FACT SHEET

I. PROJECT PARTICIPANTS

	Company Name	Role of Participants
Project Execution	Siemens Power Generation	Overall Project Execution, Lead Technology Development
Subcontractors	CS&E	Combustion Modeling
	ENEL	Combustion Testing
	University of Central Florida	Hydrogen Kinetic Mechanism Experiment
	Georgia Tech.	Flame Characteristics Experiment
	University of Central Florida	Advanced Turbine Cooling Concepts Studies, TBC testing
	University of Florida	Advanced Alloy Studies
	Texas A&M University	Advanced Turbine Cooling Configuration Studies
	ConocoPhillips	Gasification Technology
	FTT	Engine Performance Calculation, Turbine Components Design
	Trans-Tech	TBC Powder Development
	Engelhard	TBC Application Testing

II. PROJECT DESCRIPTION

A. Objective(s) –

The objective of this project is to design and develop a fuel flexible (coal derived hydrogen or syngas) gas turbine for IGCC and FutureGen type applications that meets DOE turbine performance goals. The overall DOE Advanced Power System goal is to conduct the research and development (R&D) necessary to produce coal-based IGCC power systems with high efficiency (45-50% (HHV)), near-zero emissions (2 ppm_v NOx @ 15% O_2) and competitive capital cost (< $1000/kW).

This project will be implemented in two phases entitled Phase I–Conceptual Design and R&D Implementation Plan: Concept to Commercial Deployment; and Phase II–Detailed Design and Validation Test Program. The objectives of these two phases are:

Phase I–Conceptual Design and R&D Implementation Plan: Concept to Commercial Deployment -- Develop an R&D Implementation Plan that defines in detail the approach, options, cost, risk, schedule and deliverables associated with the R&D required to meet DOE goals and objectives, develop a conceptual design of the turbine that meets program goals, produce power system level performance models / simulations to show these conceptual turbine designs deployed in likely IGCC and FutureGen applications, and conduct the necessary R&D needed to focus or direct Phase II work.

Phase II–Detailed Design and Validation Test Program – Develop detailed designs of components and systems required to meet the project objectives, develop validation test plans for systems and components, perform validation testing of systems and components, demonstrate the ability to attain the Turbine Program performance goal.

B. Project Relevancy –

- Reduced natural gas/oil consumption
- Energy self-sufficiency
- Reduced Greenhouse emissions
- Improved U.S. competitiveness along with increased global co-operation on FutureGen
- Creation of high quality U.S. jobs
- Reduced IGCC plant capital cost
- H2 co-production for transportation
- Increased U.S. energy production with sequestered CO2

C. Project Summary –

Siemens has focused on efficiency, risk mitigation and design flexibility to achieve the program goals and ensure program benefits to the power generation industry. This approach also considers marketability of the developed technologies to maximize the benefits to society and the environment.

Increased efficiency

- Substantially reduce emissions per MW produced.
- Reduce fuel required per MW produced.
- Minimize IGCC plant capital costs per MW produced.
- Improve economic performance and viability of an IGCC power system.

Risk mitigation

- Build on extensive Siemens gas turbine experience with IGCC and high temperature operation.
- Platform development approach to minimize risk associated with introducing new technologies and build on proven components.
- High availability and reliability to maximize plant utilization

Design flexibility

- Gas turbine will be adaptable to different IGCC plant configurations so as to allow various options with regard to gasification, air separation and integration.
- High fuel flexibility to allow utilization of syngas and hydrogen as well as natural gas as a backup.
- Operational flexibility to be able to adapt to various duty cycles and allow for polygeneration.

D. Period of Performance – October 2005 – September 2012

III. PROJECT COSTS

	Total	Phase 1	Phase 2
Total	**$64,395,295**	**$8,830,871**	**$55,564,424**
A. DOE Costs	$45,518,250	$6,623,153	$38,895,097
B. Prime Cost Sharing	$18,876,545	$2,207,218	$16,669,327
C. Partner Cost Sharing	$ (Not Applicable)		

IV. MAJOR ACCOMPLISHMENTS SINCE THE BEGINNING OF THE PROJECT

Complete baseline thermal model development **12/2005**

The gas turbine (GT) and plant thermal models were generated for the different cases under investigation. A thermal performance model was produced for the SGT6-6000G based IGCC plant Performance was estimated for the current SGT6-6000G engine fired on syngas and hydrogen fuels in IGCC application utilizing the state of the art SGT6-5000F balance of plant components. (DOE Milestone No.1).

Submission of RDI Plan **3/2006**

The Research & Development Implementation Plan was prepared for the two Phase, 6-year Advanced Hydrogen Turbine Development Program and submitted to DOE. (DOE Milestone No. 2) The plan described the planned activities, technical approach, technical barriers, technologies down selection criteria, testing and validation, major milestones, program critical path, schedule and cost estimates for the planned R&D activities.

CO2 Capture Performance Study **5/2006**

The performance penalty for CO_2 removal was estimated for different carbon capture rates. The results showed that there will be severe performance penalties above 70% carbon capture rate.

Design of Experiments on Major GT Parameters **6/2006**

The Design of Experiments study, the objective of which was to narrow down the major cycle design parameters, was completed. Based on the study results, the optimum cycle TIT, PR and ASU type were identified and will be used in the conceptual gas turbine (GT) and plant design.

First Iteration of Plant Cost **6/2006**

The first iteration on the hydrogen-fueled, advanced GT-IGCC plant capital cost estimation was completed (DOE Milestone No. 3).

Preliminary Turbine Aerodynamic Calculation Complete **7/2006**

Turbine aerodynamic studies' results showed that optimizing the outer flow path elevations, as well as vane and blade aerodynamics will result in over 1% improvement in turbine efficiency. 2D throughflow analysis was completed and preliminary airfoil mid-section layouts and cooling schemes were generated.

Complete Initial Diffusion Flame Combustion Test **8/2006**

The diffusion flame combustion system was tested up to SGT6-6000G firing temperatures on syngas and hydrogen fuels with full-sized combustor rig test. As high as 70% hydrogen by volume was tested. These tests confirmed that the diffusion flame combustion system could operate on high hydrogen fuels with dilution at low NOx emission levels at SGT6-6000G conditions.

Turbine Cooling Concepts Prioritized **9/2006**

Internal cooling concepts for turbine (hot end) airfoil were identified & prioritized (DOE Milestone No. 4).

Demonstration of Bond Coat Phase Stability **9/2006**

High temperature bond coat oxidation and mass gain tests are being conducted in a steam-enriched environment. Phase stability tests carried out on high temperature, low thermal conductivity TBC at elevated temperatures showed no phase transformation.

Customer Advisory Board Constituted **5/2006 & 10/2006**

A Customer Advisory Board for the Advanced Hydrogen Turbine Development was formed. The first meeting was held in May during Electric Power Conference & the second meeting was held in November during PowerGen Conference. A web-survey was also conducted to obtain the customers' perspective on the IGCC market drivers, constraints and enablers. 56 responds were obtained with over 60% indicated an intent to build IGCC.

V. MAJOR ACTIVITIES PLANNED DURING THE NEXT 18 MONTHS

TBC Conceptual Design	01/2007
Baseline Combustor Test Completion	04/2007
IGCC Plant Conceptual Design	07/2007
Engine Conceptual Design	10/2007

VI. ISSUES

- Additional resources will be required to avoid technology compromise throughout the development process.