENNAGE



SHORT MEDIUM RANGE (SMR) TRANSVERSAL TOPICS

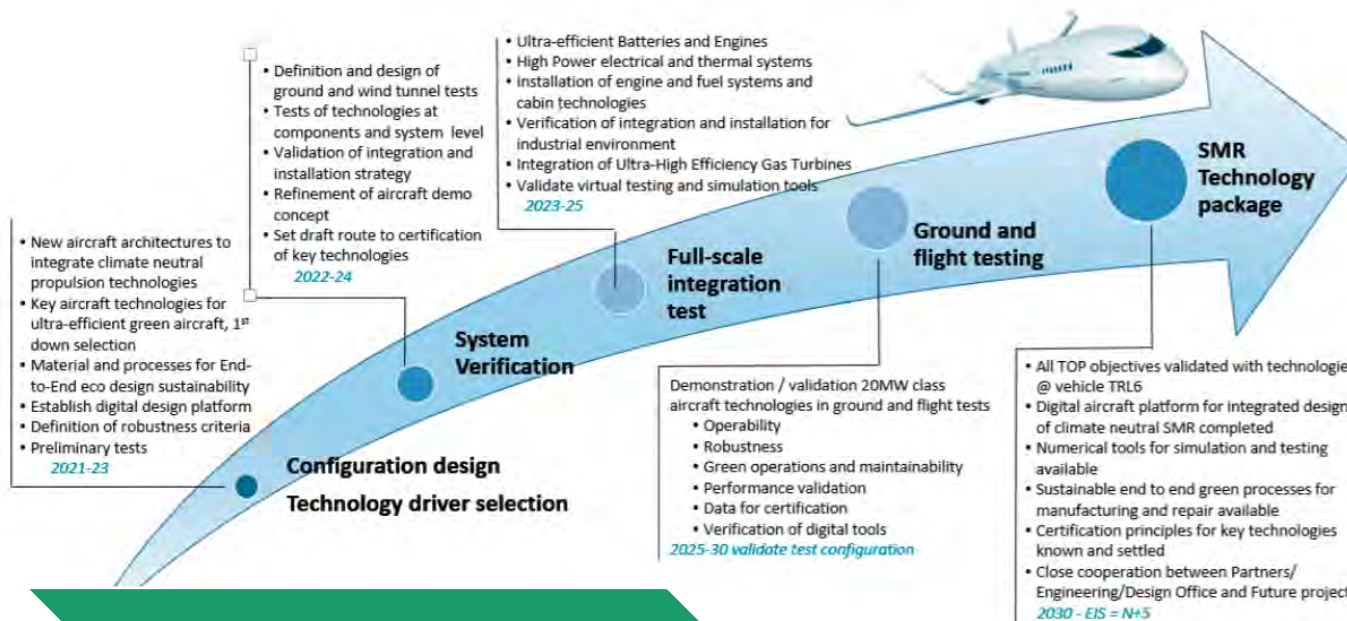
TRA-01 - AIRCRAFT ARCHITECTURES & TECHNOLOGY INTEGRATION FOR AIRCRAFT CONCEPTS
Maturity at aircraft level at least TRL4 for all key technologies critical to the aircraft concept, to be progressed forward into a potential future project in Phase 2
TRA-02 – NEW CERTIFICATION METHODS AND MEANS OF COMPLIANCE

TRA-01
AIRCRAFT
ARCHITECTURES
AND INTEGRATION

+

TRA-02
CERTIFICATION

Short and Medium Range Aircraft Ambition – Roadmap Technology and concept validation & verification



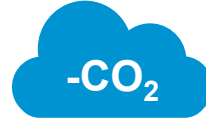
Phase II
Accelerate technology maturation through integrated demonstration



BUILDING UP ON CLEANSKY AND CLEANSKY2



Technology Evaluation



Short-Medium Range -17% to -26%

-8%(2) to -39%

-20% to -30%

(2) SMR++ (-8% NOx) as CROR core engine model does not yet include low NOx combustor technology, unlike SMR+ model (-39%).



And many more!
(more than 100 demos in CS2)

DRIVERS FOR SUCCESS



SHORT MEDIUM RANGE TAKE AWAYS

The
MOST
EXCITING
TECHNOLOGICAL
DECADE
for AERONAUTICS
IS
BEGINNING

- »»»»»»» **Keep pushing the envelope in ‘traditional’ disciplines:** low drag solutions, weight reduction, optimized methods, **concurrent design,...**
- »»»»»»» Build up in **non-traditional disciplines:** new materials, disruptive methods/concepts, digital solutions
- »»»»»»» **Enable certified solutions,** establishing early exchange with certification authorities.
- »»»»»»» **End2End aspects** considered since early design: Life-Cycle footprint of technologies, maintenance/in-service no-waste culture and recyclability



CLEAN AVIATION

ENGAGE
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