COURSE SYLLABUS

Advanced Sustainable Aviation Fuels and Aircraft Design

Eleven live sessions connecting fuel chemistry and combustion evidence to aircraft design, propulsion integration, infrastructure, certification, and life-cycle climate impact.

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COURSE DATES	MEETING TIME	FORMAT	FACULTY
Oct 20 – Nov 20, 2026	12:00 – 2:00 PM CT	11 live sessions, online	6 instructors

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REGISTRATION VIA AIAA · AIAA.MYCROWDWISDOM.COM

WHY THIS COURSE

This advanced short course treats sustainable aviation fuels (SAF) as an integrated aircraft, propulsion, airport, supply-chain, certification, and sustainability challenge. Participants connect fuel chemistry and combustion evidence to aircraft design, operability, materials compatibility, infrastructure, life-cycle assessment, and multi-criteria decision making.

Technical foundations, experimental evidence, real-world case studies, design tools, and a fuel–aircraft–operations co-design project build a practical framework for evaluating SAF, hydrogen, batteries, and hybrid-electric architectures across performance, payload range, durability, lifecycle climate impact, economics, and technology risk.

COURSE EXPERIENCE

11 live, two-hour sessions

Evidence-based technical instruction

Applied trade studies

Fuel–aircraft–operations co-design project

Curated technical readings

WHAT YOU WILL BE ABLE TO DO

- Explain how SAF composition and properties affect combustion, operability, emissions, durability, and fuel efficiency.
- Quantify fuel and energy-carrier effects on aircraft sizing, payload-range performance, and propulsion-system integration.
- Evaluate material compatibility, fuel-system architecture, certification pathways, supply chains, and airport infrastructure.
- Apply conceptual design and multi-criteria methods to fuel-aware aircraft and operations decisions.
- Interpret life-cycle assessment, carbon-intensity, sustainability certification, and chain-of-custody requirements.

BUILT FOR AVIATION DECISION-MAKERS

Designed for aerospace and propulsion engineers, SAF producers, fuel-system specialists, airport and airline operations teams, sustainability and life-cycle assessment (LCA) professionals, certification and policy leaders, researchers, and advanced students.

Seats are limited — enroll today

Scan the code or visit the AIAA course catalog to register.

Instructor Team

Dr. Swapnil Jagtap

Assistant Professor, Low Carbon Propulsion Systems; Founding Director, FlyCLean Laboratory, University of Manchester. Low-carbon propulsion, hydrogen aircraft, and model-based systems engineering.

Dr. Randall Boehm

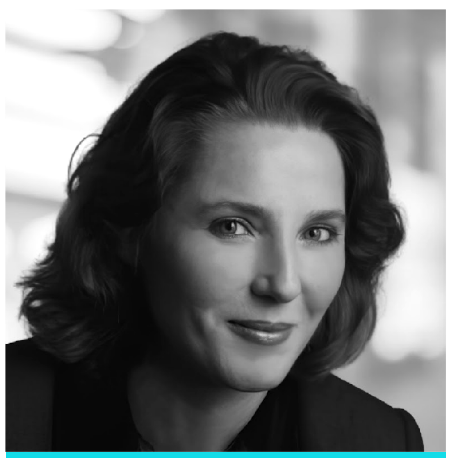
Associate Research Professor, BSEL, Washington State University Tri-Cities; 20+ years at GE Aviation. Gas-turbine combustion, fuel-nozzle design, and alternative fuels.

Dr. Matthew Clarke

Assistant Professor, University of Illinois Urbana-Champaign; Director, Laboratory for Electric Aircraft Design and Sustainability. Aeroacoustics, physics-AI, and hybrid-electric propulsion.

Dr. Bhupendra Khandelwal

Associate Professor, The University of Alabama; Fellow, Royal Aeronautical Society. Propulsion, thermodynamics, SAF combustion, emissions, and zero-emission technologies.



Dr. Jasenka Rakas

Senior Continuing Lecturer, UC Berkeley; Deputy Director, NEXTOR. Airport systems, airspace capacity, communications reliability, and aviation operations research.

Dr. Eva Maleviti

Assistant Professor and MS Program Coordinator, Embry-Riddle Aeronautical University. Aviation sustainability, ICAO CORSIA, EU ETS, ESG, certification, and MRO.

Learn directly from this faculty — register now

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Schedule at a Glance

MODULE	DATE	LECTURE	INSTRUCTOR
1.1	Tue, Oct 20	SAF Combustion Fundamentals, Fuel Efficiency and Experimental Evidence	Dr. Swapnil Jagtap
1.2	Thu, Oct 22	Engine Integration, Operability, Fuel Efficiency and Non-CO_2 Impacts	Randall Boehm
2.1	Tue, Oct 27	Fuel-Driven Constraints and Fuel Efficiency in Aircraft & Propulsion System Design	Dr. Swapnil Jagtap
2.2	Thu, Oct 29	Hybrid-Electric Regional Aircraft Case Study, Fuel Efficiency and Design Trades	Dr. Matthew Clarke
3.1	Tue, Nov 3	Fuel Properties, Materials Behaviour and System-Level Implications	Dr. Bhupendra Khandelwal
3.2	Thu, Nov 5	Design & Certification of SAF-Compatible Fuel Systems	TBD
4.1	Tue, Nov 10	SAF Supply Chains, Production Pathways and Blending Infrastructure	Dr. Bhupendra Khandelwal
4.2	Thu, Nov 12	Airport Integration, Turnaround Operations and Cross-Border Considerations	Dr. Jasenka Rakas
5.1	Tue, Nov 17	Tools and Methods for Fuel-Aware Aircraft Design	TBD
5.2	Thu, Nov 19	Fuel–Aircraft–Operations Co-Design Project	Dr. Bhupendra Khandelwal
6.1	Fri, Nov 20	Sustainability, Life-Cycle Assessment & Calculating the Carbon Intensity of Fuels	Dr. Eva Maleviti

All sessions meet from 12:00–2:00 PM Central Time. Instructor and detailed content for Modules 3.2 and 5.1 are TBD.

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Secure your seat for the October 20 start

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Module Detail

MODULE 1.1 TUE, OCT 20, 2026 · 12:00–2:00 PM CT · DR. SWAPNIL JAGTAP

SAF Combustion Fundamentals, Fuel Efficiency and Experimental Evidence

This lecture introduces the relationships among SAF production pathways, fuel properties, combustion behavior, engine performance, emissions, and mission fuel efficiency. Students connect lower heating value, density, viscosity, volatility, aromatic content, and ignition quality to atomization, ignition delay, lean blowout, flame structure, operability, and measured emissions. Evidence from NASA, FAA, ASCENT, and OEM tests is used to distinguish demonstrated effects from common assumptions.

LEARNING OBJECTIVES

- Explain how lower heating value and density affect specific fuel consumption and mission fuel burn.
- Compare SAF with hydrogen and batteries as aviation energy carriers.
- Describe HEFA, FT-SPK, ATJ, and power-to-liquid pathways and their relevant fuel properties.
- Connect atomization and spray behavior to ignition delay, lean blowout, and flame structure.
- Interpret NOx, CO, unburned hydrocarbon, and non-volatile particulate matter trends in rig and engine data.
- Explain how aromatic and PAH content affects soot and secondary climate effects.

RECOMMENDED READING

- ICAO CAEP/12, *Assessment Report on Fuel Composition Effects on nvPM Emissions* (2024).
- U.S. DOE BETO, *Sustainable Aviation Fuel: Review of Technical Pathways* (2020).
- Lefebvre and Ballal, *Gas Turbine Combustion*.
- Rahmes et al., bio-derived synthetic paraffinic kerosene flight and engine testing, AIAA (2009).
- Jagtap, sustainability assessment of alternative aviation propulsion systems (2016).

Enroll in the full 11-session course
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MODULE 1.2 THU, OCT 22, 2026 · 12:00–2:00 PM CT · RANDALL BOEHM

Engine Integration, Operability, Fuel Efficiency and Non-CO_2 Impacts

This session follows fuel through the engine from inlet to exhaust and examines how physical properties and chemical reactivity affect spray formation, ignition, heat release, combustor operability, durability, and emissions. Topics include start reliability, cup-to-cup propagation, lean blowout, combustion dynamics, thermal-oxidative stability, coking, maldistribution, and the links among mixedness, heat release, and hardware life.

LEARNING OBJECTIVES

- Explain how spray characteristics affect atomization and fuel-air mixing.
- Describe how mixedness and fuel chemistry influence heat release and flame stability.
- Connect heat-release behavior to startup, lean blowout, combustion dynamics, operability, and durability.
- Evaluate fuel-system fouling and thermal-oxidation risks alongside emissions and efficiency effects.

RECOMMENDED READING

- Colket and Heyne, *Fuel Effects on Operability of Aircraft Gas Turbine Combustors*, Chapters 5–6, AIAA Progress in Astronautics and Aeronautics, Vol. 262 (2021).

MODULE 2.1 TUE, OCT 27, 2026 · 12:00–2:00 PM CT · DR. SWAPNIL JAGTAP

Fuel-Driven Constraints and Fuel Efficiency in Aircraft & Propulsion System Design

This lecture establishes a unified framework that connects an energy carrier to tankage, structure, center of gravity, propulsion architecture, mission performance, payload range, operating cost, and technology risk. Students use first-order methods and modified Breguet relationships to compare SAF, liquid hydrogen, LNG, batteries, and hybrid-electric configurations.

LEARNING OBJECTIVES

- Quantify gravimetric and volumetric energy density for SAF, liquid hydrogen, LNG, and lithium-ion batteries.
- Estimate system-specific energy after accounting for tanks, structure, insulation, and center-of-gravity constraints.
- Apply the Breguet range relation and adapt it for hydrogen and hybrid-electric aircraft.
- Compare payload-range and mission performance across energy carriers.
- Explain how fuel choice changes aircraft layout and propulsion integration.
- Classify hybrid-electric architectures and degrees of hybridization.
- Construct a composite decision metric spanning energy, climate, cost, and technical risk.

RECOMMENDED READING

- Jagtap, doctoral research on lifecycle-integrated aircraft propulsion design (2022).
- Mangold et al., preliminary hybrid-electric aircraft design, EUCASS (2022).
- Wroblewski and Ansell, electrified aircraft propulsion review (2020).
- Abu Salem et al., alternative energy carriers for aviation, *Energies* (2023).
- Raymer, aircraft design and Breguet-range refresher.
- Isikveren et al., distributed propulsion and hybrid-electric design (2014).
- Adler and Martins, aircraft design optimization methods (2023).

Not enrolled yet? **Register for the course →**

MODULE 2.2 THU, OCT 29, 2026 · 12:00–2:00 PM CT · DR. MATTHEW CLARKE

Hybrid-Electric Regional Aircraft Case Study, Fuel Efficiency and Design Trades

Using a 50-seat regional aircraft case study, students compare a SAF-fueled parallel-hybrid concept with a liquid-hydrogen fuel-cell serial-hybrid concept. The session uses the open-source RCAIDE conceptual design environment to explore energy-management strategy, mission performance, climate impact, direct operating cost, and technology risk. Route-dependent outcomes demonstrate why no single architecture dominates every mission.

LEARNING OBJECTIVES

- Compare SAF parallel-hybrid and liquid-hydrogen fuel-cell serial-hybrid concepts using MJ/ASK and gCO_2e/RPK.
- Use a conceptual design loop to examine configuration and energy-management choices.
- Evaluate designs with a multi-criteria figure of merit spanning block energy, lifecycle climate impact, direct operating cost, and technology risk.
- Explain why route length, infrastructure, technology readiness, and operational constraints can change the preferred solution.

RECOMMENDED READING

- Clarke et al., RCAIDE, *Aerospace Science and Technology* (2026).
- de Vries et al., hybrid-electric regional aircraft design, AIAA (2026).
- Mangold et al., preliminary hybrid-electric aircraft design, EUCASS (2022).
- Rao and Yin, hybrid-electric aircraft architecture and sizing (2020).
- Rompokos et al., hybrid-electric propulsion system design (2020).

MODULE 3.1 TUE, NOV 3, 2026 · 12:00–2:00 PM CT · DR. BHUPENDRA KHANDELWAL

Fuel Properties, Materials Behaviour and System-Level Implications

This lecture examines chemical and physical interactions between SAF and aircraft materials. It focuses on how lower aromatic content in synthetic fuels affects elastomer swelling, seal integrity, component durability, maintenance requirements, fleet compatibility, dispatch reliability, and operational fuel efficiency.

LEARNING OBJECTIVES

- Assess material compatibility and identify risks associated with exposure to different SAF types.
- Explain the relationship among fuel composition, elastomer behavior, material durability, performance, and fleet-level operational efficiency.
- Connect material-degradation mechanisms to maintenance planning, dispatch reliability, and transition strategies for legacy fleets.

RECOMMENDED READING

- FAA, *Impact of Alternative Jet Fuel and Fuel Blends on Non-Metallic Materials Used in Commercial Aircraft Fuel Systems*, DOT/FAA/AEE/2014-10.
- Hamilton et al., “Investigation on elastomer behavior when exposed to conventional and sustainable aviation fuels,” *The Aeronautical Journal* 128(1325) (2024).
- Khandelwal, “Impact of alternative fuels and properties on elastomer compatibility,” in *Aviation Fuels*, Elsevier (2019).
- FAA AC 20-24D, *Approval of Propulsion Fuels, Additives, and Lubricating Oil.*

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MODULE 3.2 THU, NOV 5, 2026 · 12:00–2:00 PM CT · INSTRUCTOR TBD

Design & Certification of SAF-Compatible Fuel Systems

Lecture details, learning objectives, and recommended readings are TBD.

MODULE 4.1 TUE, NOV 10, 2026 · 12:00–2:00 PM CT · DR. BHUPENDRA KHANDELWAL

SAF Supply Chains, Production Pathways and Blending Infrastructure

This lecture examines the physical and commercial infrastructure between an approved SAF pathway and fuel in an aircraft wing. It covers ASTM-approved production routes and feedstocks, the movement of neat synthetic blending components, blending and recertification locations, and accounting systems that allow environmental attributes to travel separately from molecules. The lecture emphasizes that near-term constraints are largely feedstock, infrastructure, commercial, and regulatory constraints.

LEARNING OBJECTIVES

- Distinguish the eight ASTM D7566 annexes by feedstock, chemistry, maturity, and blend limit, and explain both HEFA's current dominance and its scale limits.
- Trace fuel from feedstock through conversion, blending, recertification, distribution, and delivery to the wing, identifying segregation and certification points.
- Evaluate possible blending locations and the infrastructure, cost, and attribution trade-offs associated with each.
- Explain how density and aromatic-content specifications shape current blend limits and the technical route toward 100% SAF.

TOPICS

- ASTM D4054 qualification and the D7566-to-D1655 redesignation mechanism.
- HEFA, Fischer–Tropsch, alcohol-to-jet, and power-to-liquid pathways.
- Feedstock aggregation, plant siting, segregated handling, batch and in-line blending, recertification testing, and multiproduct-pipeline risks.
- Mass-balance and book-and-claim accounting.
- Synthetic aromatic kerosene, density, seal swell, and the technical requirements for 100% SAF.
- Mandates, market capacity, and supply-chain scale-up.

RECOMMENDED READING

- ASTM D7566-25a, *Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons.*
- ASTM D1655, *Standard Specification for Aviation Turbine Fuels.*
- CAAFI guidance on the ASTM D4054 fuel qualification process.
- IATA Sustainable Aviation Fuel program and current production estimates.
- EASA, *State of the EU SAF Market.*
- ICAO, approved SAF conversion processes and CORSIA lifecycle values.
- NREL/TP-5100-87802, *Sustainable Aviation Fuel: State-of-Industry Report.*
- Undavalli et al., "Recent advancements in sustainable aviation fuels," *Progress in Aerospace Sciences* 136 (2023).
- Undavalli and Khandelwal, fuel-composition effects on gas-turbine emissions, *The Aeronautical Journal* (2026).
- Hamilton, Khandelwal, and Elliott, synthetic-fuel chemistry and elastomer swelling, *Fuel* 424 (2026).

MODULE 4.2 THU, NOV 12, 2026 · 12:00–2:00 PM CT · DR. JASENKA RAKAS

Airport Integration, Turnaround Operations and Cross-Border Considerations

This session moves the analysis to the airport and ramp. Students compare SAF with hydrogen and electric-aircraft infrastructure, examine turnaround and refueling requirements, and evaluate airports as multi-energy hubs. Cross-border logistics, certification, availability, CORSIA, and low-carbon fuel accounting are connected to aircraft and airline design assumptions.

LEARNING OBJECTIVES

- Compare SAF refueling with hydrogen and electric-aircraft turnaround constraints.
- Evaluate airports as multi-energy hubs serving conventional fuel, SAF, hydrogen, and electricity.
- Assess cross-border logistics, certification, availability, CORSIA, and low-carbon fuel-standard accounting.
- Translate airport and infrastructure constraints into aircraft-design and operational requirements.

RECOMMENDED READING

- Connected Places Catapult, *Zero Emission Flight Infrastructure* white paper (2022).
- IATA, *Energy and New Fuels Infrastructure Roadmap* (2023).
- IATA, *Policy Net Zero Roadmap* (2024).

MODULE 5.1 TUE, NOV 17, 2026 · 12:00–2:00 PM CT · INSTRUCTOR TBD

Tools and Methods for Fuel-Aware Aircraft Design

Lecture details, learning objectives, and recommended readings are TBD.

Scan to enroll

AIAA & HySky Society joint course · Oct 20 – Nov 20, 2026

MODULE 5.2 THU, NOV 19, 2026 · 12:00–2:00 PM CT · DR. BHUPENDRA KHANDELWAL

Fuel–Aircraft–Operations Co-Design Project

This applied session guides participants through a co-design exercise that integrates aircraft configuration decisions with operational, fuel-supply, infrastructure, and policy constraints. Students build a multi-criteria figure of merit combining direct operating cost, lifecycle climate impact, resource availability, and technical risk to compare configurations and future scenarios involving SAF, conventional kerosene, hydrogen, methane, and hybridization.

LEARNING OBJECTIVES

- Apply multi-criteria trade-study methods to evaluate SAF, hydrogen, and hybrid propulsion concepts under mission and infrastructure constraints.
- Explain the sensitivity of aircraft configurations to fuel type, hybridization, SAF blend requirements, and evolving carbon policy.
- Integrate direct operating cost, climate impact, resource availability, infrastructure, and technical risk into a transparent decision framework.
- Communicate a configuration recommendation and the assumptions that drive it.

RECOMMENDED READING

- Mangold et al., "Preliminary hybrid-electric aircraft design with advancements on the open-source tool SUAVE," *Journal of Physics: Conference Series* 2526 (2023).
- Botero et al., "SUAVE: An Open-Source Environment for Conceptual Vehicle Design and Optimization," AIAA-2016-1275.
- Moebs et al., "Adaptive Initial Sizing Method and Safety Assessment for Hybrid-Electric Regional Aircraft," *Aerospace* 9(3) (2022).
- Marciello et al., "Design Exploration for Sustainable Regional Hybrid-Electric Aircraft," *Aerospace* 10(2) (2023).
- Castro et al., "Feasibility of Using Fuel Cell in a Small Aircraft," AIAA AVIATION Forum (2021).

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MODULE 6.1 FRI, NOV 20, 2026 · 12:00–2:00 PM CT · DR. EVA MALEVITI

Sustainability, Life-Cycle Assessment & Calculating the Carbon Intensity of Fuels

The final lecture examines sustainability and lifecycle carbon accounting for aviation fuels. Students compare system boundaries, functional units, feedstock and conversion assumptions, indirect land-use change, electricity inputs, and chain-of-custody models. The session connects carbon-intensity calculations to SAF certification, CORSIA eligibility, auditing, design choices, and procurement claims.

LEARNING OBJECTIVES

- Define environmental, social, and economic sustainability in U.S., EU, Canadian, and ICAO contexts.
- Explain life-cycle assessment methods and compare carbon intensity for pathways such as alcohol-to-jet with indirect land-use change, HEFA, and power-to-liquid.
- Identify SAF certification, chain-of-custody, CORSIA audit, and sustainability-verification requirements.
- Apply lifecycle and carbon-intensity evidence to aircraft, fuel, and operational decisions.

RECOMMENDED READING

- Recent SAF lifecycle-assessment review in *Energies* 18(14):3705.
- ICAO ACT-SAF sustainability guidance.
- ICAO CORSIA Sustainability Criteria (June 2025).
- ICAO list of CORSIA sustainability certification schemes.
- ISCC CORSIA certification guidance.
- IATA SAF book-and-claim guidance.

SCHEDULE AND CONTENT NOTE

Current as of September 2026. Modules 3.2 and 5.1 will be finalized before the course begins. An AIAA & HySky Society joint course.

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