



CAPE

**Consortium for Advanced Production and Engineering of
Gas Turbines and Rotating Machinery**

NIST Advanced Manufacturing Technology Consortia (AMTECH) Program

**U.S. Department of Energy-NETL
University Turbine Systems Research Workshop
November 3, 2015**

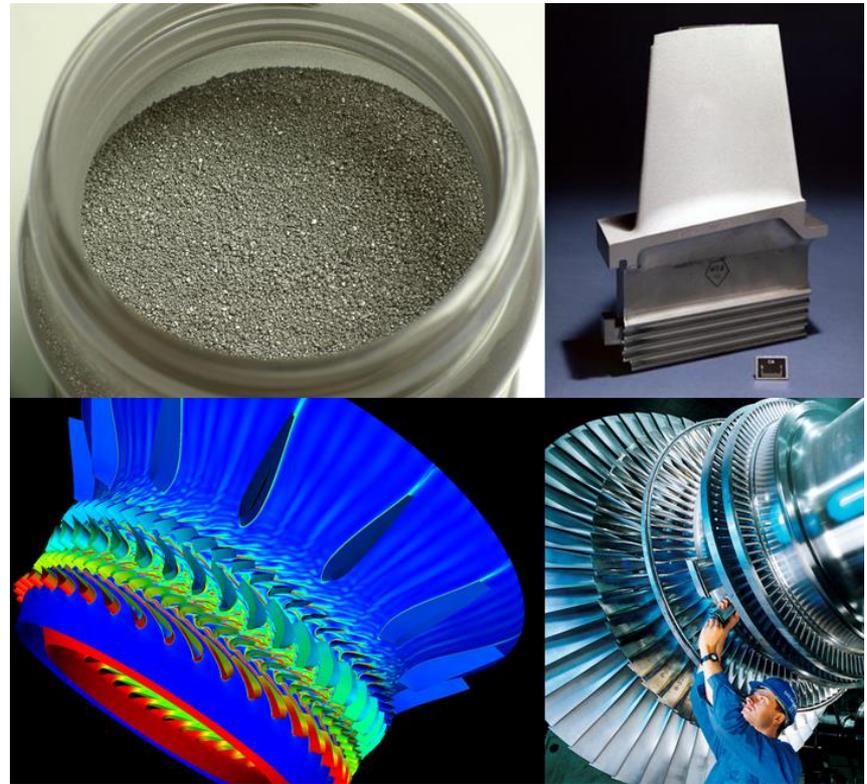
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CAPE Turbine Industry Materials Standards Roadmap

With the support of a NIST AMTech planning award, Energy Florida and the Gas Turbine Association (GTA) have jointly established the Consortium for Advanced Production and Engineering of Gas Turbines and Rotating Machinery (CAPE).

The CAPE's initial focus will be to roadmap and outline standards for new industrial materials, accelerating the introduction of innovative new materials into the design and manufacturing process for turbines and rotating machinery.



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Energy Florida



Energy Florida is the industry-led nonprofit association developing partnerships and marshalling resources to grow the energy sector and related industries across Florida, the Southeastern US, and Latin America and the Caribbean.

We are Building America's Energy Economy



What is AMTech?

The Advanced Manufacturing Technology Consortia (AMTech) Program

Launched by NIST in FY 2013 to incentivize the formation of industry-driven consortia and roadmapping activities in order to

- Support basic and applied research
- Develop long-term, pre-competitive, and enabling technology for the U.S. manufacturing industry



The goal of AMTech-supported consortia is to strengthen the capacity of U.S. industry and the nation to compete in global markets.

The CAPE – Consortium for Advanced Production and Engineering of Gas Turbines and Rotating Machinery

Goals:

- Support the development of a robust industry-led consortium and technology development strategy focused on turbines, rotating machinery, and related processes and materials.
- Strengthen the United States' position as a world-class developer, manufacturer and exporter of turbines and related parts and components.



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Overall Focus of the CAPE Material Standards Roadmap Project

Outline the necessary steps for developing new industrial materials, testing standards and certification parameters enabling the introduction of new materials into the manufacture of gas turbines and rotating machinery.

The project will accomplish this by focusing on the following areas:

- Material characterization and certification
- Qualification Standards for new materials
- Characterization and Standardization of new processes

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Current End-state Technical Goal(s) for Next-Generation Gas Turbines

- 65%-67% Efficiency for NG Combined Cycles by 2027
- ~1700+°C Operating Temperature

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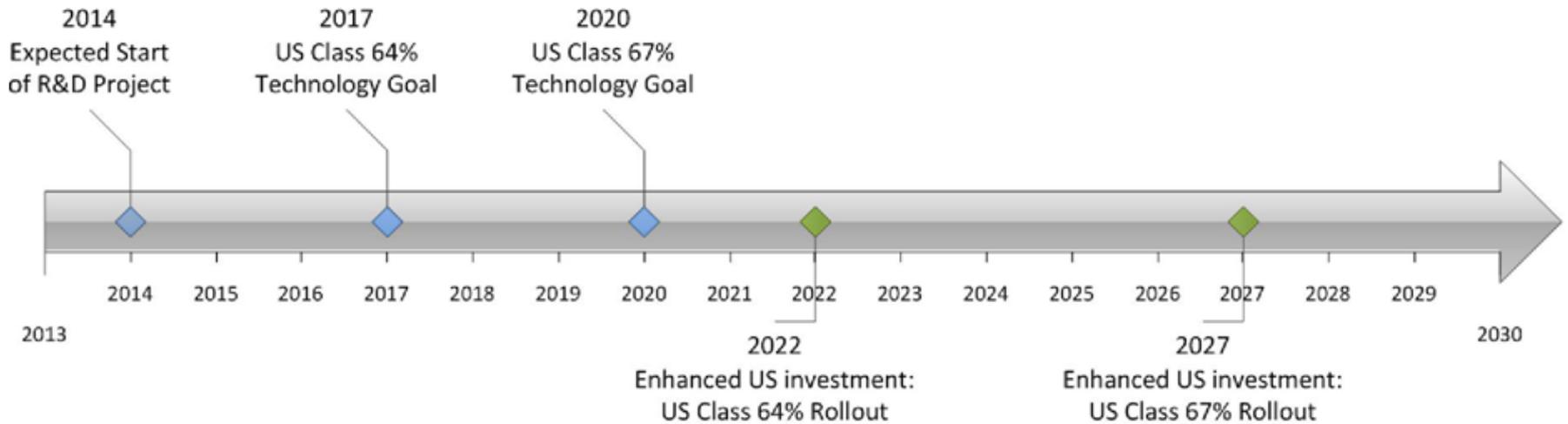


Presidential Energy Goals

- Reduce energy-related greenhouse gas emissions by 17 % by 2020 and 83% by 2050 from 2005 baseline.
- By 2035, 80% of America's electricity will come from clean energy sources.



Timeline/Implications of Gas Turbine Association's 67% NG Combined Cycle Efficiency Goal

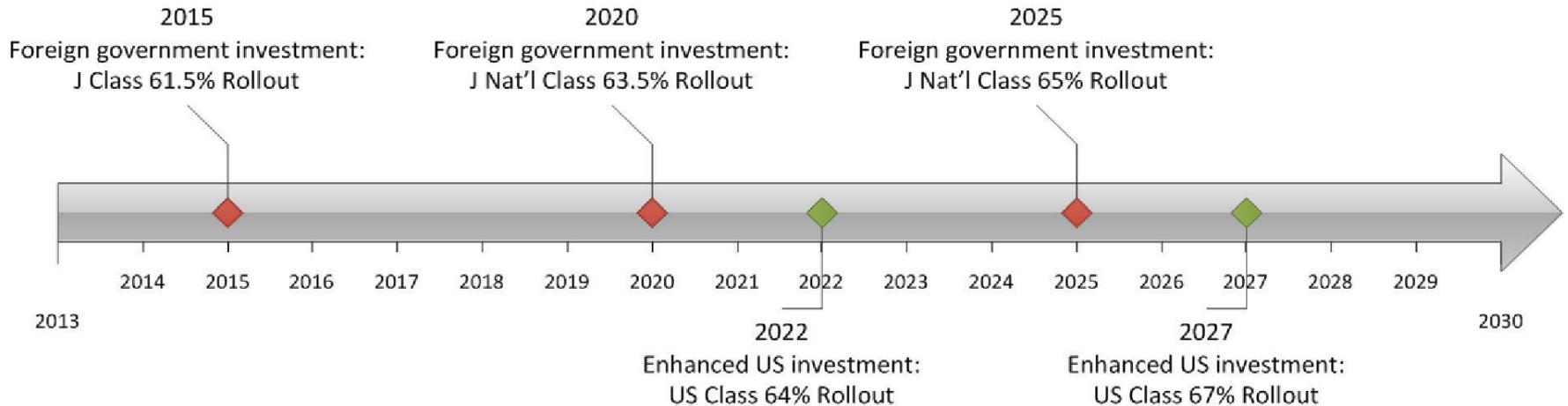


- 2013 GTA task force recommended a US Gov't Advanced Gas Turbine R&D investment program of \$50 million/year for seven years (2014-2020, \$350M total)
- Targeted ~4 years from start of program to achieve 64% efficient design, 7 years from start for 67% design, would take 5 to 7 years after technology design targets are met to achieve commercial manufacturing and unit delivery (rollout)

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Impacts of Foreign Gov't Investments in Advanced Gas Turbine R&D on US Industry Competitiveness

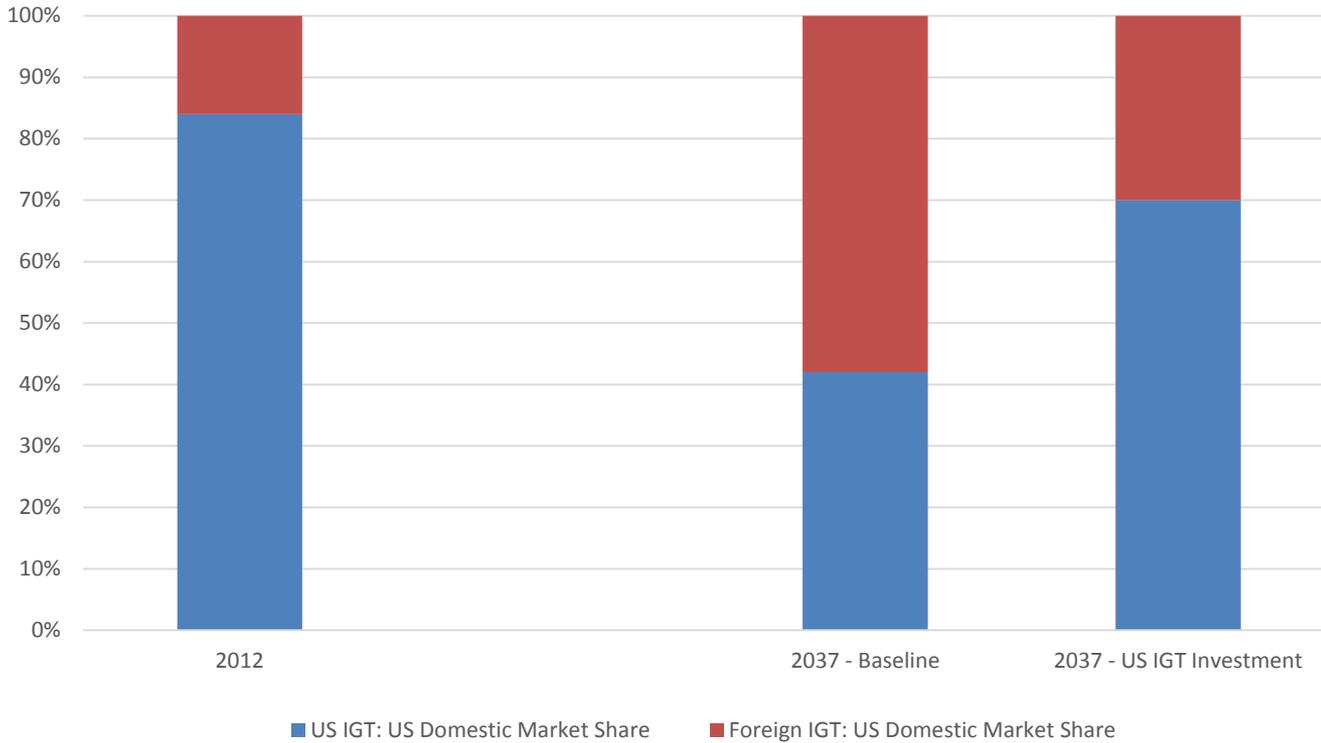


- Foreign Government investment in Advanced Gas Turbine R&D programs is creating a potentially significant competitive advantage unless US industry & government respond by increasing investments in advanced gas turbine R & D

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Impact of US Investment in Next-Generation Gas Turbines on US Industry Competitiveness, 2012-2037



- ICF/GTA estimates that unless investments are made, US industry's share of our domestic market ***could be cut in half*** by 2037.
- With US R&D investment, US industry retains more than 2/3rds of US domestic market share by 2037.



How CAPE will benefit US Turbine Industry Competitiveness

- Higher efficiency of combined cycle generation = higher operating temperatures
- Higher operating temperatures will require new classes of materials (as well as new manufacturing techniques, improved cooling architecture, etc.) in order to support the manufacturing and operating requirements of new machines
- CAPE Turbine Material Standards Roadmap will set out the areas that industry and government should look to invest in to accelerate the development of a new class of gas turbine designs
 - Provide a venue for industry dialogue and collaboration on topics of common interest and collective need, outline & catalyze pathfinder/demonstration projects
 - Coordinate pilot projects in areas of greatest promise or technical impact
 - Assess adaptation of advances from aviation engine industry or other relevant sectors

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Initial Technical Areas of Interest

- Considering Basic Qualification Standard for material to be considered for use in Industrial Gas Turbine (IGT) applications
- Recommend protocol(s) for Original Equipment Manufacturers (OEMs) to define for prospective material candidates / materials suppliers to meet
 - Define what a new material or process would need to undergo in terms of testing and verification in order to meet the standard(s) that IGT OEMs would want to see
 - Speed the acceptance of new materials within the industry through adherence to a common “playbook” for assessment of those materials
- Connect with university research programs to help define parameters that are helpful/useful in the “real world” industrial gas turbine engineering environment
 - Provide a more direct link between OEMs and leading design and engineering firms and resources in the university research community
 - Expand the pipeline of technical solutions available from UTSR and similar research programs into the IGT manufacturing industry’s development process



Topics of Interest: Processes

- Additive Manufacturing / Rapid Prototyping
- Joining of Disparate Materials
- Impact of manufacturing process(es) on material properties
- New Non-Destructive Evaluation and Modeling techniques
- Repair/Reconditioning techniques



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CAPE Roadmap: Process Timeline

Stage 1. Gathering Data – *Fall 2015 – Spring 2016*

Stage 2. Review & Evaluate – *Fall 2015 / Winter 2016*

Stage 3. Prioritize, Down-select & Refinement – *Winter 2016*

Stage 4. Roadmap Draft Production & Review – *Spring 2016*

Stage 5. Release & Distribution – *Summer/Fall 2016*

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Timeline & Upcoming Events

- Roadmap Information Gathering & Technical Expert Review – Fall 2015
- DOE Adv. Mfg. Ofc. Workshop on Materials for Harsh Service Conditions, (Pittsburgh, PA), November 19-20, 2015
- Power-Gen (Las Vegas, NV) – December 9, 2015
 - Workshop to review CAPE roadmap findings to date, prioritize areas of focus
- CAPE Workshop – February 2016 - assess specific challenges in areas of focus, identify implementation projects, goals, partners & resources
- Initial Technical Challenges Report - June 2016 (target)
- CAPE Stakeholders Summit at ASME Power & Energy (Charlotte, NC) - June 26-30, 2016

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CAPE Project Contacts

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Gas Turbine Association (GTA) – www.GasTurbine.org

- The Gas Turbine Association is the unified voice for the U.S. gas turbine industry. Representing all major power gas turbine equipment manufacturers, the mission of the Gas Turbine Association is to provide the information needed to fully realize the industry's vast potential.
- **GTA Contact:** Dr. Bill Day, Managing Director, billday3@gasturbine.org



Thank You!

- For more information: www.EnergyFlorida.org

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