AIR WAKE SURFING FOR EFFICIENCY

Tapping into an Unrealized Energy Source

AIR FORCE OPERATIONAL ENERGY

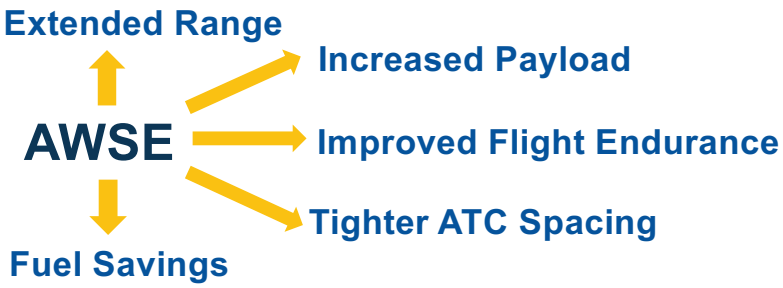
NEW FLIGHT CONFIGURATIONS REDUCE FUEL BURN

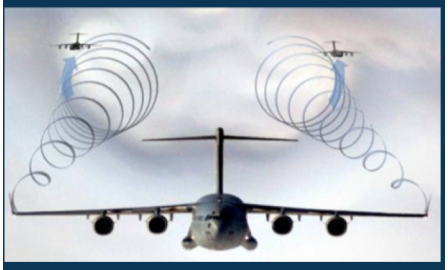
In 2017, NATO Science and Technology Organization (STO) initiated a research effort on efficient flight formation. The STO task force investigated the idea of air wake surfing for efficiency (AWSE), or taking advantage of wingtip vortices generated by an aircraft in-flight. During flight an aircraft loses energy through the creation of a vortex at the wingtip. A trail aircraft positioned in the updraft of the vortex can recapture some of the 'lost' energy. Flying in this manner provides free lift for trail aircraft, reducing required thrust, and decreasing fuel burn.

The Air Force has explored the AWSE flight configuration for a number of years.

In 2013, an initial C-17 flight test demonstrated a **fuel savings of over 10% in trail aircraft.**

This fuel savings potential was confirmed during recent operational flight tests conducted by Boeing, DARPA, NASA, AFRL, and AMC. Prior efforts required aircraft to be hand-flown, but recent tests prove AWSE configurations to be viable by using autopilot, station keeping equipment, flight systems integration, and datalink. During the 10.5 hour flight test, the C-17s flew 6 hours in a AWSE position 4,00-6,000 feet in trail, resulting in an average fuel savings of 8-10% in trail aircraft. This efficient flight configuration is compatible with current C-17 operations, requires minor software changes, involves no additional work for aircrew, and preserves flight comfort.





Automated trail, at a safe distance, maintains position in wingtip vortex updraft.

WHY IT MATTERS

Air wake surfing for efficiency has proven that with minor software changes, autopilot is able to sustain AWSE configurations at a safe distance to ensure about **8-10% fuel savings** for trail aircraft. Fuel savings is just one example of the realized benefits from flying efficiently, although fuel savings can lead to extended range, increased payload, and improved flight endurance. As the Air Force looks towards automated operations, AWSE will become the standard for fuel efficient flight operations.

Research demonstrates that AWSE is most effective on platforms that burn large quantities of fuel and have higher weight to span squared ratios (e.g. KC-10, C-5, KC-46, KC-135). However, AWSE may provide significant benefits for other aircraft, particularly in future concepts of operation such as "loyal wingman" drones accompanying piloted aircraft. Research is ongoing to determine which airframes can transition to AWSE configurations. Although the initial intent of AWSE was to reduce fuel burn, the benefits of improving capabilities and operations are far-reaching.

OUR MISSION

To enhance combat capability and mitigate operational risk to the warfighter through energy-informed solutions.

OUR VISION

To create an energy optimized Air Force that maximizes combat capability for the warfighter.

OPTIMIZING OPERATIONAL ENERGY LEADS TO:

INCREASED
Combat Capability

INCREASED
Aircraft Lifespan

LOWER
Aircraft Maintenance Costs

MORE
Training Opportunities

$5-7 BILLION
is spent on Air Force aviation fuel **ANNUALLY**

81% of the Air Force **ENERGY BUDGET** is spent on aviation fuel

2 BILLION
GALLONS of aviation fuel used by the Air Force **ANNUALLY**

8,000
additional sorties fueled from a **1% EFFICIENCY INCREASE**

#FUELMOREFIGHT

AIR FORCE OPERATIONAL ENERGY

Office of the Deputy Assistant Secretary of the Air Force for Operational Energy (SAF/IEN)
Email: SAF.OpEnergy@us.af.mil | Phone: (571) 256-4711
www.safie.hq.af.mil/OpEnergy | www.Facebook.com/AirForceEnergy | www.Twitter.com/AFEnergy