

# Next Generation Turbine Program



*Advanced Turbine Systems  
Conference*

*December 6, 2000*

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**Strategic Center for Natural Gas**



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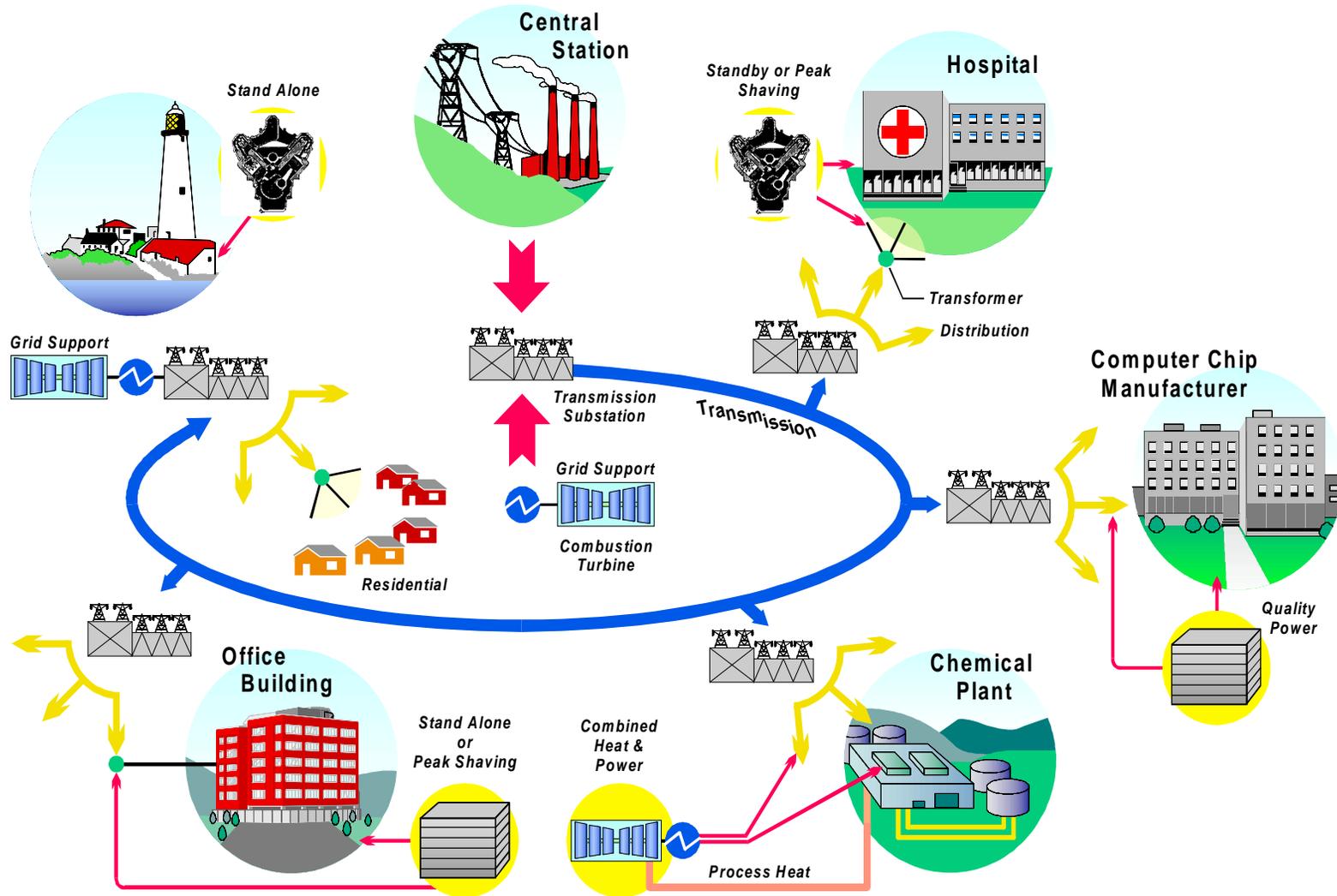
# **A Need Exists for Continued Government Investment in Gas Turbines**

## ***Significant Messages from Industry***

- **Growing worldwide demand for electricity**
- **Tightening environmental requirements**
- **Declining R&D budgets in restructured U.S. electric industry**
- **Need flexible power generating technology:**
  - Fuel flexible (coal, oil, gas, biomass)
  - Satisfy intermediate/peak loads
  - Low operating costs
- **Maintain U.S. leadership in multi-billion dollar global power market**



# Power Generation Markets



Green Power



Ancillary Services



Peaking & Intermediate Load



Next  
Generation  
Turbine Market  
Applications

Cogeneration



Repowering



Military



# Vision - Clean, Reliable Power Supply

*Develop advanced technologies that will significantly improve the performance, operation, and reliability of gas turbine power plants while maintaining United States industry leadership in global electric power markets. These technologies will support the continued supply of lowlife cycle cost, clean, and reliable gas turbine based power for the United States.*



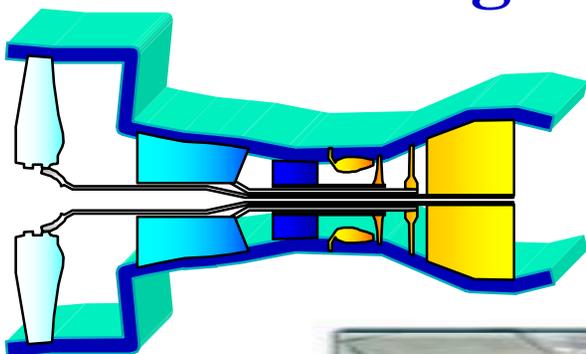
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## Program Goals

- Reduce life-cycle cost and improve reliability, availability, and maintainability of existing and advanced turbine power plants
- Develop and demonstrate ultra-clean, high performance turbine power systems for near-term markets and long-term Vision 21 integration
- Develop critical technology to solve cross-cutting technical barriers
- Collaborate with agencies and develop sound technical information to produce appropriate and beneficial regulatory decisions related to gas turbine power plants



# Program Focus Areas

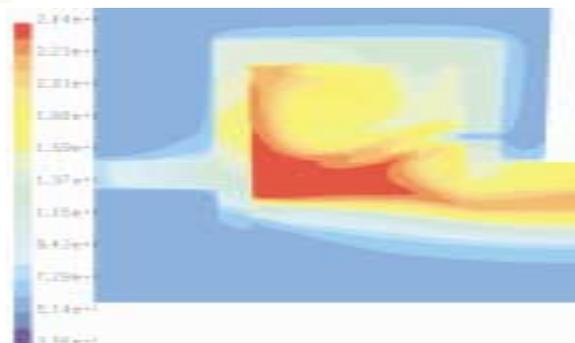


*Systems Development  
and Integration*

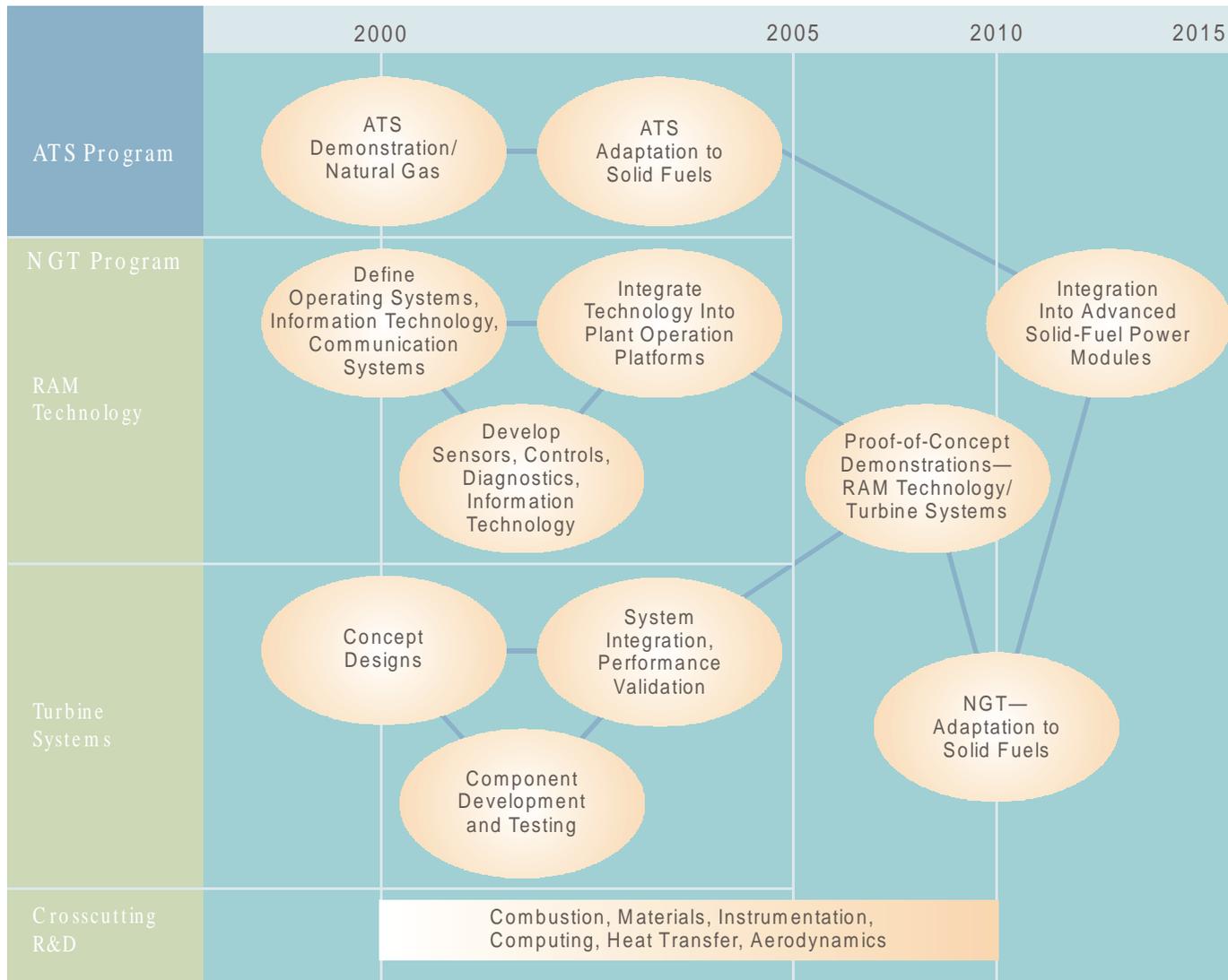


*Reliability,  
Maintainability,  
and Availability  
Improvement*

*Cross-cutting  
Research and  
Development*



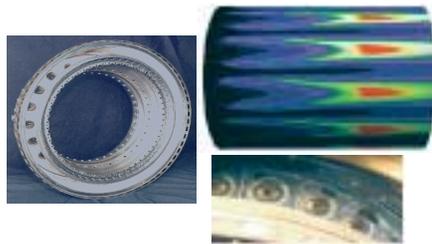
# Program Roadmap



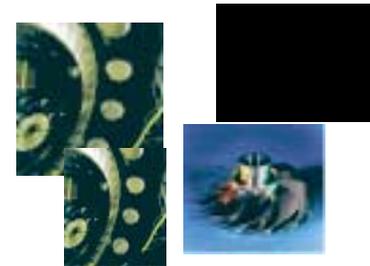
# NASA/DoD/DOE Collaboration

## *Several Areas of Research and Testing*

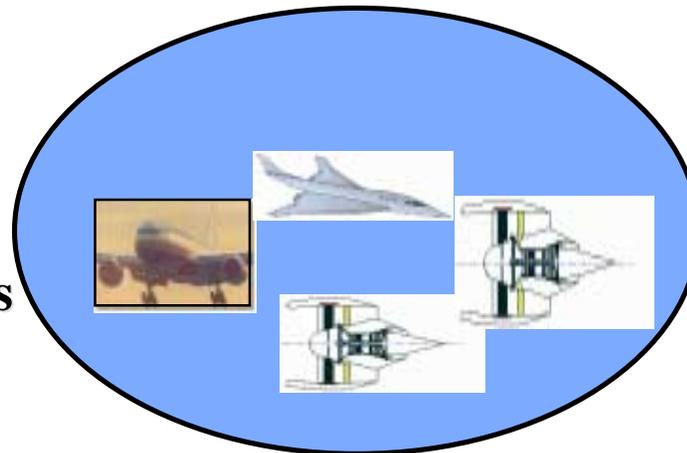
### Combustion



### Turbomachinery



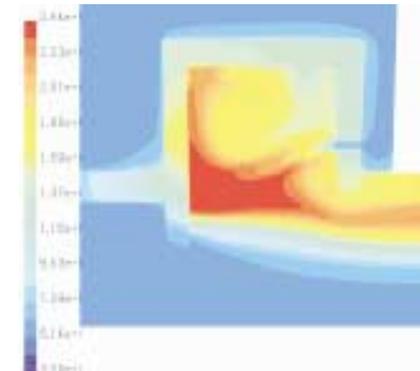
### Intelligent Engines



### Materials and Structures



### Advanced Computing



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## Goals and Objectives

- **Determine the feasibility of developing >30MW flexible gas turbine systems that, compared to 1999 state-of-the-art systems, shall include:**
  - Improved system efficiency of 15% or higher
  - 50% or higher improvement in turndown ratios
  - 15% or higher reduction in the cost of electricity
  - Improved service life
  - Reduction of emissions
  - 15% or higher reduction on O&M and capital costs
  - Flexibility of at least 400 starts per year
  - Improvement of RAM
  - Capability to use multiple fuels



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# Next Generation Turbine (NGT) Systems Studies

- **Conduct Market Assessment**
- **Identify Ability to Serve Multiple Applications**
- **Vision 21 Adaptability**
- **Public Benefits**
- **Enabling Technologies Roadmap**
- **Development Plan & Cost**
- **Development Schedule**



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# NGT Systems

## *General Electric Power Systems*

- **Cost:** \$1,067,830
- **Start Date:** July 11, 2000
- **Duration:** 15 months
  - Market analysis
  - Options screening
  - Detailed analysis of candidates
  - Enabling technologies
  - Analysis of benefits
  - Multiple uses analysis



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# NGT Systems

## *Pratt and Whitney*

- **Cost:** \$860,149
  - **Start Date:** August 16, 2000
  - **Duration:** 17 Months
- 
- Confirm component performance goals and decide what technologies are needed for 48% efficiency
  - Estimate off design performance/operability
  - Define materials, parts count, etc. for recurring cost estimate, and designs of components
  - Define development program cost and schedule



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# NGT Systems

## *Rolls Royce*

- **Cost:** \$762,133
  - **Start Date:** September, 2000
  - **Duration:** 12 Months
- 
- Rolls-Royce Energy engine/skid products suited for NGT
  - Initial cycle performance assessment show NGT power/efficiency goals can be achieved



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# NGT Systems

## *Siemens-Westinghouse*

- **Cost:** \$850,127
  - **Start Date:** July 13, 2000
  - **Duration:** 15 Months
- 
- Evaluate standard base design with technology modules to address specific markets >30MW
  - Assess technology modules and enabling technologies
  - Compare configurations against cost, performance goals



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# **Fabricate and Test an Advanced Non-Polluting Turbine Drive Gas Generator**

*Clean Energy Systems, Inc.*

- **Cost:** \$2,716,685
  - **Start Date:** September, 2000
  - **Duration:** 22 Months
- Test and evaluate a 10-MW prototype gas generator
  - Obtain parametric data to characterize performance
  - Assess gas generator and turbine integration issues



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# Development & Testing of a Mach 2 Pre-Prototype Ramgen Engine for the Demonstration of an Advanced Power System

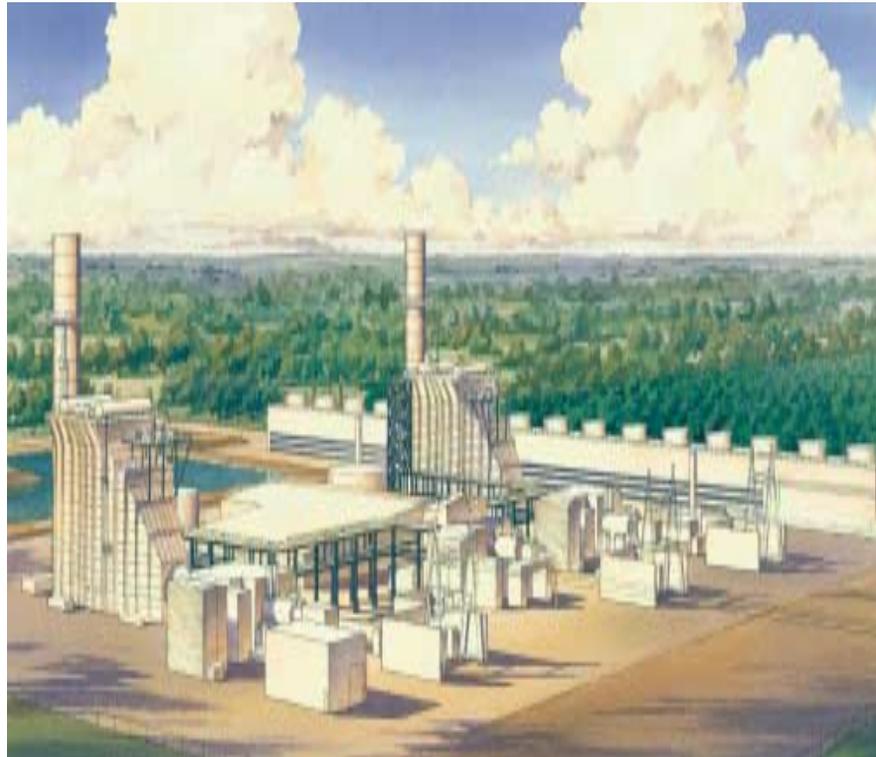
## *Ramgen Power Systems*

- **Cost:** \$1,815,937
  - **Start Date:** September, 2000
  - **Duration:** 8 Months
- Testing continues at the Tacoma, WA facility to address:
- rotor drag/instrumentation
  - fuel injection/mixing
  - cooling
  - monitoring
  - noise reduction



# Upcoming Solicitations -- Fiscal Year 2001

- Targeted Solicitation- July, 2001
- Systems Design, Component Testing, and Integration
- Five to six year project



*Systems Development and Integration*



# Upcoming Solicitations -- Fiscal Year 2001

- Fossil Energy Broad Based Financial Assistance
- Release Date - December, 2000
- Five-year projects
  - Teams to development, integrate, and demonstrate advanced IT and plant operations platforms



***RAM Technology Improvement***



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# NGT Program Benefits

- **Potential U.S. Market (year 2005-2015) - 160GW**
- **By year 2015, cumulative savings:**
  - 4,900 trillion BTU of primary energy
  - \$6,900 million in fuel savings
  - 490 million metric tons in reduced CO<sub>2</sub> emissions
  - 0.55 million metric tons in reduced SO<sub>x</sub> emissions
  - 1.1 million metric tons in reduced NO<sub>x</sub> emissions
- **Maintain U.S. industry competitive position in growing international power markets**
- **National solutions for power and defense -- Collaboration between agencies**



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# Challenges for the New Millennium

- Advanced Turbine Systems Program -- *field validate goals by the year 2002*
- Address tomorrow's needs - *NGT Program*
- Maintain DOE investment in turbine power R&D - *Maintain U.S. industry competitiveness*
- Continue government/industry collaborations across propulsion & power - *leverage our resources*

*Ensure that the United States has a plentiful supply of clean, reliable electricity for the new millennium!*

