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DOE/METC/C-94/7151

Conf-9406131--38

Integrated Gasification Combined Cycle - A View to the Future

Authors:

Schmidt, Dale K. (METC)

Conference Title:

Coal Fired Power Systems 94 --  
Advances in IGCC and PFBC Review Meeting

Conference Location:

Morgantown, West Virginia

Conference Dates:

June 21-23, 1994

Conference Sponsor:

U.S. Department of Energy, Morgantown Energy Technology Center

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# Integrated Gasification Combined Cycle - A View to the Future

Dale K. Schmidt  
Morgantown Energy Technology Center

## INTRODUCTION

DOE is involved in research, development, and demonstration (RD&D) of Integrated Gasification Combined Cycle (IGCC) because of a strong belief that it will result in widespread commercialization that will be of great benefit to this Nation. METC's long-range vision comprises (1) product goals that require improvements to known technical advantages, and (2) market goals that are based on expectations of market pull.

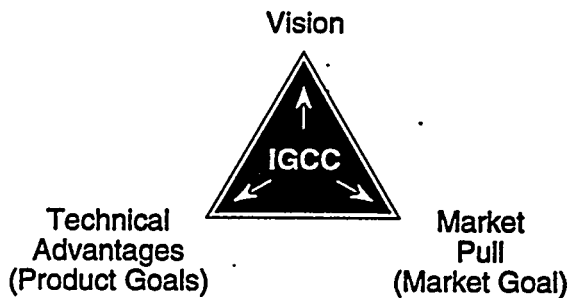


Figure 1. Vision and Goals for IGCC

The first IGCC plant in the United States was built for about \$3,000 per kilowatt (kW) in the mid 1980s and operated at an efficiency comparable to conventional coal-fired plants. The six IGCC clean coal projects scheduled for startup from the mid to late 1990s will demonstrate significant reductions in capital cost ranging from \$1,500 to \$2,000 per kilowatt and impressive increases in efficiency of around 40 percent, based on higher heating value (HHV). The METC vision for IGCC is that over the next 20 years R&D-based technology advances and plant learning curve cost

reductions will yield even more dramatic improvements resulting in plant efficiencies of over 50 percent and cost reductions to nearly \$1,000 per kilowatt.

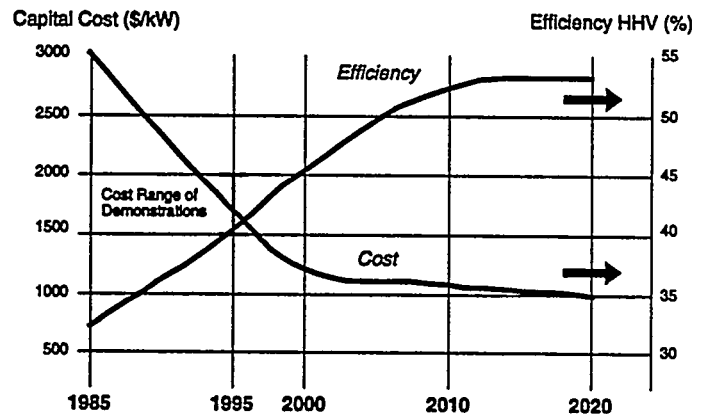
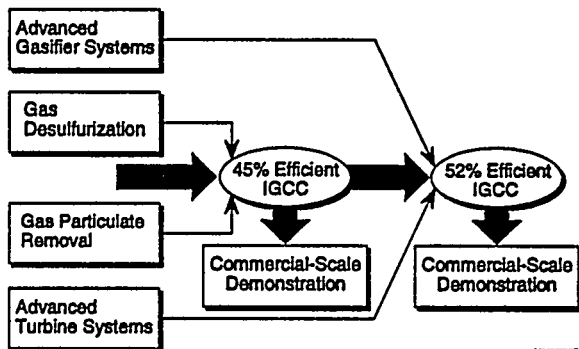


Figure 2. IGCC Vision: Cost versus Efficiency

Specific goals (Table 1) are that by the year 2010, capital cost as low as \$1,050/kW and efficiencies as high as 52 percent HHV are viable along with superior coal-based environmental performance, resulting in possibly the lowest cost electricity option. Commercial-scale demonstration of multiple IGCC technologies that will result in healthy competition is critical to this goal.

Fossil Energy research and development (R&D) is interactively supporting the IGCC product goals. The year 2000 goal of 45 percent efficient IGCC plants is aided by over 50 METC contracted and in-house projects that are topics of these conference proceedings. Major

initiatives are underway in advanced gasifier systems and advanced turbine systems toward achievement of the more ambitious year 2010 goal of 52 percent efficiency.

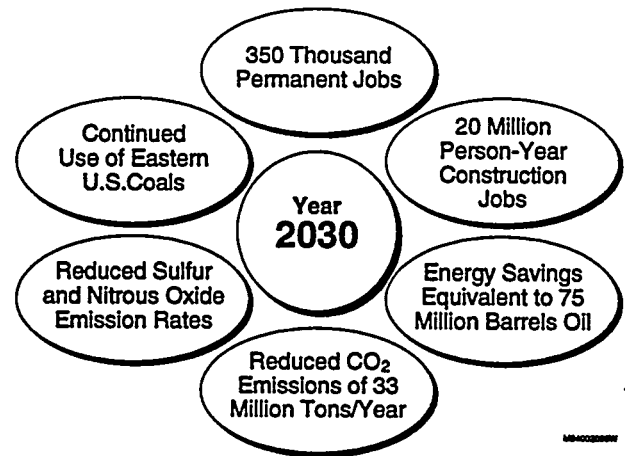


**Figure 3. Interaction of IGCC Product Improvements**

DOE projections of our Nation's electricity needs are provided by the Energy Information Administration-Annual Energy Outlook (AEO). (See Table 2.) Considering the AEO-1994 projection for coal-based and gas turbine-based electricity production, modest assumptions about the IGCC market share of three market segments are made. These market segments are: (1) coal plant additions, (2) coal plant repowerings, and (3) staged addition of gasifiers to natural gas combined cycle plants. It is expected that the IGCC investment could exceed \$150 billion by the year 2030.

The combination of these IGCC technology goals and market goals suggest great benefit to our Nation. The IGCC dollar investment, as projected through the year 2000, has the potential of millions of person/year construction jobs, thousands of permanent operating jobs related to domestic projects, and thousands of U.S. jobs related to overseas projects.

Six IGCC commercial-scale demonstration projects costing nearly \$3 billion are underway



**Figure 4. National Benefits of IGCC**

in DOE's Clean Coal Technology (CCT) program. The Government is cost sharing about one-third of these CCT demonstrations. METC's strategy is to link RD&D via a product improvement concept so that (a) the CCT projects will benefit from the latest R&D results, and (b) R&D will be focused toward technical breakthroughs that shortcut achievement of the longer range IGCC goals.

The IGCC R&D budget (Table 3) necessary to accomplish these purposes projects a modest growth for FY 1995 to about \$28.2 million. Additionally, there is about \$2 million of IGCC-related funding in two other budget categories: advanced research and environmental technology (AR&ET), and advanced research and technology development (AR&TD).

Within the IGCC budget (Table 4), about 40 percent is allocated to the Power Systems Development Facility, about 25 percent to Gasifier Product Improvement, about 20 percent to two large-scale hot gas cleanup systems test facilities, one at General Electric and one at METC, and the balance of about 15 percent to other hot gas cleanup (HGCU) activities. Essentially, all of these projects are described in these conference proceedings.

**Table 1. IGCC Product Goals by Year 2010**

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<b>Capital Cost:</b>	<b>NO<sub>x</sub> Emissions:</b>
\$1,050 per kW to build	0.06 lb. per million Btu
<b>Efficiency:</b>	<b>SO<sub>2</sub> Emissions:</b>
Operating at 52 percent efficiency	0.06 lb. per million Btu
<b>Commercial-Scale Demonstrations:</b>	
Six U.S. technologies	

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**Table 2. IGCC Market Goals**

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Market Area	By 2010	By 2030	By 2050
Added or Replaced Plants IGCC Share	1%	20%	30%
Aged Plants > 30 IGCC Repowered	0.5%	20%	80%
Nat. Gas CC Plants Conversions to IGCC	0%	10%	50%
Cumulative IGCC Capacity (Thousand Megawatts)	6	155	450

**Table 3. R&D Budget - IGCC Related**

Budget Category	FY93	FY94	FY95*	
AR&ET	5.3	3.7	2.9	} ~ \$2 Million per Year is IGCC Related
AR&TD	3.6	2.5	2.7	
IGCC	19.5	27.2	28.2	

*Dollars in Millions*

\* *Proposed to Congress*

**Table 4. IGCC R&D Budget**

	FY 93	FY 94	FY 95*
Power Systems Development Facility	6.8	10.2	12.9
Gasifier Product Improvement Facility	4.2	6.0	7.8
GE/METC PDUs	3.4	5.9	5.2
Other HGCU	5.1	5.1	2.3
IGCC Total	19.5	27.2	28.2

\* *Proposed to Congress* *Dollars in Millions*