# Southern Company's Demonstration of a 285 MW Coal-Based Transport Gasifier Project

## *Benefits Presentation*

***Clean Coal Power Initiative***

***- Round 2 -***

Demonstration of Air-blown Integrated Gasification Combined Cycle (IGCC) Power Plant With Coal-based Transport Gasifier

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# Outline

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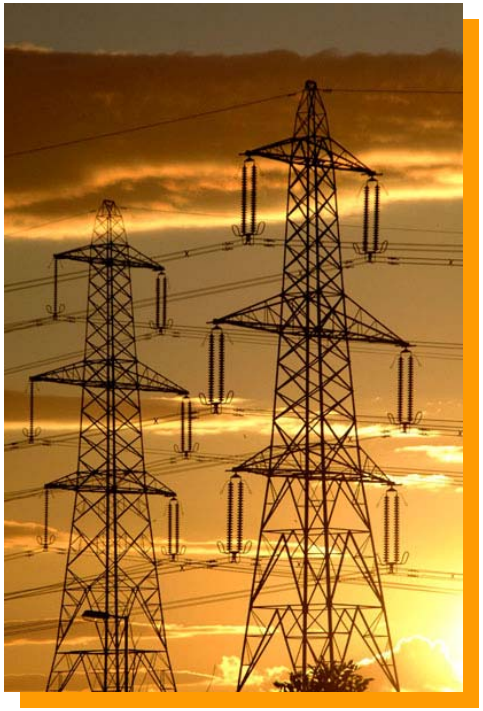

# Outline (continued)

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# Executive Summary

- **Southern Company Services, Inc., will design, construct, and operate a coal-based transport gasifier as part of an air-blown IGCC power plant under CCPI, Round 2**
- **The design will be fuel-flexible with higher efficiency and lower capital and operating costs than currently available designs**
- **Process uses oxygen from the air to produce synthetic gas (syngas). Does not require the costly separation of oxygen from the air as in oxygen-blown gasifiers**
- **Economics are preserved when incorporating $CO_2$ capture and sequestration into the design**

# Project Information

## *Plant, Fuel, Location, Cost, and Schedule*

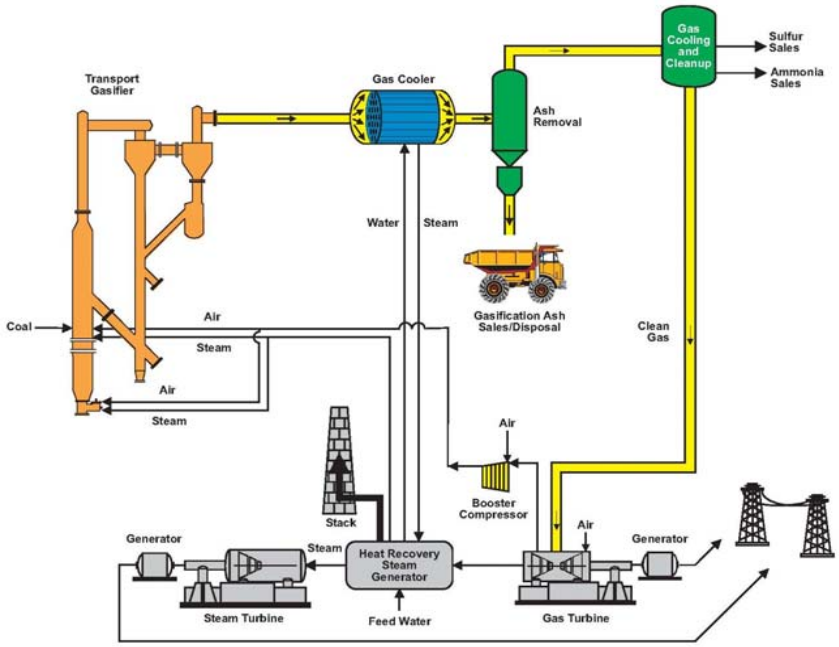
- **Design, construction and operation of a full-scale demonstration of a highly efficient, fuel-flexible, coal-based, air-blown transport gasifier in an IGCC power plant**
- **3,300 tons of sub-bituminous coal per day producing 285 MW of electricity**
- **Location: Stanton Energy Center, Orange County, FL**
- **Project Cost: $844 million (DOE share: $294 million)**
- **Schedule:**
  - 2006 Project Start
  - 2007 to 2010 Construction
  - 2010 to 2014 Operation

# Project Information (continued)
## *Team Members*

- **Southern Company Services, Inc. (Birmingham, AL)**
  - Project & technology management
- **Southern Power Company Orlando Gasification, LLC (Birmingham, AL)**
  - Co-owner
- **Orlando Utilities Commission (Orlando, FL)**
  - Co-owner
- **Kellogg Brown and Root, LLC (Houston, TX)**
  - Technology partner

# Project Information (continued)
## *IGCC System Basics*

- **IGCC plants use two power cycles, generating electricity more efficiently**
  - Coal is heated in a specialized process to release syngas which is used to generate electricity in a turbine
  - Then exhaust gas from the turbine is used to heat water, which produces steam to generate additional electricity
- **With two power cycles, the amount of electricity generated from a ton of coal is increased**



# Project Information (continued)

## *Oxygen ($O_2$) versus Air-blown IGCC Systems*

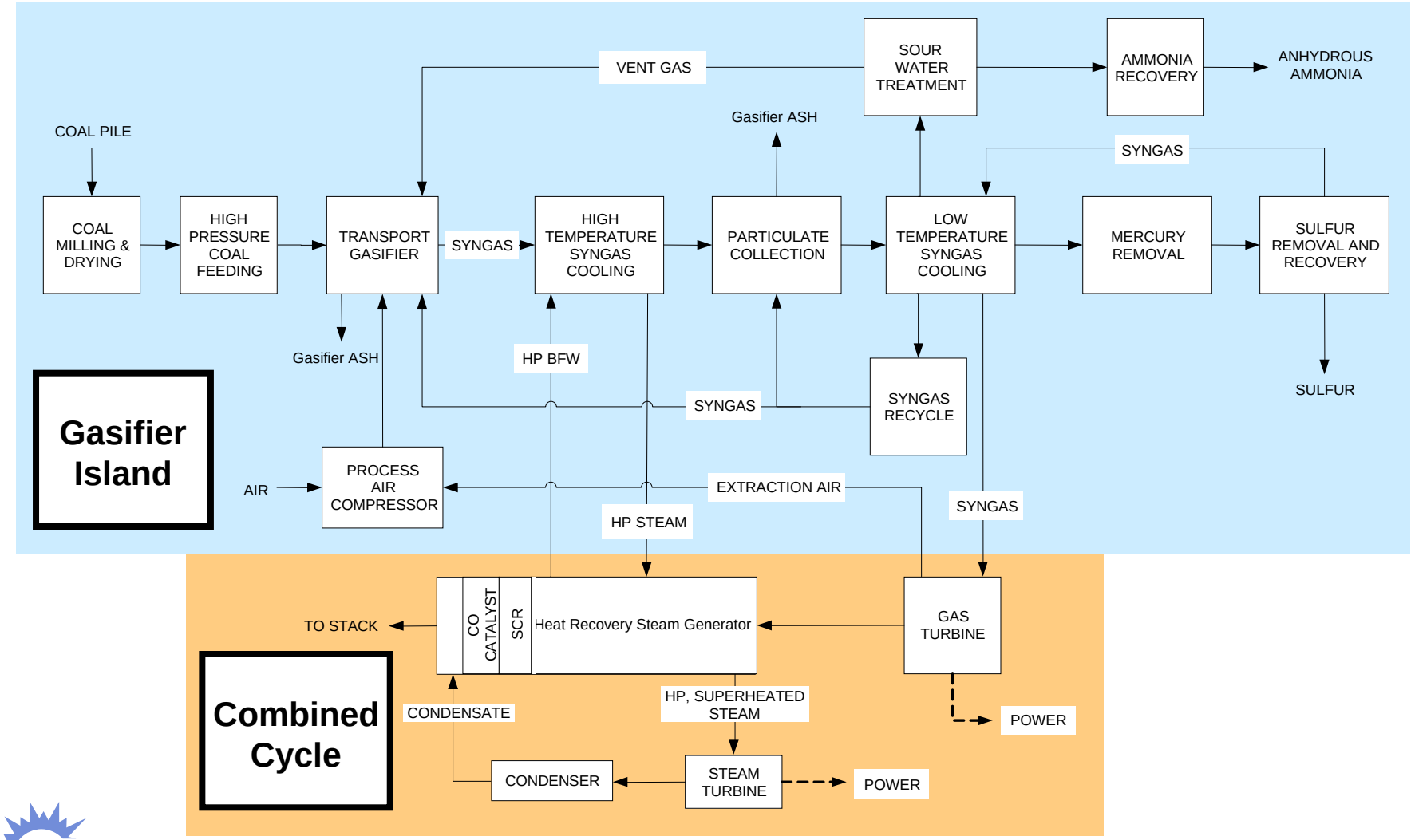
- **Coal gas is produced with $O_2$ in some IGCC plants**
- **$O_2$ plants:**
  - Are expensive to build
  - Require high levels of electricity to operate
  - Reduce electricity available for sale to consumers
- **Southern Company's air-blown IGCC system uses $O_2$ from the air to produce syngas, increasing the overall efficiency of the plant**
  - Process does not require a costly $O_2$ plant

# Project Information (continued)
## *Transport Gasifiers*

- **This project builds on substantial FE sponsored research on the transport gasifier at the Wilsonville Process Development Facility, which was:**
  - Fuel-flexible
  - Unique because it can cost-effectively process low rank coals and coals with high moisture or high ash content
  - Adaptable to other applications beyond power generation, such as chemical production

# Project Information (continued)

## *IGCC Summary Flow Diagram*



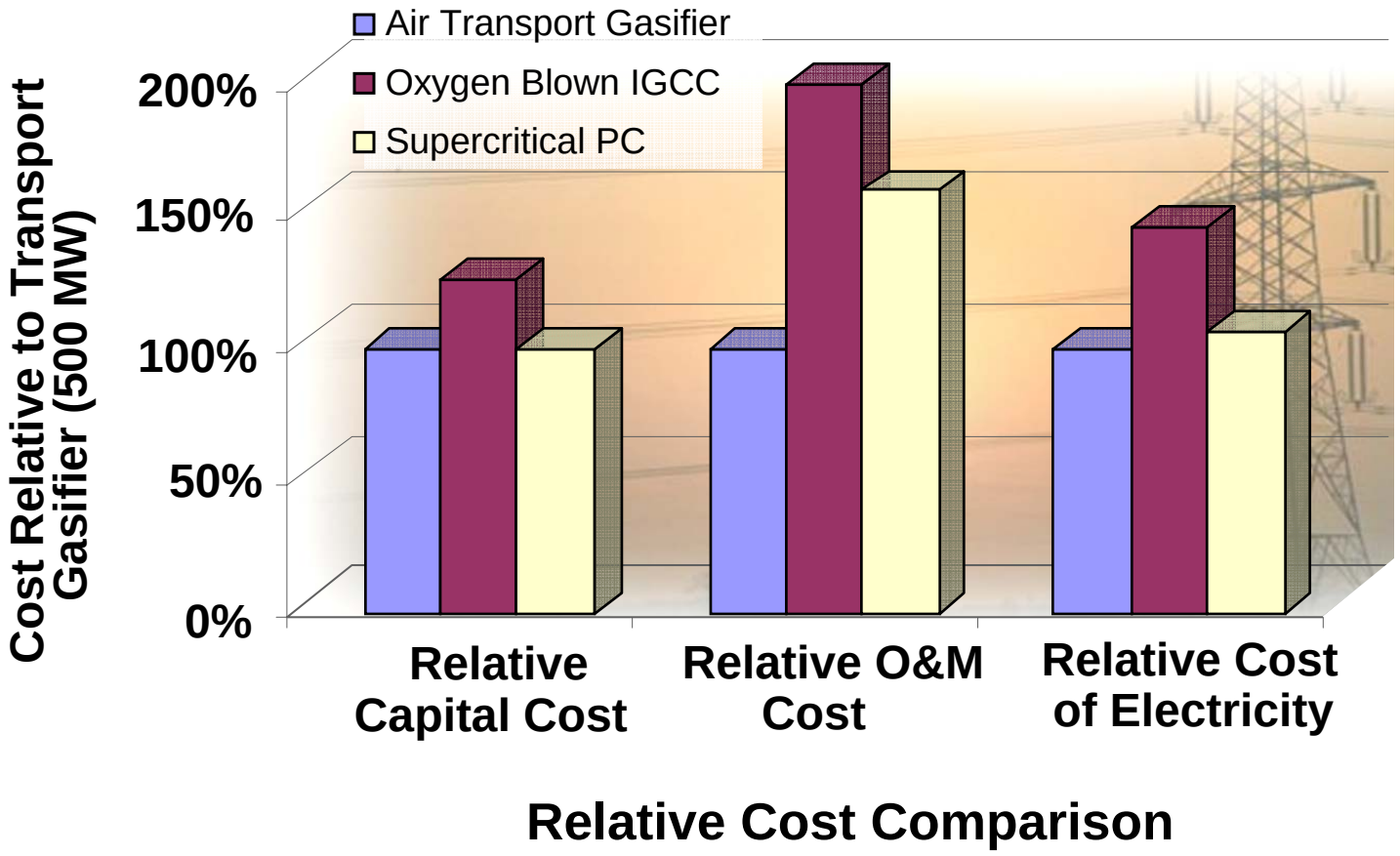
# Estimated Benefits
## *Approach*

- **Compare the IGCC Plant emission performance against standards for Clean Coal Technology Roadmap plant in 2020**
- **Compare scaled-up 500 MW transport gasifier plant (more efficient than demonstration plant) to emission rates and capital and operating costs to those of other coal-based technologies of equal size**

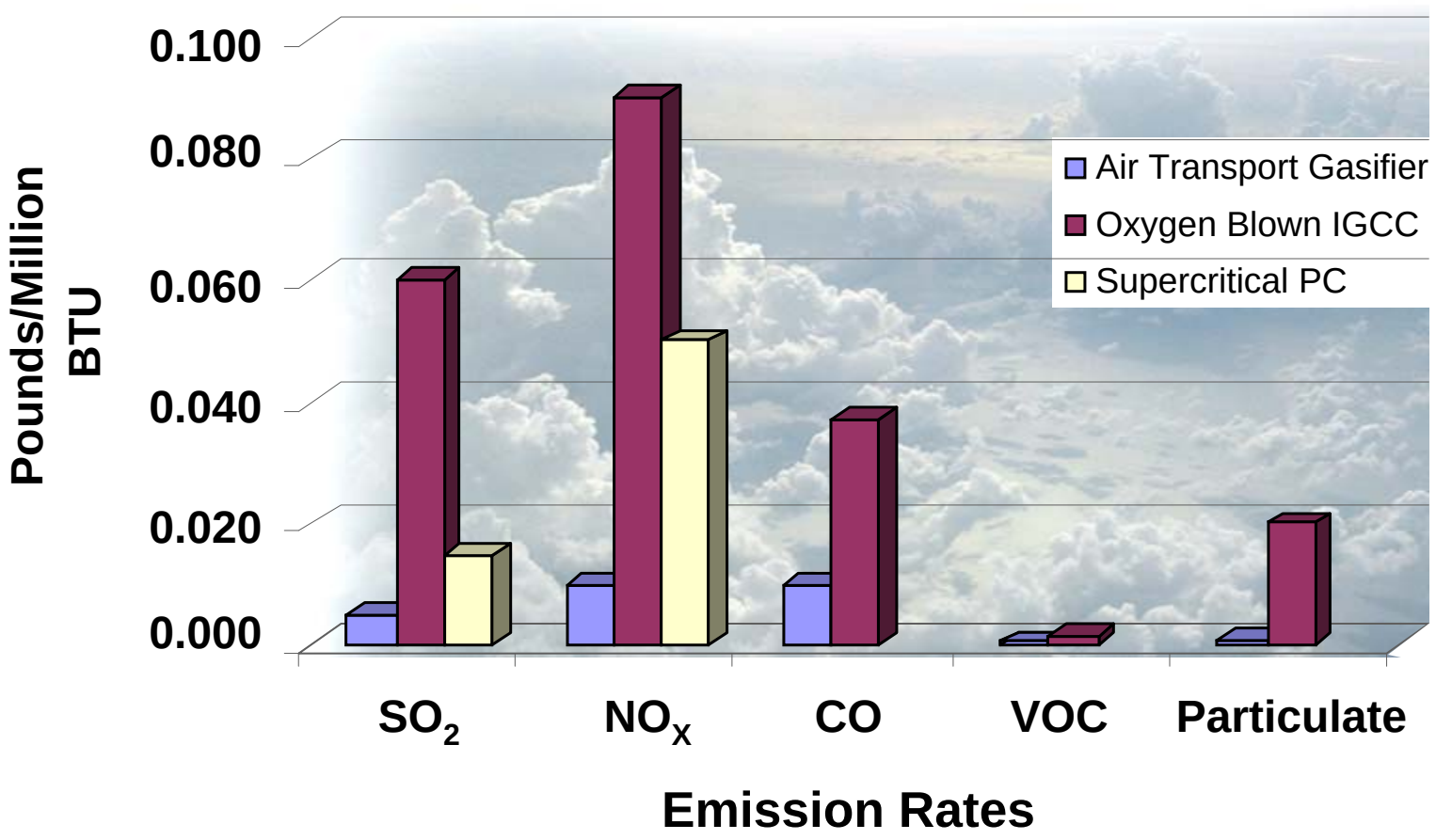
# Estimated Benefits (continued)
## *Comparison Assumptions*

- **Benefits comparisons are based on the following plant configurations for a sub-bituminous coal:**
  - Oxygen-blown IGCC plant based on two gasifiers, two GE 7FA gas turbines, full heat recovery, methyldiethanolamine (MDEA) sulfur removal and 1,615 psia /1,000$^{o}$F/1,000$^{o}$F steam conditions
  - Supercritical Pulverized Coal (PC) plant with Selective Catalytic Reduction (SCR) & Spray Dryer Absorption (SDA) 97% sulfur capture and 3,515 psia/1,050$^{o}$F/1,050$^{o}$F steam conditions
  - Transport gasifier plant based on two gasifiers, two GE 7FA gas turbines, CrystaSulf™ sulfur removal and 1,815 psia/1,000$^{o}$F/1,000$^{o}$F steam conditions

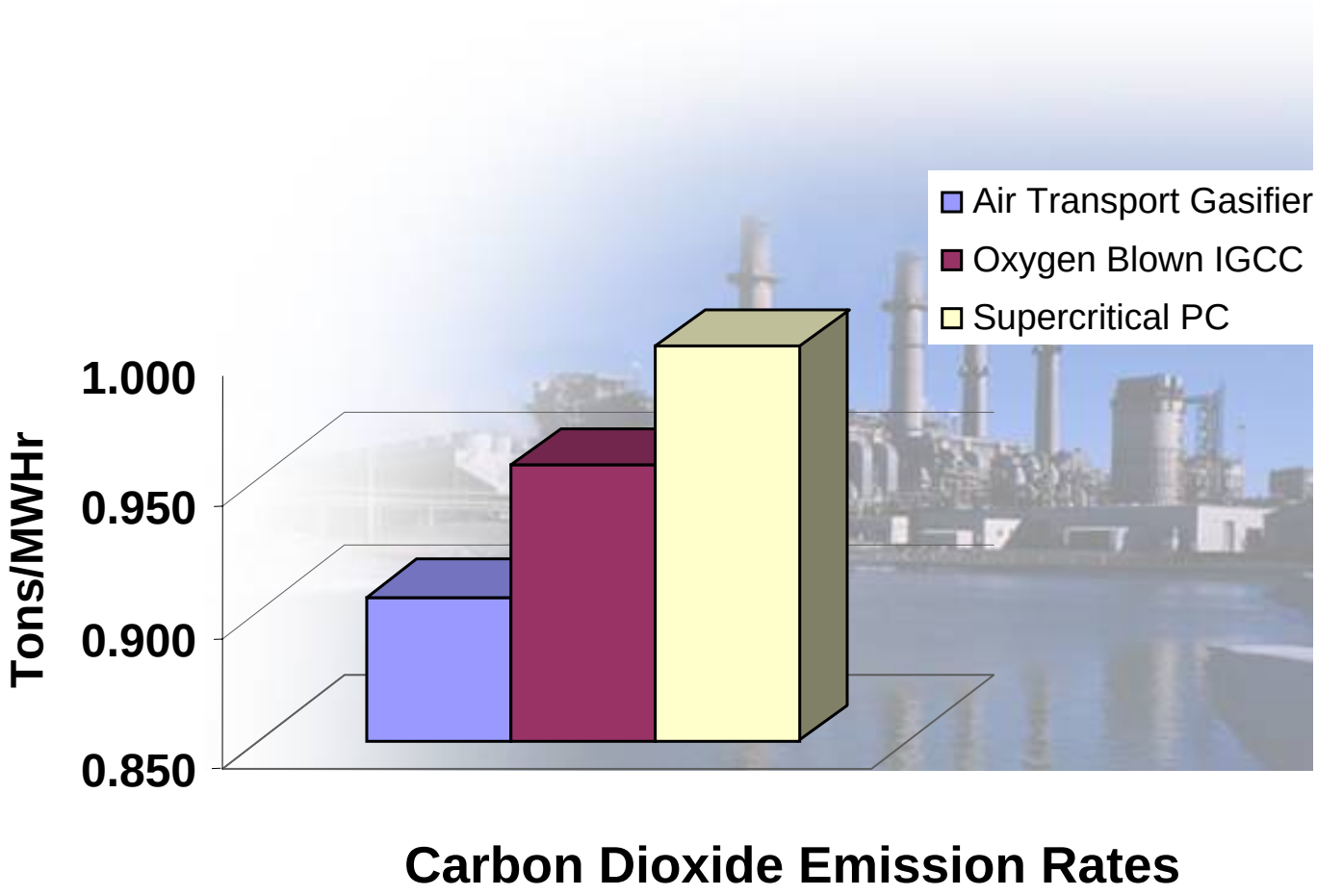
# Estimated Benefits (continued)
## *Financial*



# Estimated Benefits (continued)
## *Emissions*



# Estimated Benefits (continued)
## *$CO_2$ Emissions*




**Carbon Dioxide Emission Rates**

# Estimated Benefits (continued)
## *Reliability and Availability*

- Reduced number and duration of outages due to lower operating temperature extending refractory and component life
- Less maintenance on ash removal system than in more complex oxygen-blown systems
- Air-blown capability avoids $O_2$ plant maintenance issues
- Transport gasifier requires no burners

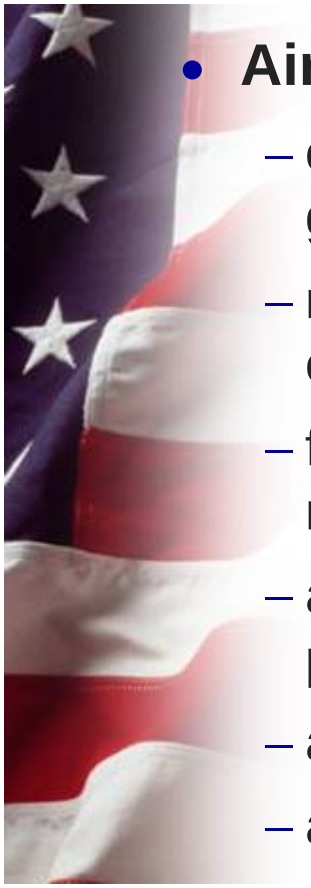
# Estimated Benefits (continued)
## *Combustion Utilization By-product*

- **All recovered sulfur marketable locally**
- **Gasifier ash tested and designated non-hazardous**
  - Potential applications identified
  - Remaining ash can be land filled on-site
- **Anhydrous ammonia recovered from process water**
  - Utilized in demonstration SCR unit
  - Remainder consumed by units at the Stanton Energy Center or sold

# Estimated Benefits (continued)
## *Regional*

- **Plant construction will create an estimated 1,800 jobs in Orange County, FL**
- **Reduced water consumption is incorporated into plant design**
- **On-site research projects, in partnership with the Florida Energy Office, can potentially expand the use of "next generation" hydrogen technology for fuel cells or vehicles**

# Estimated Benefits (continued)
## *National*



- **Air-blown systems will be:**
  - one of the cleanest, simplest, and most robust methods for generating power from coal
  - more energy and cost efficient than currently available oxygen-blown entrained-flow gasifiers
  - fuel flexible, processing low rank coals and coals with high moisture or high ash content (half the proven reserves in U.S.)
  - able to meet high environmental standards for $SO_2$, $NO_x$, particulate, and mercury emissions
  - adaptable to other applications, such as chemical production
  - adaptable for carbon capture and sequestration technologies

# Estimated Benefits (continued)
## *National*

- **Beneficial uses for gasifier ash have been identified**
- **The technology increases energy security by utilizing the Nation's sub-bituminous coal reserves**
- **Furthers environmental initiatives for America:**
  - FutureGen
  - Hydrogen

# Conclusions

- **The transport gasifier is very flexible, offering numerous regional as well as national benefits**
- **The gasifier will readily adapt to possible future requirements**
  - Greenhouse gas management
  - Economic benefits are preserved when $CO_2$ capture and sequestration is incorporated into the design

**Visit the NETL web site for information on all Power Plant Improvement Initiatives and Clean Coal Power Initiative projects**

**www.netl.doe.gov/technologies/coalpower/cctc**