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# Most efficient flight

The most efficient operation of an aircraft depends on many factors. Design and performance of the aircraft of course play a key role. So too does the flightpath and profile which are extremely important in reducing fuel consumption and emissions.

## Routing

The routing of a commercial flight is agreed between the crew and the air traffic controller. Before takeoff, the airline fills in a so-called flight plan. This is a routing from waypoint to waypoint, including departure, enroute, arrival and approach segments - following airways very similar to roads on the ground. This has to be approved by the ATC-provider. Flightplan and routing will be modified and optimized continuously depending on the traffic situation and weather conditions.

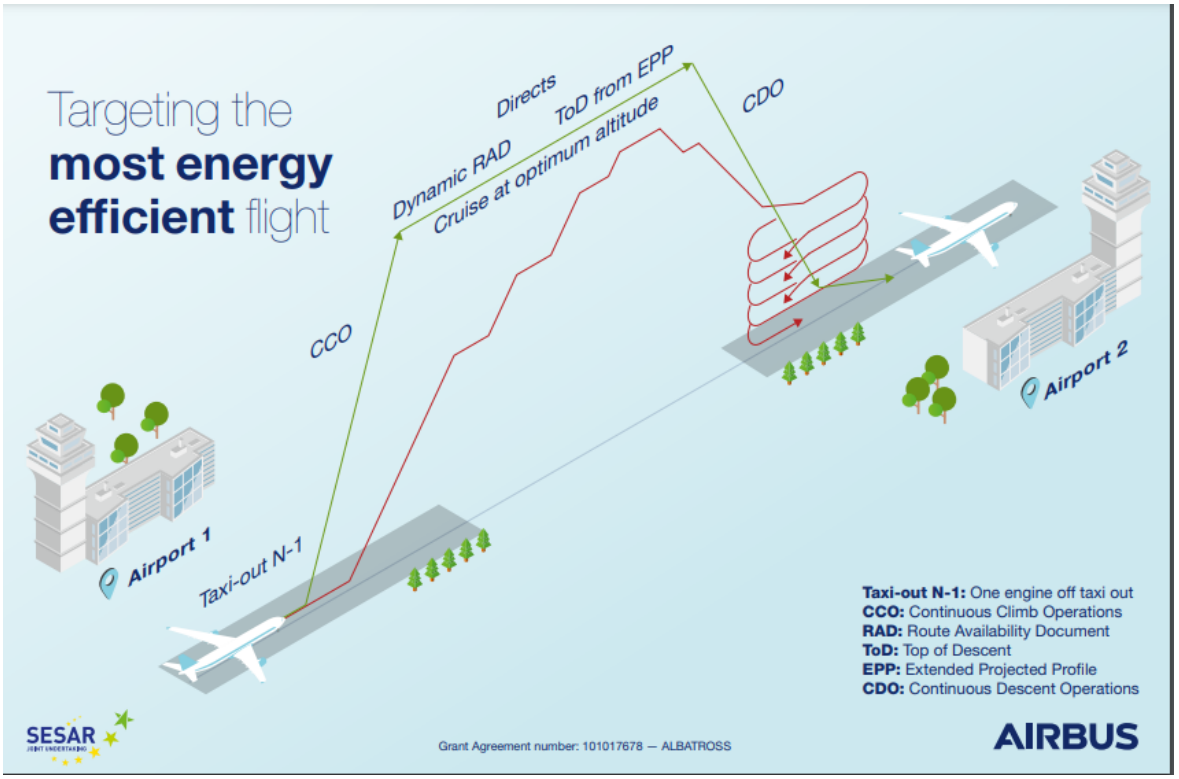
## Fuel calculation and efficiency

Fuel planning for a commercial aircraft usually follows the same standard scheme.

The different flight phases:

1) Taxi on the airport: This is the fuel needed to start the engines and then taxi to the runway. This is a first opportunity to save fuel. Aircraft engines are designed to be efficient in flight, but not idle on the ground. Airports and air traffic providers are working on projects to optimize the movements and flow of aircraft on the ground to minimize the time from gate to takeoff.

2) Takeoff and climb to an optimum cruise level: Each and every flight is different. The climb performance of an aircraft depends on the actual weight, the weather conditions and air traffic situation. The crew is able to calculate with the onboard systems the most efficient climb. The cruise altitude or flight level is not primarily the decision of the flight crew. The air traffic controller assigns a certain level, climb rate and speed based on capacity of airspace and trajectory of the aircraft.




3) Cruise flight: with regards to efficiency, the cruise altitude needs to change during the flight. This is the result of burning fuel and losing weight. Fuel is 15-40% of the takeoff mass of an aircraft. By burning fuel in cruise, the aircraft is lighter and able to climb to higher altitudes where flight is more efficient. This offers the opportunity to burn less fuel. Today, an aircraft climbs in steps. By improving the data-transmission between airplanes and air traffic control, the controller is able to assign the aircraft the most efficient flight level.

   In addition, the routing could be optimized during the flight. Depending on the air traffic situation, the controller could be looking for a direct routing being assigned to a certain flight. This avoids extra fuel burn.

4) Descent: The so-called Continuous Descent is the most efficient way for the final phase of the flight. If the crew sets the thrust levers to idle and the aircraft then glides to the airport, fuel is saved and emissions are reduced. But in many cases, aircraft today have to reduce the altitude in several steps. This results in inefficient level flying at lower altitudes. The flight management system of the aircraft offers the crew the possibility to calculate the most efficient descent and define a certain point of descent for the flight. The air traffic controller then has to check if the traffic situation permits this approach. By jointly optimizing the flightpath, descent could be as close as possible to the optimum descent.

5) Holdings (waiting for a landing slot): One of the most inefficient situations in commercial aviation are holdings. An A320-family aircraft burns ~100kgs of fuel in a four minutes standard holding.

6) Movement to the parking position and ground power: Similar to the situation on departure, an efficient surface movement guidance after landing helps saving fuel. The power supply during the turnaround of the aircraft is another opportunity to save fuel. The aircraft could be powered on the ground either by a connector and electricity from the airport or by running the so called APU, Auxiliary Power Unit of the aircraft, which is burning kerosene.