



the **ENERGY** lab

PROGRAM FACTS

Hydrogen Turbines

University Turbine Systems Research Program

Overview

The University Turbine Systems Research (UTSR) Program addresses scientific research to develop advanced turbines and turbine-based systems that will operate cleanly and efficiently when fueled with coal-derived synthesis gas (syngas), hydrogen fuels, and other fossil fuels. This research focuses on the areas of combustion, aerodynamics, heat transfer, and materials in support of the Department of Energy (DOE) Office of Fossil Energy's (FE) Hydrogen Turbine Program goals.

These goals are advanced by an informal network of universities, the collaborating gas turbine (GT) industry, and the FE Hydrogen Turbine Program. UTSR also offers a Gas Turbine Industrial Fellowship funded by sponsoring GT manufacturers. This fellowship helps to facilitate the transition of the best students from academia to the GT industry, thereby helping to maintain U.S. leadership in this important technology area.

UTSR projects are established through a bi-annual competitive solicitation open to all U.S. universities. Solicitation R&D topics are established in response to FE program goals and given specific focus through communications with the GT industry. An annual UTSR workshop is held to facilitate technical communications between the GT industry, academia, and the DOE and to provide a critical peer review of UTSR projects.



UTSR Projects

UTSR projects focus on the areas of aerodynamics, heat transfer, combustion, and materials in support of the DOE Office of FE's Hydrogen Turbine Program goals. Listed below are current topical areas being addressed by universities through the UTSR Program:

Aero-Heat Transfer

Designing turbine endwalls for deposition resistance, endwall contouring and leading edge film cooling for improved aerodynamics, deposition and film cooling effects, trenched film cooling and contoured endwalls and cooling of vane leading edges.

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CURRENT UTSR UNIVERSITIES

Georgia Institute of Technology
Louisiana State University
Ohio State University
State University of New York
Purdue University
Virginia Tech
Tennessee Technological University
Texas A&M University
University of California–Irvine
University of Connecticut
University of Michigan
University of North Dakota
University of Pittsburgh
University of South Carolina
University of Texas–Austin

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U.S. DEPARTMENT OF
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Combustion

Combustion stability, combustion flashback, validation of H₂-CO-air combustion kinetics, turbulent flame speed measurements and modeling, experimental and numerical modeling of mixing processes, high pressure kinetics, multi nozzle combustor dynamics, flame speeds, pressure gain combustion, high pressure oxy-fuel combustion and NO_x kinetics with contaminants and dilution.

Materials

Degradation of thermal barrier coatings (TBC) by deposition, materials for oxy-fuel turbo machinery, effects of hafnia-based nanostructure on TBC, understanding protective oxide and TBC degradation, and computational designs for new TBC.

UTSR Industry Stakeholders

Industry involvement and leadership help guide university research to keep it relevant and to set the highest standard for project execution. The GT industry provides leadership to define the thrust of the research program solicitation consistent with DOE goals and technical experts to evaluate the university research proposals. In many ways, the GT industry is the customer for this government-funded, university-performed research; this relationship drives R&D excellence. Graduate students who assist in R&D project execution often participate in the fellowship program and are ideally situated to matriculate to the GT industry. Industry involvement includes the following:

- Recommendation of research topic areas.
- Evaluation of university proposals.
- Review and collaborative support of ongoing university research.
- Funding to the Fellowship Program.
- Hosting of UTSR Fellows.
- Participation in the annual UTSR workshops.

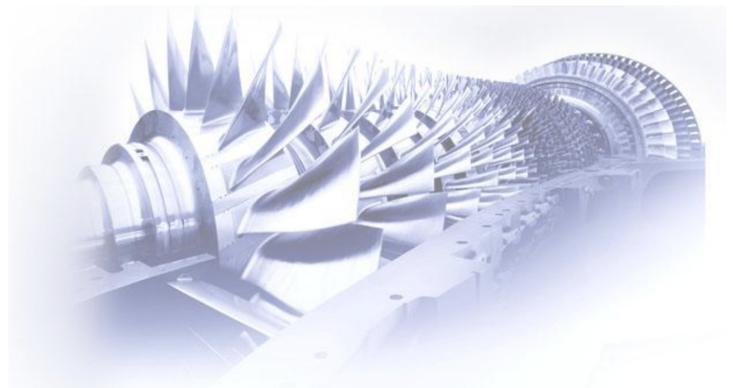
Industry committee members are as follows: FlexEnergy, Florida Turbine Technologies, General Electric, Siemens Energy, Solar Turbines, and Woodward.

Gas Turbine Industry Fellowship

The Gas Turbine Industrial Fellowship (GTIF) Program, implemented by Southwest Research Institute (SwRI), is a key part of the UTSR effort. GTIF provides undergraduate and graduate level science and engineering students with the opportunity to conduct research, engineering, and design projects with leading GT industry sponsors who are members of the UTSR industry committee. Under the guidance of industry experts, selected students complete a 10–12 week summer project in a variety of areas that include heat transfer, aerodynamics, combustion, thermodynamics, advanced materials and coatings, design, manufacturing, and test and evaluation. Students prepare a final report and presentation on their project for distribution to the industry sponsors and posting on the UTSR website. GTIF provides distinct benefits for anyone considering employment in the GT industry or a related field.

UTSR Workshop

The UTSR workshop is held each fall at different university venues across the country. The workshop brings together experts from academia, industry, and government for presentation and discussion of ongoing UTSR research projects. A poster session is held during the workshop to display newly awarded UTSR projects, UTSR Fellowship assignments, and other turbine-related programs.



For more details on the UTSR Program and workshop please visit the following web links:

<http://www.netl.doe.gov/events/conference-proceedings>

and

<http://www.netl.doe.gov/research/coal/energy-systems/turbines/university-turbine-systems-research>