AUG / SEPT '23
VOL. 62 NO. 4

GLOBAL GAS TURBINE NEWS

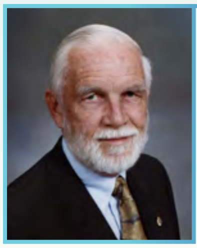
IN THIS ISSUE...

50 As the Turbine Turns...
52 Raising Ambition in Net Zero Aviation
55 A Decarbonized Aviation Path with Sustainable Aviation Fuel
57 IGTI and GTTG Appoints New Members
58 Awards Information
60 Turbo Expo 2023 Goes to Boston

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Gas Turbine Technology Group / 11757 Katy Frwy, Suite 1500 Houston, Texas 77079 / go.asme.org/igti

Abrams Tank Gas Turbine Power



Lee S. Langston
Professor Emeritus, University of Connecticut
lee.langston@uconn.edu

The Russia-Ukraine War has recently brought the gas turbine powered American Abrams battle tank into international news. On January 24, 2023, U.S. President Joe Biden said the US would send 31 M1A1 Abrams tanks to Ukraine. The Abrams tanks would take months to deliver. Also, the Ukrainian diesel engine tank crews would require training to operate and maintain these uniquely gas turbine powered tanks.

Some years ago, I had a graduate student at the University of Connecticut who had been an Abrams Tank Army commander in the 1991 Persian Gulf, Operation Desert Storm, in actions against Iraqi military forces. He had nothing but high praise for his unit's operation with their gas turbine powered Abrams M1A2 tanks. His only complaint was their fuel supply units had trouble keeping up with their needs in battle, given the combined effects of the higher speed of the 63-ton Abrams – and its high rate of fuel consumption.

The M1 Abrams battle tank entered service in 1980 [1]. Since then, over 10,000 have been produced, all powered by the 1500 hp (1.120 MW) AGT1500 three-spool, regenerative gas turbine (more on this later). This would make the Abrams by far, the most successful gas turbine powered land vehicle in the world. (For those of us who remember, the much-advertised 1963-64 Chrysler Turbine Car program resulted in only 55 gas turbine automobiles produced, before it was ended in 1966. A few gas turbine race cars were entered in the Indianapolis 500 in the late 1960s, but they were so fast, they were quickly banned from competition.)

Abrams tanks are heavy (up to 74 US tons), but highly maneuverable (four speeds forward and two in reverse). The gas turbine engine gives them unrivaled noise-free operation, acceleration, and high speed (on paved road, a governed top speed of 45 mph and an ungoverned speed of around 60 mph (depending on the driver's youth and daring). Compared to a diesel engine, the AGT1500 has much lower levels of vibration, noise, and has a detection-free (no smoke) exhaust. The Abrams engine has an exceptional multifuel capability (jet fuel, diesel, and gasoline), but has poor fuel economy and a shorter operating range compared to tank diesel engines.

There are three operational versions of the Abrams: M1 (60 tons), M2A1 (63 tons) and the M1A2 series (68-74 tons). The Abrams constitutes the main battle tank of the United States Army. An export version is used by the armies of Egypt, Kuwait, Saudi Arabia, Australia, Poland, and Iraq.

THE AGT1500 GAS TURBINE

The 1500 hp (1.120 MW) AGT1500 gas turbine is shown in the cutaway image in Fig. 1. It has a dry weight of about 2500 lb (1100 kg), a volume of 40 cubic feet (1.1 m^3) and an axial length of 63 in. (1.6 m). It is then roughly the size of a large kitchen refrigerator, and smaller (and lighter) than an equivalent diesel engine. Its smaller size frees up space in the cramped interior confines of the Abrams, providing more room for munitions and the four-person crew. The mechanical simplicity of the gas turbine components offers a clear advantage over the more complicated reciprocating piston configuration of a diesel engine.

Following the description given in [1] the AGT1500 is a three-shaft gas turbine with contra-rotating shafts and a free power turbine shaft. The low-pressure compressor has five axial stages that are driven by a single-stage turbine. The high-pressure compressor has four axial stages followed by a centrifugal stage, which are driven by a single-stage turbine. A two-stage power turbine drives a rear-power takeoff through a reduction gearbox. Mounted to the engine inlet is a self-cleaning filter system to clean sand and foreign objects from the air before it enters the engine, through adjustable inlet guide vanes.

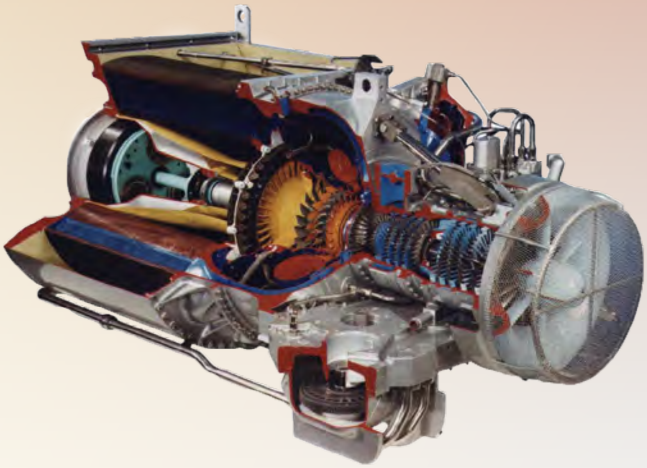


Figure 1. Cutaway view of the Honeywell AGT1500 gas turbine engine, with air inlet on the right, power output on the left, and exhaust radially upward on the rear half, exiting the recuperator. 1500 hp (1.120 MW), axial length 63 in (1.6 m), 40 ft^3 (1.1 m^3), 2500 lb (1100 kg).

A recuperator recovers waste heat from the exhaust gases leaving the turbine to improve the engine's cycle efficiency and thus its fuel economy. Air discharged from the high-pressure compressor passes through the recuperator where it is heated by the exhaust gases and then returned to the engine where it enters the engine's cannular combustor. As Fig. 1 shows, the recuperator is wrapped around the power turbine and gearbox. After the exhaust gases are passed through it to be cooled, they are discharged radially upward, and out of the tank through rear vents.

HISTORY OF THE TANK GAS TURBINE ENGINE

Starting in 1963, the early development of the AGT1500 gas turbine tank engine was begun, with the award of a U.S. Army contact to the aircraft engine company, Lycoming, for design, test, and production, to commence in their Stratford, Connecticut plant. The first AGT1500 engine ran in Stratford in November, 1966, some 57 years ago. Lycoming was an operating division of Avco Corporation, which itself is a subsidiary of Textron. In 1994, Textron sold Lycoming to Allied Signal Corporation. In 1999, Allied Signal purchased Honeywell Corporation and adopted the well-recognized Honeywell brand name and identity. Under the newly formed corporation the AGT1500 engine now falls under the Honeywell Aerospace unit in Phoenix, Arizona.

As Horan [2] reported in 1992, since its production start in 1980, over 11,000 AGT1500 engines had been delivered, making it the most widely produced gas turbine engine in automotive/vehicular history. Its then 1992 production rate was over 100 units per month and the engine had achieved unprecedented reliability during very demanding and highly cyclic operation over twenty million miles and seven million hours.

History of the AGT1500 can be traced back to early German tank gas turbine engine efforts in the closing years of WWII. The AGT1500 engineering team at Lycoming's Stratford plant were led by the Austrian-born engineer, Anselm Franz (1900-1994). In 1939, Franz was in charge of the design and development of the Junkers 109-004 turbojet engine which powered the Messerschmitt ME 262 jet fighters.

After the war, Franz moved to the U.S. as part of Operation Paperclip, where he joined Lycoming to promote and direct the Stratford development of the AGT1500. Franz was well-aware of the late WWII 1943-45 efforts in Germany to develop a multifuel gas turbine tank engine. Kay [3] gives a detailed account of these efforts, and this has been recently added to, by Eckhardt in Jet Web [4]. If the war hadn't ended when it did, German efforts were planned to equip the German Panther tank (then powered by a gasoline piston engine) with a multifuel gas turbine engine.

Subsequently, the plan for a gas turbine engine in a 1940s German Army Panther tank, became a reality in 1980 with the first production of the U.S. Army Abrams tank, powered by the AGT1500. ◆

Figure 2. Multi-fueled AGT1500 powered M1A2 Abrams Tank, firing its 120 mm cannon. Tank hull is 26.02 ft (7.93 m) long and 12 ft (3.66 m) wide.

REFERENCES

1. Leyes, Richard A. II, and Fleming, William A., 1999, The History of North American Small Gas Turbine Aircraft Engines, pp. 218-220.
2. Horan, Richard, 1992, "Textron Lycoming AGT1500 Engine---Transitioning for Future Applications", ASME IGTI Gas Turbine Conference and Exposition, Cologne, Germany, June 1-4, Paper No. 92-GT-436. V002T044016, 11 pages.
3. Kay, Antony L., 2002. German Jet Engine and Gas Turbine Development, 1930-1945, Airlife (UK), pp. 156-173.
4. Eckardt, Dietrich, 2022, Jet Web, Springer, pp. 571-585.

Raising Ambition in Net Zero Aviation

Rob Miller and Paul Hodgson, University of Cambridge
Steven Barrett, Massachusetts Institute of Technology

THE CHALLENGE

Aviation is the fastest-growing mode of transportation, with a forecast doubling of CO_2 emissions by 2050. The sector is also unique in that its climate impacts are around double CO_2 alone, mainly due to contrails. It is also a sector with long time constants and tremendous technological challenge. All of this means that there is an urgent need to raise ambition if we are to achieve an aviation sector with zero climate impacts by 2050.

WHAT IS NEEDED

There is no single pathway for achieving net zero aviation. Exploring the possible solution space requires a system-level understanding – from green power generation for creating e-fuels or hydrogen through to the climate effects of contrails (see Figure 1). Governments and industry are motivated to act but find it difficult due to the complexity and uncertainty inherent in the problem. To unlock the necessary policy measures, investments, and experimentation there is a need for evidence-based models capable exploring complexity and uncertainty. To meet this challenge the Aviation Impact Accelerator was setup, a global collaboration comprising of over 100 experts from organisations such as the University of Cambridge, MIT, the University of Melbourne, UCL, Boeing and Rolls-Royce, with the aim of developing the whole system models required to raise ambition and drive action. In the following sections, the modelling is used to compare resource requirements at a systems-level, for a range of Sustainable Aviation Fuels, hydrogen-powered flight and contrail avoidance, and to identify several opportunities for raising ambition.

SUSTAINABLE AVIATION FUELS

Sustainable Aviation Fuels (SAF) can be used as direct replacement for jet fuel. However, in 2022 the total SAF used was only sufficient to power global aviation for around 8 hours. A common SAF today is ‘HEFA’ made from waste oils or fats, but feedstock limitations mean that at maximum it can make around 1% of jet fuel. Biomass-derived SAF is an alternative, made from a range of feedstocks, but the volume required is immense – comparable to the world’s entire timber supply. Synthetic SAF made from renewable electricity and direct air capture (of CO_2) would compete less with agriculture, but would require around 40% of the world’s current electricity production just for today’s jet fuel demand. A way of raising ambition is to focus on scaling a hybrid approach – power and biomass to liquid. It uses all the carbon from the biomass, upgrading it with green hydrogen. By using all the carbon it uses a third of the biomass of only biomass-derived fuels, and up to 50% less electricity than synthetic fuels.

Figure 1. Model tracking sources of uncertainty across the whole aviation sector - Aviation Impact Accelerator recce.aiatools.org

HYDROGEN

Hydrogen offers a significant advantage both in direct emissions and of being approximately one third the weight of jet fuel. However, it must be stored in a liquid cryogenic form at -253°C. This necessitates the use of insulated tanks, which reduces the net weight advantage of hydrogen.

A challenge with liquid hydrogen is its large volume, around four times that of kerosene, requiring the fuel tanks to be placed in the fuselage. A clean sheet hydrogen replacement for the Boeing 737 would match the energy requirements per passenger to within 20%. The introduction of liquid hydrogen also opens up the potential for new types of jet engine designed to exploit this new fuel. These have the potential to reduce the energy requirement of flight by more than 20%. However, to realise the potential of hydrogen, there is an urgent need to raise ambition in terms of increased funding for technology development.

An advantage of hydrogen over synthetic SAF is that it requires 30-50% less renewable electricity. However, a major challenge is the liquefaction, distribution, and refuelling infrastructure investment which would be required, and the challenges of safety and certification of the new technologies.

CONTRAILS

Persistent contrails form when aircraft emit water vapour and soot into sufficiently cold and humid air. This occurs ~10% of flight time, when the atmosphere is "ice supersaturated" (ISS). These ISS regions are vertically thin and horizontally wide. Once formed, persistent contrails spread over time and can become kilometres wide, lasting for several hours (Figure 2).

Contrails trap outgoing heat and reflect incoming sunlight, but on net are warming. Contrail warming is uncertain, but estimates across the scientific literature put it as comparable to CO_2 warming from aviation. This means that if contrails could be turned off it would be a powerful way to reduce warming from the sector, which is comparable warming attributable to the UK as a whole.

Since the contrail forming (ISS) regions are vertically thin and horizontally wide, it has been long theorized that contrail formation could be averted with vertical deviations (short-term altitude changes). Most often this would be flying lower in warmer air by a few thousand feet. This does mean, however, that the aircraft would fly at a non-optimal altitude for a period. While estimates vary, it looks like a 1-2% fuel penalty will be achievable in exchange for reducing or eliminating contrails – this needs to be demonstrated at scale in operational conditions - however, in the short to medium term, contrail avoidance offers a way of significantly raising ambition.

RAISING AMBITION

As has been shown, the key to raising ambition is to provide senior policy makers, investors, and industrial experts with an ability to explore the whole system – allowing them to understand the impact of multiple uncertainties – so that they can accelerate action.

We have recently taken several important steps. In April, MIT and the University of Cambridge brought together leading policy makers and academics from the UK, US, and the EU in Cambridge MA for an interactive whole systems workshop allowing real time exploration, with the aim of finding opportunities to increase ambition and action. In May these findings were taken to a roundtable held in Cambridge in partnership with the Sustainable Markets Initiative, drawing on His Majesty The King's unique convening power to bring together leading players in the field from industry, government, and academia, who each in their different ways are needed to contribute to the system level change which is required.

We believe that it is only through providing senior policy makers, investors and industry experts with the ability to understand the whole system that we will be able to raise ambition and drive the urgent action necessary to achieve net zero emissions aviation by 2050. ◆

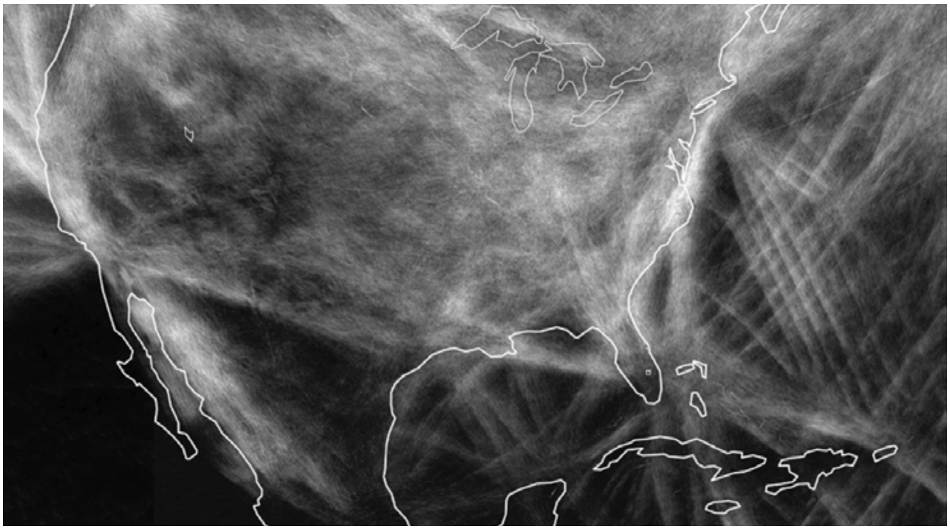


Figure 2. Contrails observed from satellites from 2018-2019

ASME
SETTING THE STANDARD

ASME
INTERNATIONAL GAS
TURBINE INSTITUTE

Turbo Expo 2024

LONDON, UNITED KINGDOM • ExCeL CONVENTION CENTER

SAVE THE DATE **June 24 – 28, 2024**

Whether you're looking for your next R&D partner or employer, discovering new research ideas, or building your company's brand, ASME Turbo Expo is where the turbomachinery community gathers. Join 2,000+ professionals from around the globe to advance your career and advance the industry.

THE 2022 PROGRAM INCLUDED:

- 2,000+ Attendees
- 1,000+ Technical Presentations, Tutorials and Panels
- 90+ Exhibitors
- Endless Networking Opportunities

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS® (ASME®) • WWW.TURBOEXPO.ORG

A Decarbonized Aviation Path with Sustainable Aviation Fuel

Joshua S. Heyne, Battelle Distinguished Professor
Washington State University

Aviation contributes around 3.5% of the total radiative forcing emissions from human activity. That number is expected to increase as other energy markets decarbonize, such as those for electric vehicles in ground transportation. Aviation is considered one of the most challenging sectors to decarbonize due to the energetic demands of flight, safety standards, current airline operations and market, the service life of aircraft, and the time needed to design, build, and certify new hardware technologies. Three alternative energy storage strategies have gained significant traction to meet industry and global 'net-zero' goals: battery electric, hydrogen, and sustainable aviation fuels (SAF).

The future is still being determined regarding the mix of these various technologies. Still, SAF offers the most straightforward path for minimizing radiative forcing emissions from aviation now, in the next several decades, and possibly, in perpetuity. All currently approved SAFs are 'drop-in,' which makes them somewhat 'boring.' (Sorry. No cool airplane model or poster needs to be the outcome of this sustainability path.) SAFs, when produced to spec, can be used interchangeably with conventional derived fuel. The rigorous process to get a new SAF pathway qualified ensures that the product is as safe or safer for use in existing infrastructure, aircraft, and engines. SAFs have similar handling (flash point), fluidity (density and viscosity), and altitude properties (freeze point) to conventional fuels. Additionally, SAFs are subject to many further specifications than conventional fuels.

It has been said that "aviation is more evolutionary than revolutionary." Safety in aviation has been accrued, in part, through historical events and many tests. While there is a fair amount of redundancy across aviation systems, there is only one fuel on aircraft today. And the current standard turbine fuel in the US and Europe has developed some passive safety features. (Visitors to my lab are often astonished to see a graduate student dip a lit match into a beaker of SAF only to see the flame extinguish.) The fuel doesn't need to be cooled or constrained to high pressures, which are active safety measures. Even ground safety is an important consideration. Airports know how to manage a kerosene fire, while hydrogen flames are nearly invisible in sunlight.

The predominant issue with SAF scale-up is that they are presently more expensive than conventional fuel. Additional relative costs for SAF are accrued through increased production costs and the availability of cheap renewable carbon. Unlike conventional crude, SAF feedstock carbon may be partially or entirely oxidized. Meaning carbon may be lost in the conversion (lowering the SAF yield), or substantially more energy is needed to upgrade the feedstock to a kerosene free of oxygen or other feedstock-related contaminants. Similarly, conventional crude production sources carbon more centrally, while SAF carbon tends to be more diffuse, like crop residues spread over a field or direct air capture of CO_2 in the atmosphere.

The cost of SAF will go down with scale and technology development. The impact of hundreds, if not thousands, of engineers working on SAF production will drive down costs. Incremental gains will be made on existing pathways with investment and time. And perhaps most importantly, new SAF pathways will be developed with new feedstocks and conversion processes. At present, there are many competing technologies to produce SAF. SAF can be made from municipal solid waste, corn ethanol, woody biomass, waste oils, and algae, to name a few. These production pathways will have their costs reduced in time. In parallel, many new technologies are being developed for SAF production. For example, five companies are currently engaged with ASTM to qualify a new methanol-to-jet process to produce SAF. Methanol has traction in other transportation markets, like shipping, and is already a $20+ billion industry. Continued public and private investment in SAF technologies can form a virtuous feedback cycle to reduce costs and increase production (see Figure 1).

The radiative emissions from aviation stem from CO_2 and non-CO_2 emissions, like contrails and nitrous oxides. It's been estimated that most of the radiative forcing from aviation is due to non-CO_2 impacts, with the most significant potential contributor being contrails. Contrails and their resultant persistent cloudiness are partly influenced by the soot or non-volatile particulate matter from aircraft in flight. SAF and alternative flight patterns can potentially decrease the formation of these contrails from aviation. Specifically, some SAFs emit substantially less soot than conventional fuels, and avoidance strategies in flight patterns could mitigate contrail formation even without SAF usage (see Figure 2).

Things are changing fast. The idea that aircraft could be powered by hydrogen and battery electric propulsion wasn't much more than a faint dream some years ago. Now both technologies are demonstrating feasibility. Similarly, an ASTM working group is currently discussing a 100% 'non-drop-in' SAF spec for aviation that could minimize contrails and drive down SAF costs. However, new infrastructure, logistics, and aircraft certifications will be required. Tight tolerances can drive costs up, and current specifications have very tight tolerances. There is the opportunity to develop aircraft in the coming decades with broader tolerances to the fuel while maintaining safety. A drop-in 100% SAF with low carbon intensities is the most powerful lever for aviation's 'net-zero' 2050 future. But, an evolutionary change to a spec, planned with decades of lead time, could enable more renewable carbon into aviation and drive down costs.

Overall, reports from governments, industrial organizations, and ICAO consistently state that SAF will have the majority burden to reduce aviation's environmental impact by 2050 (>73 to 60% in most reports). Therefore, the US government has passed legislation to support SAF production and established the SAF Grand Challenge to facilitate the domestic production of 3 billion gallons of SAF by 2030 and 35 billion gallons of SAF by 2050. In that challenge, SAF must have a carbon intensity (CI) of less than 50% of conventional fuel. Of note, due to the relatively high uncertainty of soot on contrails and the radiative forcing of contrails, the carbon intensity of SAF only includes the considerations of CO_2 via life cycle analysis emissions. The SAF Grand Challenge is being led by the DOT/FAA, DOE, and USDA in coordination with EPA. More details of this effort can be found in the SAF Grand Challenge Roadmap*.

SAF production will need to approximately double annually in the US every year between now and 2030 to meet the first goal. Last year SAF production more than tripled the previous year. Rough tracking of planned commercial activities in the US by CAAFI illustrates a path to 1.188 billion gallons of SAF production capacity in 2027, putting the 2030 goal in sight. Accomplishing that goal, in my opinion, is nothing short of revolutionary. ◆

*SAF GRANT CHALLENGE CAN BE FOUND HERE

energy.gov/eere/bioenergy/articles/sustainable-aviation-fuel-grand-challenge-roadmap-flight-plan-sustainable

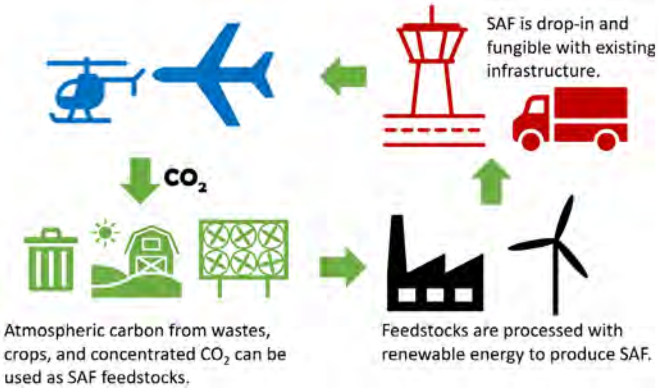


Figure 1. the SAF lifecycle

Figure 2. Flame using conventional fuel (left) vs. SAF (right)

ASME IGTI Division Executive Committee and ASME Gas Turbine Technology Group Appoint New Members

THE ASME IGTI EXECUTIVE COMMITTEE WELCOMES NEW MEMBERS

The IGTI Executive Committee Chair is pleased to announce the appointment of Douglas Hofer, Southwest Research Institute, as the 2023 – 2024 IGTI EC. Dr. Hofer welcomes three new executive committee members: Rich Dennis; Dimitra-Eirini Diamantidou, Mälardalen University; and Dr. Natalie R. Smith, Southwest Research Institute.

Rich Dennis
Treasurer
Retired

Dimitra-Eirini Diamantidou
Student Advisory Committee, Past Chair
Mälardalen University

Natalie R. Smith, PhD
Turbo Expo Organizing Committee Liaison
Southwest Research Institute

THE ASME GAS TURBINE TECHNOLOGY GROUP (GTTG) WELCOMES NEW MEMBERS

The GTTG is pleased to announce the appointment of Susan Scofield, Siemens Energy, as the 2023 – 2024 GTTG Chair. Susan Scofield welcomes three new technology group members: James Heidmann, NASA; Michael Koenig, Siemens Energy; and Christian Steinbach, MAN Energy Solutions.

James Heidmann, PhD
NASA

Michael Koenig, PhD
Siemens Energy

Dr.-Ing. Christian
SteinbachMAN Energy Solutions Schweiz AG

Awards Information

Congratulations to all award recipients and thank you to all ASME IGTI committee award representatives whose work assists the awards and honors chair and the awards committee in the recognition of important gas turbine technological achievements. Thank you to William T. Cousins for serving as the IGTI Honors and Awards Committee Chair, John Gülen as Industrial Gas Turbine Technology Award Committee Chair, and Konstantinos Kyprianidis as the Aircraft Engine Technology Award Committee Chair.

2023 ASME R. TOM SAWYER AWARD

Dr. Karen A. Thole, Distinguished Professor, Pennsylvania State University

2021 ASME GAS TURBINE AWARD

Jinwook Lee, Space Exploration Technologies Corp.

Zoltán S. Spakovszky, Massachusetts Institute of Technology

Edward M. Greitzer, Massachusetts Institute of Technology

Mark Drela, Massachusetts Institute of Technology

Jérôme Talbotec, Massachusetts Institute of Technology

2021 JOHN P. DAVIS AWARD

Dale Tree, Professor and Chair of Mechanical Engineering, Brigham Young University

Darrel Zeltner, Performance Engineer, Solar Turbines

Mohsen Rezasoltani, Principal Engineer, Solar Turbines

Dustin Badger, Brigham Young University

2023 DILIP R. BALLAL EARLY CAREER AWARD

Raghu Kancherla, Senior Combustion Aerothermal Engineer, Power Systems Mfg. LLC.

2023 INDUSTRIAL GAS TURBINE TECHNOLOGY AWARD

Vittorio Michelassi, Chief Consulting Engineer, Baker Hughes

2023 ASME DEDICATED SERVICE AWARD

Ricardo Martinez-Botas, Professor of Turbomachinery, Imperial College

Natalie R. Smith, Group Leader, Southwest Research Institute

2023 AIRCRAFT ENGINE TECHNOLOGY AWARD

Anestis Kalfas, Professor of Fluid Mechanics and Turbomachinery, The Aristotle University of Thessaloniki

2023 IGTI SCHOLAR AWARD

Dr. Rakesh K. Bhargava, Founder & President, Innovative Turbomachinery Technologies Corp

ASME Turbo Expo Early Career Engineer Travel Award

Lakshya Bhatnagar

Louis Christensen

Luca Fantaccione

Vasilis Gkoutzamanis

Jim Hickey

Rory Hine

Richard Hollenbach III

Melissa Kozul

Eric Kurstak

Oguzhan Murat

Preethi Rajendram Soundararajan

Bryan Rodriguez

Neha Singh

Ananth Sivaramakrishnan Malathi

Jose Torres

Dung Tran

Ladislav Vesely

Alexander Wildgoose

Peter Wilkins

Yu Xia

Student Advisory Committee Travel Award Winners

Achinie Warusevitane

Akchhay Kumar

Anand Darji

Andrea Notaristefano

Antonino Torre

Deepanshu Singh

Evan Lundburg

Gustavo Lopes

Konstantinos Papadopoulos

Mizuki Okada

Noraiz Mushtaq

Pratikshya Mohanty

Ryan Wardell

Sean Hanrahan

Sergio Martinez

Taha Sherif

Troy Krizak

Umang Rathod

Vamsi Krishna Undavalli

Zhenhao Jing

Upcoming Award Opportunities

2025 ASME IGTI SCHOLAR AWARD

SEPTEMBER 1

2024 ASME IGTI AIRCRAFT ENGINE TECHNOLOGY AWARD

OCTOBER 15

Nominate *form.jotform.com/230728016407148*

2024 INDUSTRIAL GAS TURBINE TECHNOLOGY AWARD

OCTOBER 15

Nominate *form.jotform.com/231096473905157*

2024 STUDENT SCHOLARSHIPS

OPENS DECEMBER 2023

Applications process *www.asme.org/asme-programs/students-and-faculty/scholarships*

Turbo Expo 2023 Goes to Boston

ASME Turbo Expo 2023, in Boston, MA, USA, maintained its reputation as the world's premier turbomachinery conference with over 2000 professionals. Throughout the week, delegates shared practical experiences, knowledge, and ideas on the latest turbine technology trends. Over 1000 peer-reviewed technical presentations provided insight into the minds of industry professionals and students.

This year's Turbo Expo theme "Collaborate, Innovate & Empower – Propulsion & Power for a Sustainable Future" was woven into the conference's keynote and plenary sessions. Turbo kicked off the week addressing solutions and pathways forward that strive to balance sustainability, reliability, and affordability within the turbomachinery industry. Mark Cousins, CTO, Universal Hydrogen; Anne E White, Department Head of the Nuclear Science and Engineering Department, MIT; and Flavio Leo, Director, Aviation Planning and Strategy, Director, Aviation Planning and Strategy, Massachusetts Port Authority joined the stage for the keynote "Pathways to Net-Zero Carbon Emission" igniting excitement for the weeks long conference.

Turbo Expo 2023 buzzed with the excitement of the turbomachinery industry creating new ideas and generating productive connections between professionals. On Monday evening 1800 turbomachinery experts attended the welcome reception and enjoyed the opportunity to socialize with professionals from industry and academia. The Celebrating Women in Engineering networking event was a great success with speakers from GE Aerospace, Pratt & Whitney, and Cadence sharing their journey building successful careers in turbomachinery. With a new Networking format over 500 early career engineers and students met with various IGTI committees to enhance their turbomachinery journey and connect with organizations looking to hire the next generation of turbomachinery professionals.

This year's three-day exhibition featured almost 120 exhibitors from 23 countries. The exhibit floor was filled with activity as exhibitors and attendees networked and discussed future collaborations.

The exhibition floor is now open for ASME 2024 Turbo Expo in London. Contact igtiexpo@asme.org for sponsorship and exhibiting opportunities to meet your marketing budget and find the Exhibition floorplan online at 2024 | Turbomachinery Technical Conference & Exposition | Jun 24-28 (asme.org) to select your location. A special thanks to the sponsors that support the event. At the Platinum and most prestigious level, Ansys, GE Aerospace & Rolls Royce. Silver sponsors were Cadence and Nasa. The Bronze level was supported by Baker Hughes, Hyphen Innovations, and Solar Turbines.

Please plan to attend **Turbo Expo 2024 in London, England, United Kingdom, June 24-28** to participate in the turbomachinery industry's most highly recognized conference and exhibition.

TELL US WHAT YOU THINK-TURBO EXPO'S HOT TOPICS

The GTTG's Communications Committee wants to hear from you!

Let us know what your areas of interest from Boston's Turbo Expo were, to help us pursue articles that will best resonate for our upcoming Global Gas Turbine News segment.

PLEASE EMAIL AHMEDH@ASME.ORG WITH YOUR INPUT. WE LOOK FORWARD TO HEARING FROM YOU.

Thank you!
Your GTTG Communications
Committee Leadership