

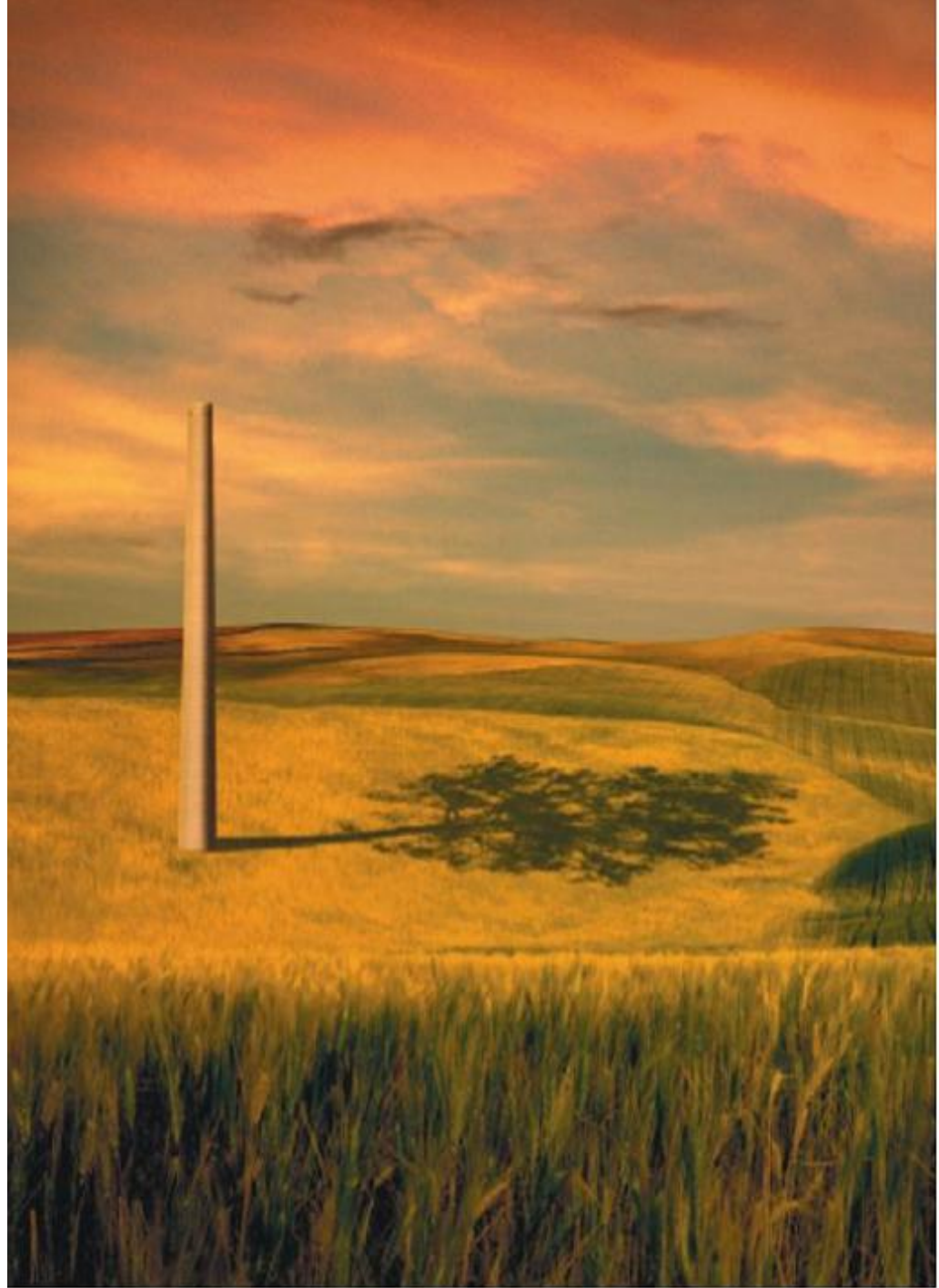
# GE Energy

## IGCC – a Coal Solution for a Carbon Constrained Environment

Large CCS Projects Meeting  
5 Sept 2006  
Brussels



imagination at work



# GE ... A global company with a strong European presence

Operations in  
over  
**100+** countries

**300,000+** employees  
worldwide...

**95,000** in Europe

Manufacturing facilities  
in **40+** countries...

# GE ... Six businesses



## Commercial Finance



## Healthcare (Global HQ – UK)



## Infrastructure

### Energy

Oil & Gas (Global HQ Italy)  
Water

Energy Financial Services

Aircraft Engines

Rail

Aviation FS



## Industrial



## NBC Universal



## Consumer Finance

# GE Energy ... Technology Diversity

## Power Generation



Gas / Steam Wind Hydro

## Services



## Aero



## Nuclear



“We are living in a carbon  
constrained world.”

Jeff Immelt

# ecomagination commitments

1

**Double** revenue  
from \$10B  
to \$20B

2

**Increase** R&D  
investment from  
\$750 MM to  
\$1.5B

3

**Improve** our  
energy  
efficiency and  
lower our GHG  
emissions

4

**Keep** the public  
informed on  
progress

# ecomagination products include...

## Renewable resources

Our 3.6 MW turbine can power ~1,200 average U.S. homes.



## Cleaner coal

GE's "one-stop shopping" for IGCC power generation



## H System Turbine

Capable of achieving 60% efficiency efficiency.



## All Carbon Driven

“The ability to lead innovation will be the primary management focus for this decade.”

—Jeff Immelt

“I never perfected an invention that I did not think about in terms of the service it might give others... I find out what the world needs, then I proceed to invent.”

—Thomas Edison

# GE acquired ChevronTexaco's Gasification Business June 30, 2004

## THE WALL STREET JOURNAL.

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### GE Discusses 'Clean Coal' Plants in Bid to Market New Technology

By KATHRYN KRANHOLD  
Staff Reporter of THE WALL STREET JOURNAL  
October 4, 2004

General Electric Co., the leader in manufacturing natural-gas-fired turbines for power plants, is negotiating with several electric companies to build new "clean coal" power plants, as it moves to create a global market for the costly, environmentally friendly technology.

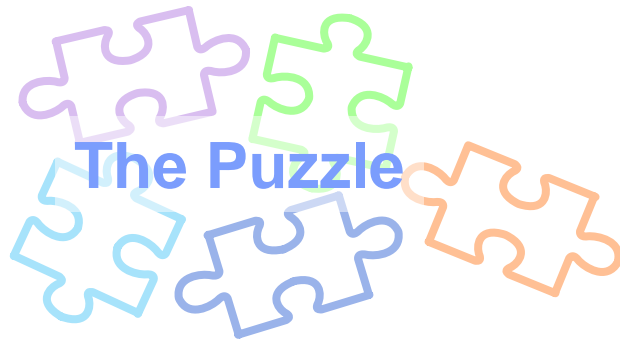
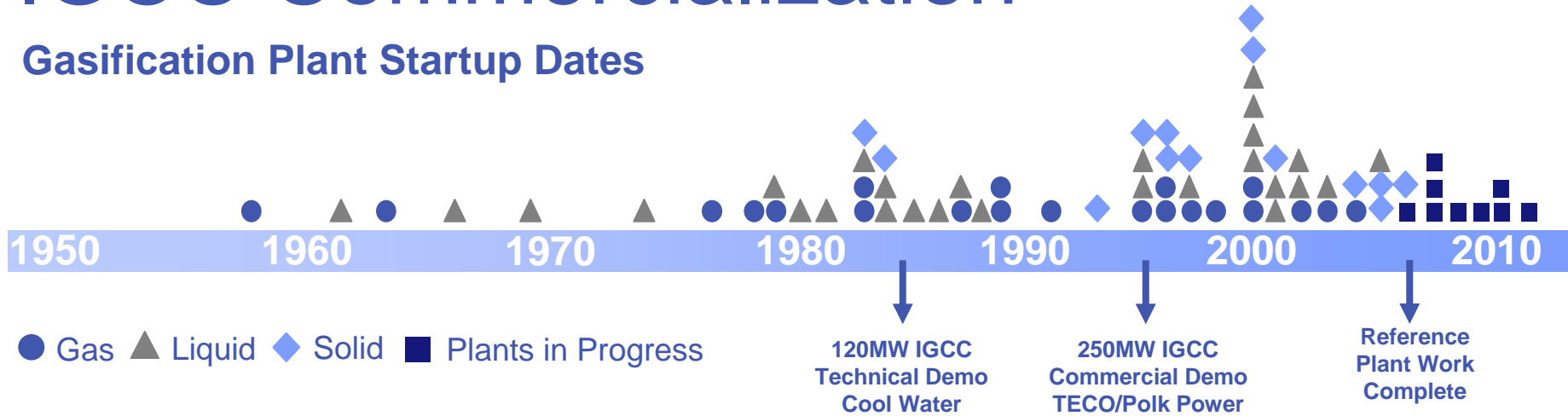
As part of its push into so-called coal-gasification technology, GE is scheduled to announce today a partnership with U.S. engineering and construction giant Bechtel Corp. in which the two companies plan to jointly a standardized plant package.

The "plant will save our customers money in the future" over its 30 to 40 year life, he says.

GE has estimated the coal-generation market at about \$25 billion a year as power companies start replacing aging plants. Smith Barney analyst Jeffrey Sprague stated in a recent report that the gasification technology "has the potential of capturing a dominant share of coal power generation capital expenditures" by the end of the decade. He notes it is in its "embryonic stage." GE said it expects sales of gasification technology to reach \$1 billion by 2010.

# IGCC Commercialization

## Gasification Plant Startup Dates



- CAPEX too high (+25%)
- COE too high (+10%)
- No system guarantees or warranties ... only license
- Poor initial RAM



- GE acquired CVX gasification and formed ref plant alliance with Bechtel
- Single point turnkey offering with strong guarantees
- Rigorous new product development programs including low rank coals

# GE IGCC Technology ... A Complete Package

- Commercial experience leader
- Proven process design expertise
- Guaranteed product performance



**Optimized  
System  
Integration**

## Power Generation

- Manufacturing excellence
- Power block equipment design
- Technology development process



## IGCC Technology

- Full plant system integration
- Optimization of plant systems
- Integrated plant controls
- Overall optimization from feedstock to plant output



# GE multiple IGCC Offerings

## IGCC Reference Plant – GE and Bechtel's IGCC Alliance

- Optimizing power generation with gasification – increased output to 630MW (7FB)
- Reference design reduces CAPEX & cycle time – premium over SCPC down by 50%
- Single point solution – full wrap & performance guarantees
- Design to be complete by end '06

## IGCC Non- Reference Plants

- Custom IGCC power plants
- Co-production – polygen applications (power, steam, H<sub>2</sub>, methanol, FT liquids)
- Performance guarantees
- Multiple EPCs

## IGCC Power Block Supply

- GTs for all gasification technologies

## NGCC to IGCC Fuel Conversion Projects

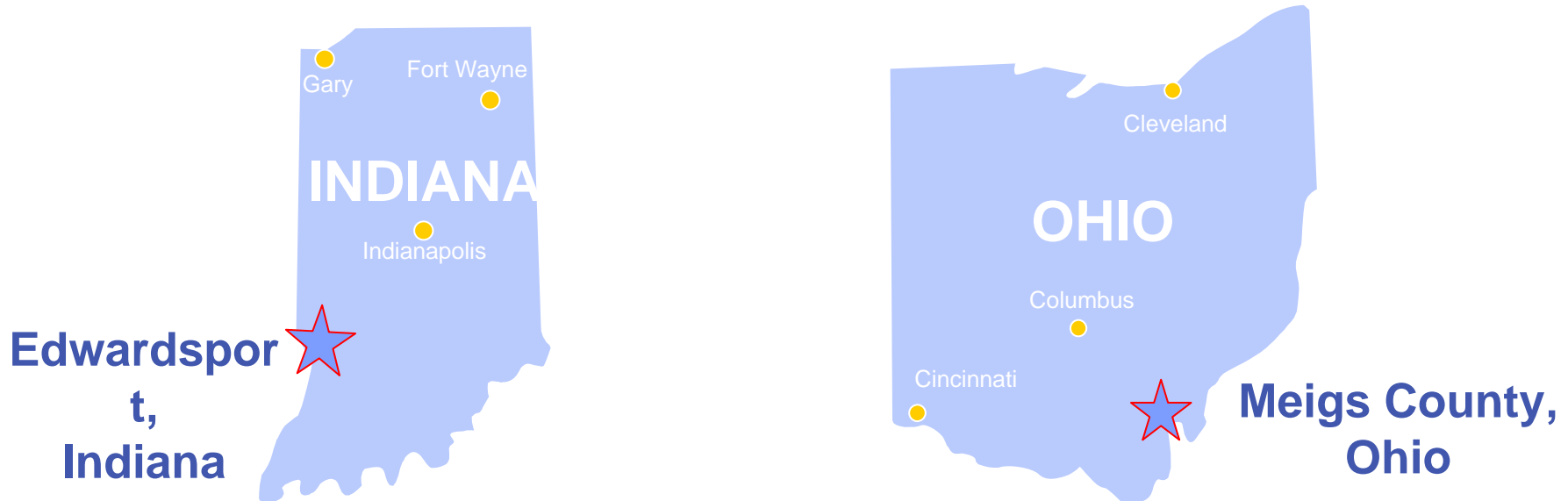
-  under-utilized assets
- IGCC performance guarantees possible with GE power blocks

# GE IGCC Commercial Experience

Project	GE Scope*	Size (MW)	Feedstock	COD
PSI Global (US)	Power		Coal/Petcoke	1995
Tampa Electric (US)	Syngas/Power	262	Coal/Petcoke	1996
Sokolov (Czech Republic)	Power	250	Coal	1996
Schwarze-Pumpe (Germany)	Power	350	Lignite	1996
Pernis (Netherlands)	Power	120	Resid Oil	1997
Sarlux (Italy)	Syngas/Power	100	Visbreaker Tar	2001
ISAB (Italy)	Syngas	550	Asphalt	2001
ISAB (Italy)	Syngas	510	Visbreaker Tar	2001
Api Energia (Italy)	Syngas/Power	280	Cracked Tar	2001
ExxonMobil (Singapore)	Syngas/Power	160	Fluid Coke	2002
Valero (US)	Syngas	160	Asphalt	2003
NPRC (Japan)		<sup>342</sup> <b>3,072 MW</b>		<b>&gt; 2 Decades</b>

\*GE Scope: Power = GE provided power generation equipment, Syngas = GE provided gasification technology

# IGCC Launch Plant Status



## Cinergy IGCC Project

- 2Q'05 completed IGCC feasibility study (GE & Bechtel 630MW Reference Plant)
- 9/22 Cinergy announced it would begin contract negotiations with GE & Bechtel for FEED

## AEP IGCC Project

- 2Q'05 completed IGCC feasibility study (GE & Bechtel 630MW Reference Plant)
- 9/29/05 announced FEED study with AEP
- 3Q'06 FEED will be complete
- 2010 expected commercial start up

FEED – Front End Engineering Design

# 2<sup>nd</sup> AEP IGCC project

## 2<sup>nd</sup> AEP IGCC Project

- Site Mason County, West Virginia
- GE & Bechtel 630MW Reference Plant
- 8/17/06 announced FEED study with AEP
- End '06 FEED will be complete

GE Energy

4200 Widewood Parkway  
Atlanta, GA, 30339

## News Release

### **GE ENERGY, BECHTEL SIGN FRONT END ENGINEERING DESIGN AGREEMENT FOR AEP'S SECOND 'CLEANER COAL' PROJECT**

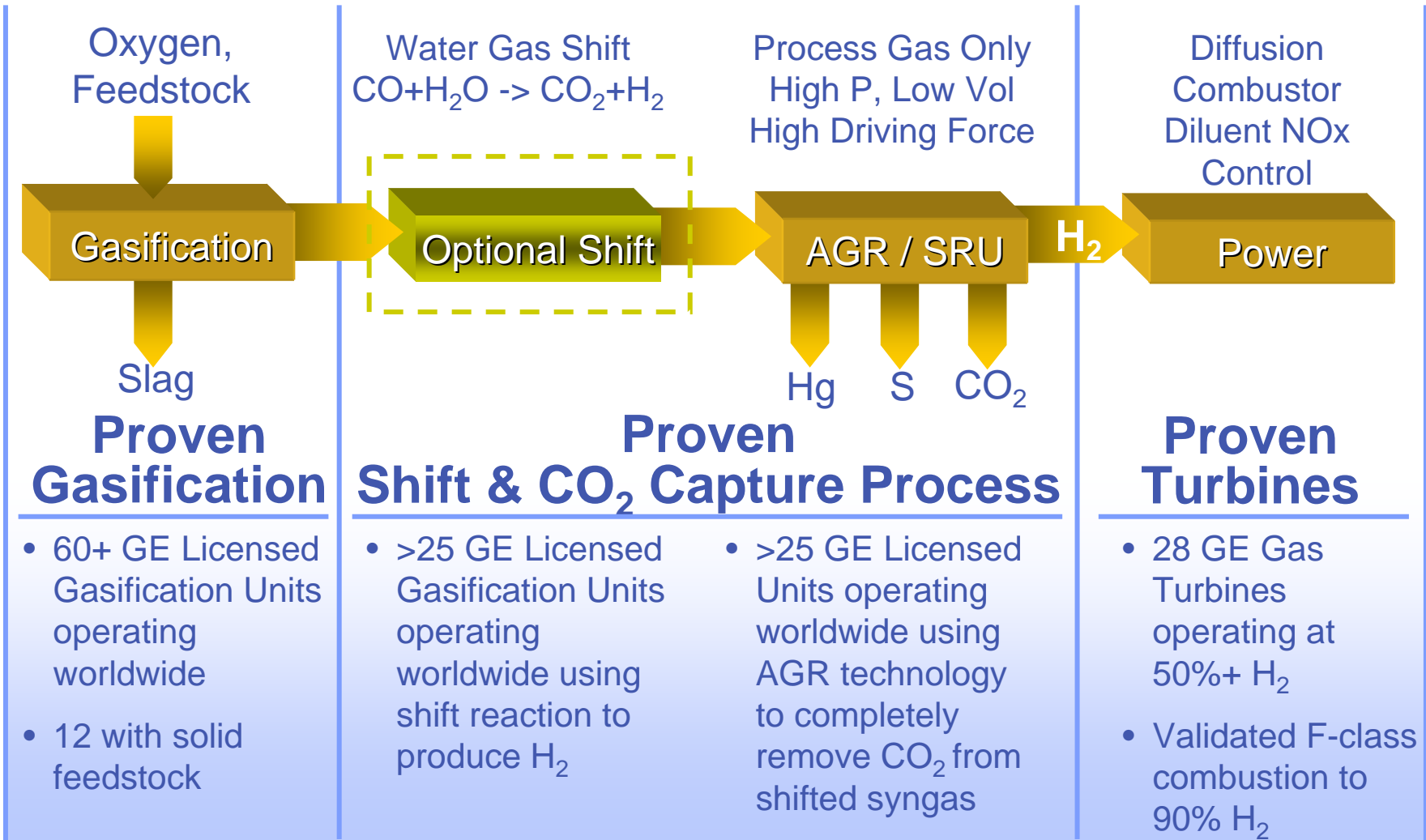
#### *630-MW Plant Planned for West Virginia Site*

ATLANTA, GEORGIA – August 17, 2006 – GE Energy and Bechtel Power have signed their second agreement with American Electric Power (AEP) to move forward with plans for an integrated gasification combined-cycle (IGCC), or cleaner coal, power plant.

Under the agreement announced today, GE and Bechtel will proceed with the front-end engineering design (FEED) phase for a proposed, 630-megawatt IGCC plant in Mason County, West Virginia. Appalachian Power, an AEP subsidiary, would operate the plant, which would be located next to Appalachian's existing Mountaineer power plant.

In September 2005, GE and Bechtel signed a FEED agreement with AEP, one of the nation's largest electricity generators, for a proposed IGCC project in Meigs County, /

# IGCC CO<sub>2</sub> Capture Readiness



# GE High H<sub>2</sub> GT Commercial

Customer/ Site	GT Model	No.	Gas	Features
1 ExxonMobil Singapore	MS6241FA	2	IGCC	44.5% H <sub>2</sub>
2 Georgia Gulf	MS7001EA	3	Blend	Methane+50% H <sub>2</sub>
3 SUV Vresova	MS9001E	2	IGCC	46.8% H <sub>2</sub>
4 BASF/ Geismer	MS6001B	1	PG	Up to 80% H <sub>2</sub>
5 Koch Refinery	MS6001B	1	RFG	12% to 50% H <sub>2</sub>
6 Daeson Korea	MS6001B	1	PG	up to 95% H <sub>2</sub>
7 Shell Int'l	MS5001P	1	RFG	60% H <sub>2</sub> , propane
8 Reutgerswerke	MS3002J	1	PG	60% H <sub>2</sub>
9 Tenerife	MS6001B	1	RFG	~70% H <sub>2</sub>
10 Cartagena	MS6000B	1	RFG	66% H <sub>2</sub>
11 San Roque	MS6000B	2	RFG	70% H <sub>2</sub>
12 Antwerpen	MS6000B	1	RFG	78% H <sub>2</sub>
13 Puertollano	MS6000B	2	RFG	Up to 60% H <sub>2</sub>
14 La Coruna	MS6000B	1	RFG	Up to 52% H <sub>2</sub>
15 Rotterdam	MS6000B	1	RFG	59% H <sub>2</sub>
16 AGIP/ Milazzo	MS5001P	1	RFG	30% to 50% H <sub>2</sub>
17 Cochin Refineries	MS5001P	1	RFG	50% H <sub>2</sub>
18 Mobil/ Paulsboro	MS5001P	2	RFG	20% to 60% H <sub>2</sub>
19 Uhde NUP	MS3002J	1	TG	~60% H <sub>2</sub>
20 Donges	GE10	1	RFG	76% H <sub>2</sub>
21 Zarqa Refinery	PGT10	1	RFG	82% H <sub>2</sub>

IGCC=Syngas; RFG=Refinery Gas; PG=Process Gas; TG=Tail Gas



- 6B 95% H<sub>2</sub> (Daeon)
- 6FA 44.5% H<sub>2</sub> (Exxon, Motiva)
- 7FA 37.2% H<sub>2</sub> (Tampa, PSI)



F-class H<sub>2</sub> Combustion Validation ... Video Capture of Flame Structure 85-90% H<sub>2</sub>

# High H<sub>2</sub> GT Development

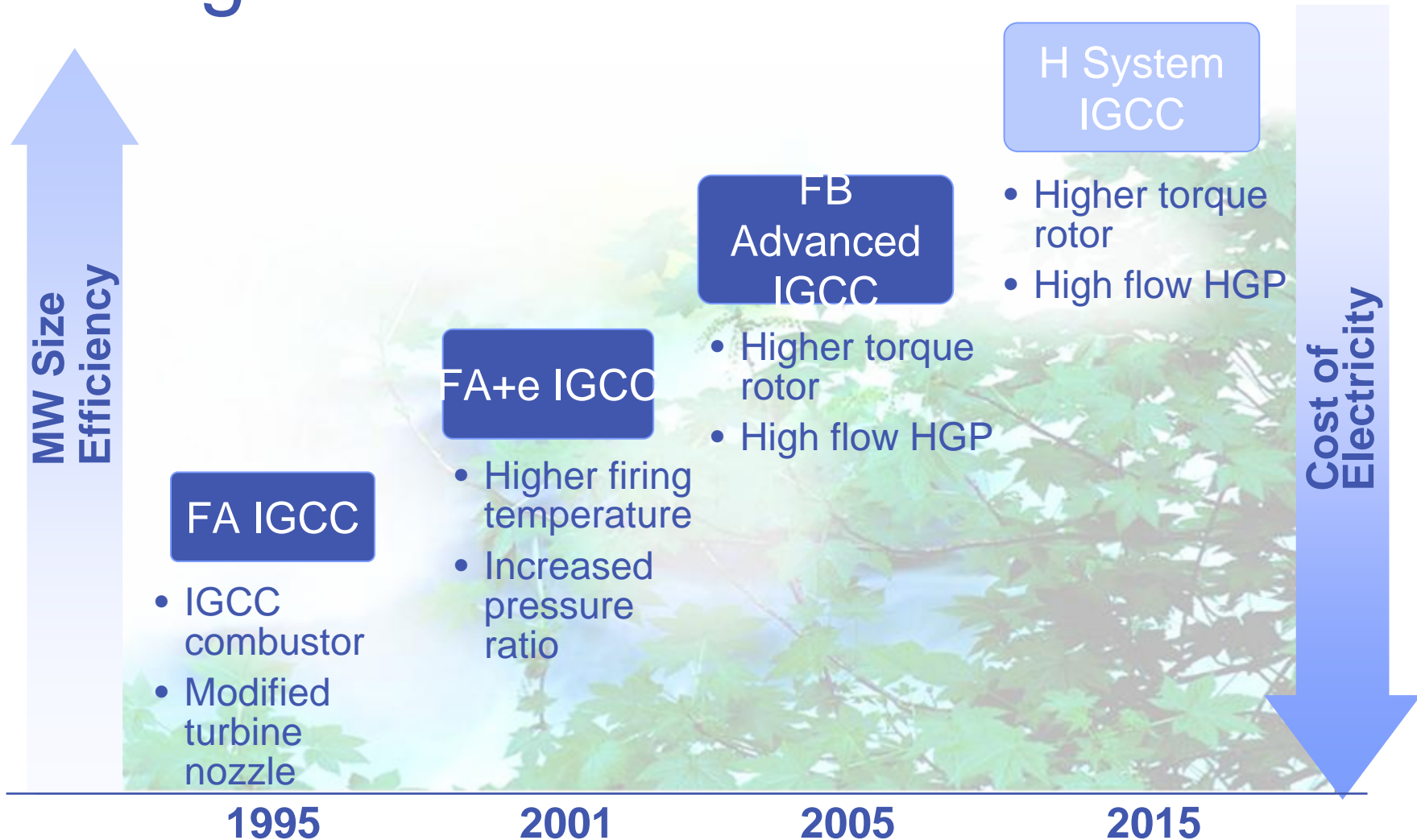
## Development Goal

- Reliable, high temperature (high efficient), fuel-flexible and low-NO<sub>x</sub> (diluent free) combustion of H<sub>2</sub> rich syngas

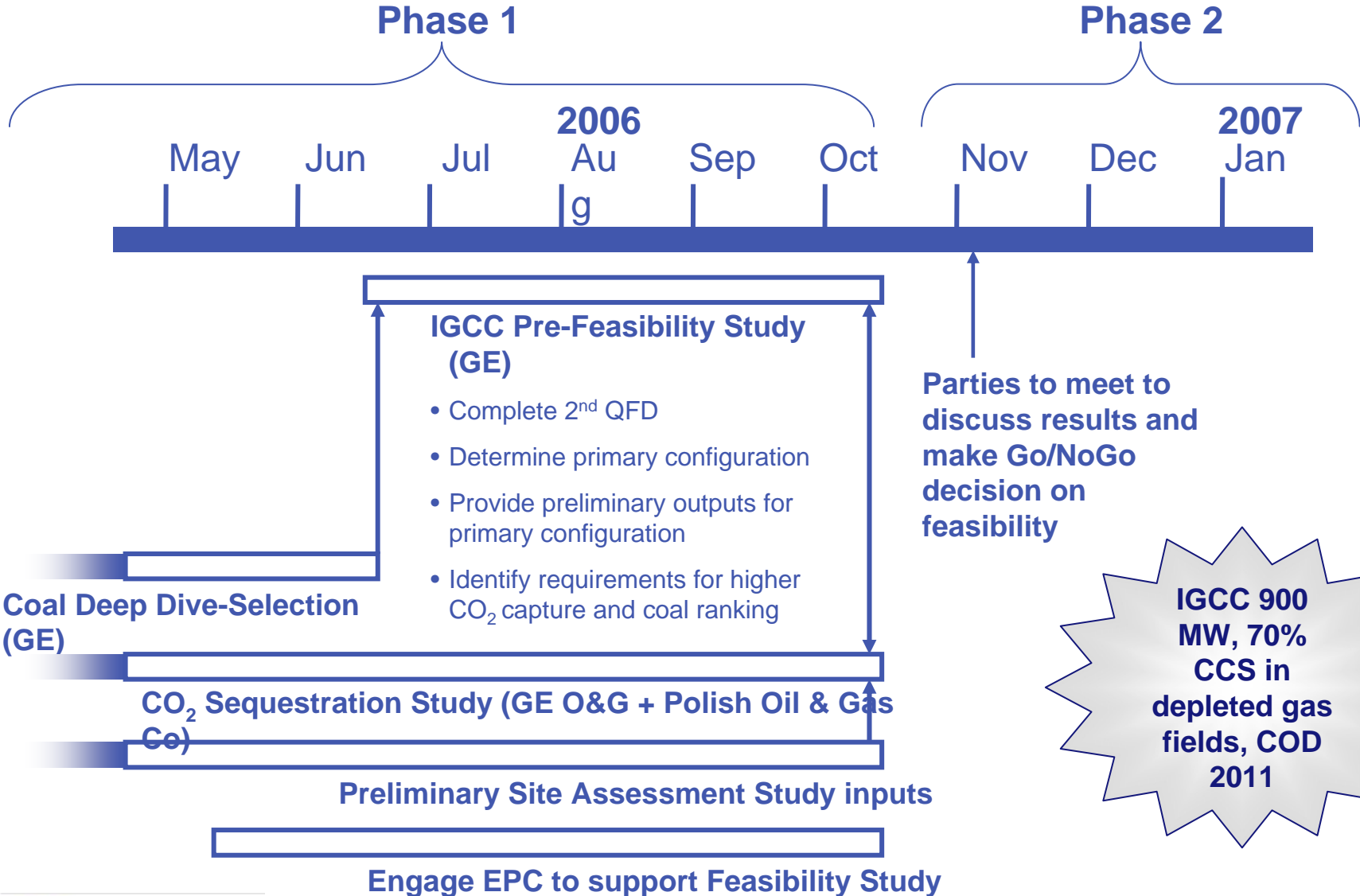
## Development Needs

- Advanced materials and thermal barrier coatings
- Leading edge H<sub>2</sub> combustion modeling and experimental validation ... aero-thermodynamic models to validate and optimize tradeoffs between emissions, efficiency and RAM (model examples: reacting CFD, fuel-air mixing, flame shape, combustion stability and heat transfer and thermal predictions)
- IGCC process evaluations for optimal gas turbine integration and demos to validate concepts ... impact of reduced fuel mass flow on power generation output

# Gas Turbine Evolution ... Driving “Cleaner Coal” Economics



# Poland IGCC CCS Project Timeline

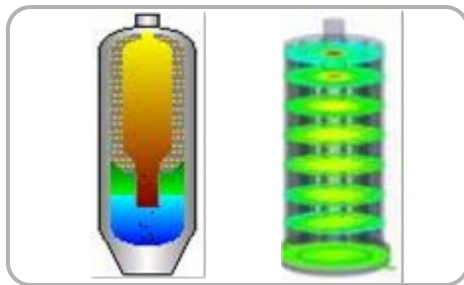
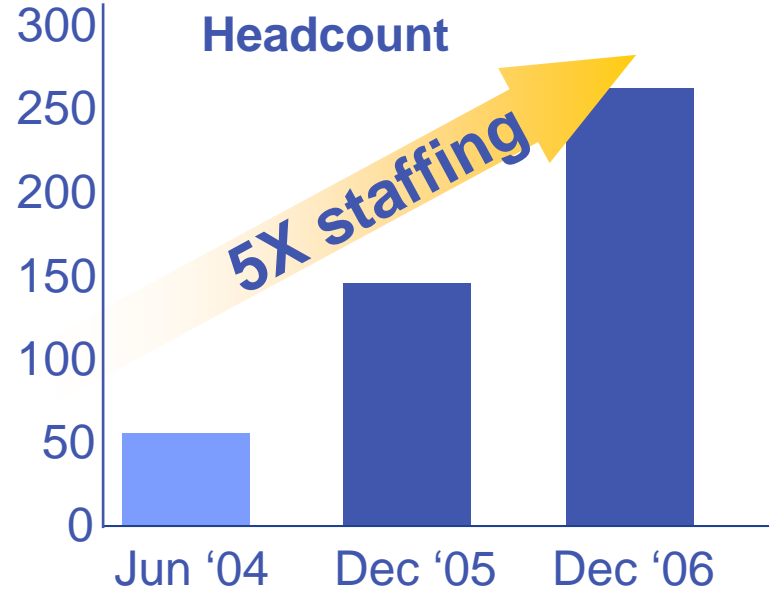


# Closing Remarks

- IGCC employs proven technology ... IGCC with pre-combustion capture can provide power from coal with low CO<sub>2</sub> now
- Viability depends on technical and economic feasibility of carbon capture and sequestration
- IGCC provides significant cost advantage in pre-combustion S and Hg cleanup and carbon treatment
- IGCC is highly flexible in configurability for various levels of CO<sub>2</sub> capture
- Compelling reasons for IGCC to be an integrated part of energy and environmental strategies

Back-Up

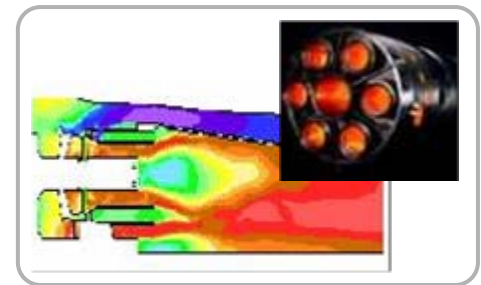
# Investing for Success



**Gasification Technology**



**Power Generation Technology**



**Advanced Technologies**

# GE's Global IGCC Resources



**GE Energy's  
Gasification Business  
Headquarters**  
Houston, TX



**Global Research  
Center Headquarters**  
Niskayuna, NY



**John F. Welch  
Technology Centre**  
Bangalore, India



**Europe Technology  
Center**  
Munich, Germany

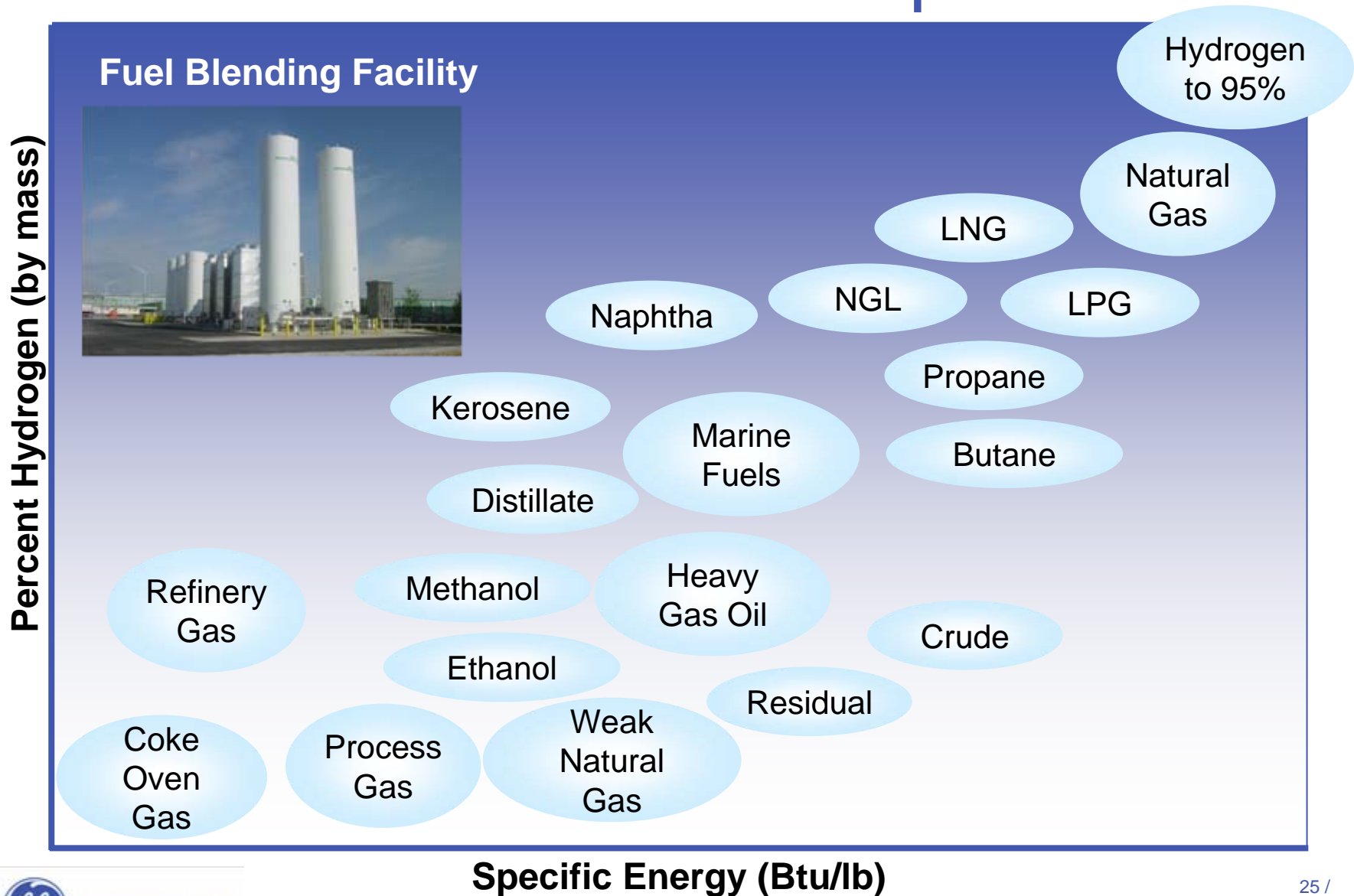


**GE Energy's Manufacturing  
Sites**  
Belfort, France    Greenville, SC



**China Technology  
Center**  
Shanghai, China

# GT Combustion Fuels Experience



# GE Energy

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imagination at work

