Conventional helicopters provide unique capabilities in that they are able to take off vertically and utilise small helipad/helideck infrastructure or even unprepared surfaces, used for emergency services, off-shore exploration and corporate/passenger transport. Helicopters are however limited in speed due to aerodynamics stall characteristics of the retreating main rotor blade during flight and hence operating range. To bridge the between conventional helicopters and utility/commuter fixed wing aircraft and retain the benefits of vertical tale-off and landing; both in speed and range/productivity, new rotorcraft configurations need to be exploited.

The Fast Rotorcraft IADP of Clean Sky 2 is investing to acquire the basic engineering know-how for rotary-wing platforms. Two types of configurations are under development: a tiltrotor and a compound
aircraft. Both will ensure more demanding operational requirements which cannot be satisfactorily met with conventional helicopter architectures. Two flying demonstrators will be produced, the NGCTR tiltrotor (Next Generation Civil TiltRotor; leader: Leonardo Helicopters) and the RACER compound rotorcraft (Rapid And Cost Efficient Rotorcraft; leader: Airbus Helicopters). Objectives are: to define new/adapted criteria for the fast rotorcraft missions, in line with the TE approach; to perform Eco-Design activities and use the Life Cycle Assessment approach to allow the implementation of greening of rotorcraft production processes; to investigate engine installation and flight trajectories optimization to reduce CO2 emissions, as well as new material, surface treatments (NGCTR); to mature the compound rotorcraft configuration allowing increased capabilities such as payload capacity, agility in vertical flight including capability to land on unprepared surfaces, load/unload rescue personnel and victims while hovering, long range, high cruise speed, low fuel consumption and gas emission, low community noise impact, and productivity for operators (RACER).

These two fast rotorcraft concepts aim to deliver superior vehicle productivity and performance with reduced environmental impact, and through this, to deliver an economic advantage to users. The NGCTR project will design, build and fly an innovative next generation civil tiltrotor technology demonstrator, the configuration of which will go beyond current architectures of this type of aircraft. This tiltrotor concept will involve tilting proprotors mounted in fixed nacelles at the tips of relatively short wings. These wings will have a fixed inboard portion and a tilting outboard portion next to the nacelle. The tilting portion will move in coordination with the proprotors, to minimize rotor downwash impingement in hover and increase efficiency. Demonstration activities will validate its architecture, technologies/systems and operational concepts. They will show significant improvement with respect to current Tiltrotors.

The RACER project aims at demonstrating the compound rotorcraft configuration, implementing and combining cutting-edge technologies from the closed Clean Sky programme, and opening up new mobility roles that neither conventional helicopters nor fixed wing aircraft can currently cover. The compound concept will involve the use of forward propulsion through turbo-shaft driven propellers in pusher configuration on short box-wings, complementing the main rotor providing vertical lift and hover capability. A large scale flightworthy demonstrator, embodying the new European compound rotorcraft architecture, will be designed, integrated and flight tested. This demonstrator will allow reaching the TRL 6 at full-aircraft level in 2021.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

2017: The demonstrators completed the operational concept definition; the selection of the innovative vehicle architecture and a preliminary sizing.

2018:
NGCTR: the architectural design phase was completed culminating in Preliminary Design Review during December 2018. Technical activities progressed with focus on the five key technologies for in-flight demonstration on the Technology Demonstrator (NGCTR-TD) with the engine supplier being selected and technical activities initiated in October 2018. A process to achieve ‘Permit to Fly’ was developed and the associated road map shared with relevant airworthiness authorities.
RACER: the architectural design phase was completed culminating in Preliminary Design Review in July 2018. Focus was made to ensure the MGB was progressed and that delivery of the airframe will be at the earliest date to start the assembly phase. The flight condition approval plan and associated means of compliance to obtain the permit to fly were initiated, with tracking of the parts necessary to perform the mandatory tests on-time for the first flight. Definition of the different phases of the flight test campaign was launched.

**Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)**

EXPECTED POTENTIAL IMPACT - can be grouped into three main areas: greening, industrial leadership and mobility.

**Greening:** The innovative rotorcraft configurations and various technologies to be developed and demonstrated are expected to provide benefits compared to conventional rotorcraft of similar class, such as; reduced CO2 emissions; reduced noise level and footprint; reduced impact on environment due to advanced manufacturing processes; materials and surface treatments compliant with REACH regulation; weight savings and energy efficiency improvements contributing to lower fuel consumption and gas emissions; smart flight control exploiting additional degrees of freedom for performance improvement, fuel burn reduction and range extension.

**Industrial leadership:** low drag design, low weight design, low cost design; high performance design, operational and safety Standards; ease of operation in all flight phases; low operating cost (maintenance, fuel); low external noise and improved internal comfort; operational flexibility (new architecture); mission productivity increase due to high speed; smaller fleet and/or number of bases needed to cover rescue area in a given time; long life mechanical components, lower direct maintenance cost; maturity of mechanical components shortening time-to-market of future fast rotorcraft products; extended flight domain and mission capabilities with same pilot workload.

**Mobility:** fast gate-to-gate passenger transport contributing to ACARE mobility objective; rescue and emergency evacuation by air over a much wider area in the same intervention time as for a conventional helicopter or reduced time, then efficiency, for current radius of action; simultaneous non-interfering procedures on busy airports (all weather) increasing rotorcraft traffic throughput.
Fast Rotorcraft fill a Mobility Gap

Next Generation Civil TiltRotor (NGCTR)
Rapid And Cost Efficient Rotorcraft (RACER)

Last update: 6 June 2019
Record number: 371122