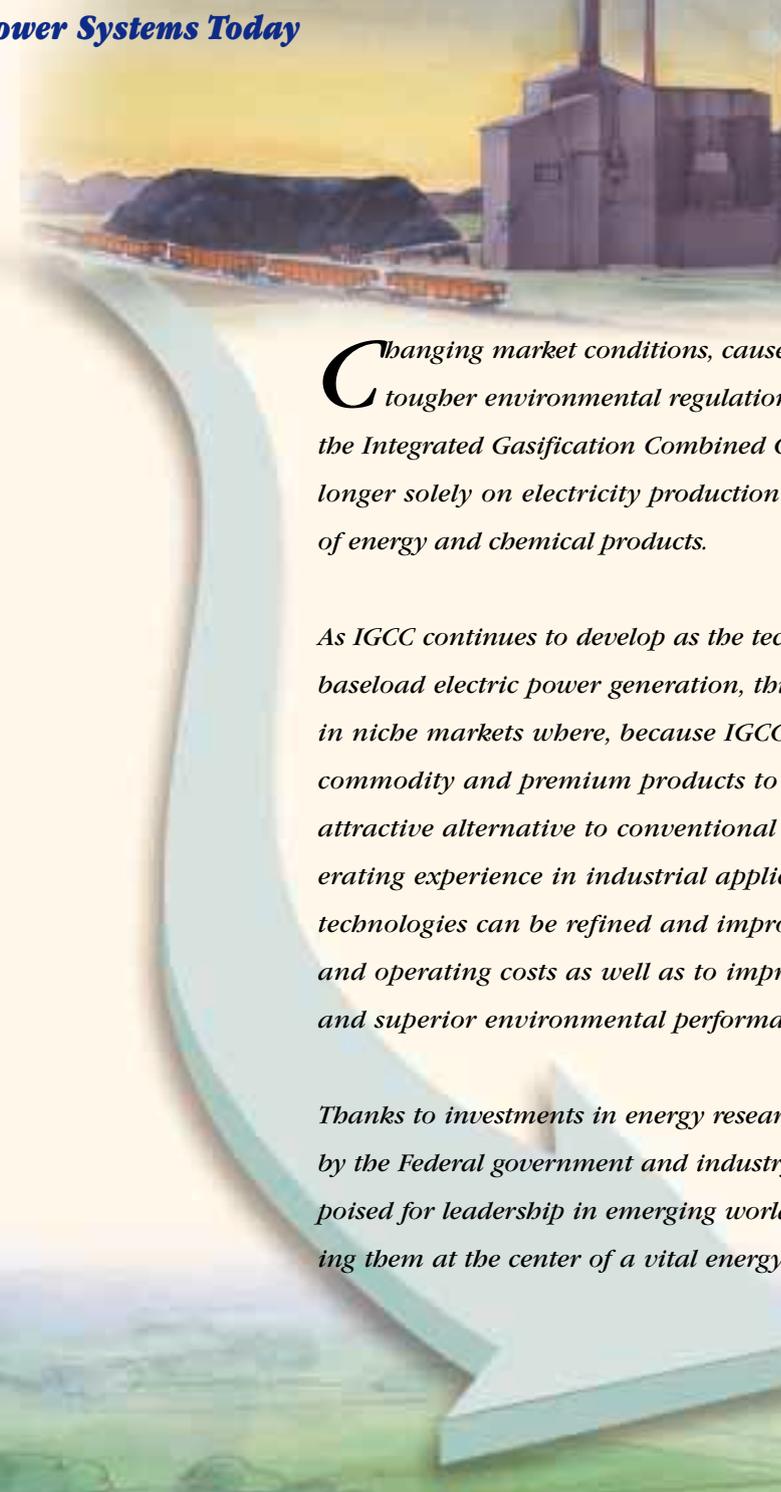


Integrated Gasification Combined Cycle



IGCC:
Clean, affordable energy
for tomorrow's world





Power Systems Today

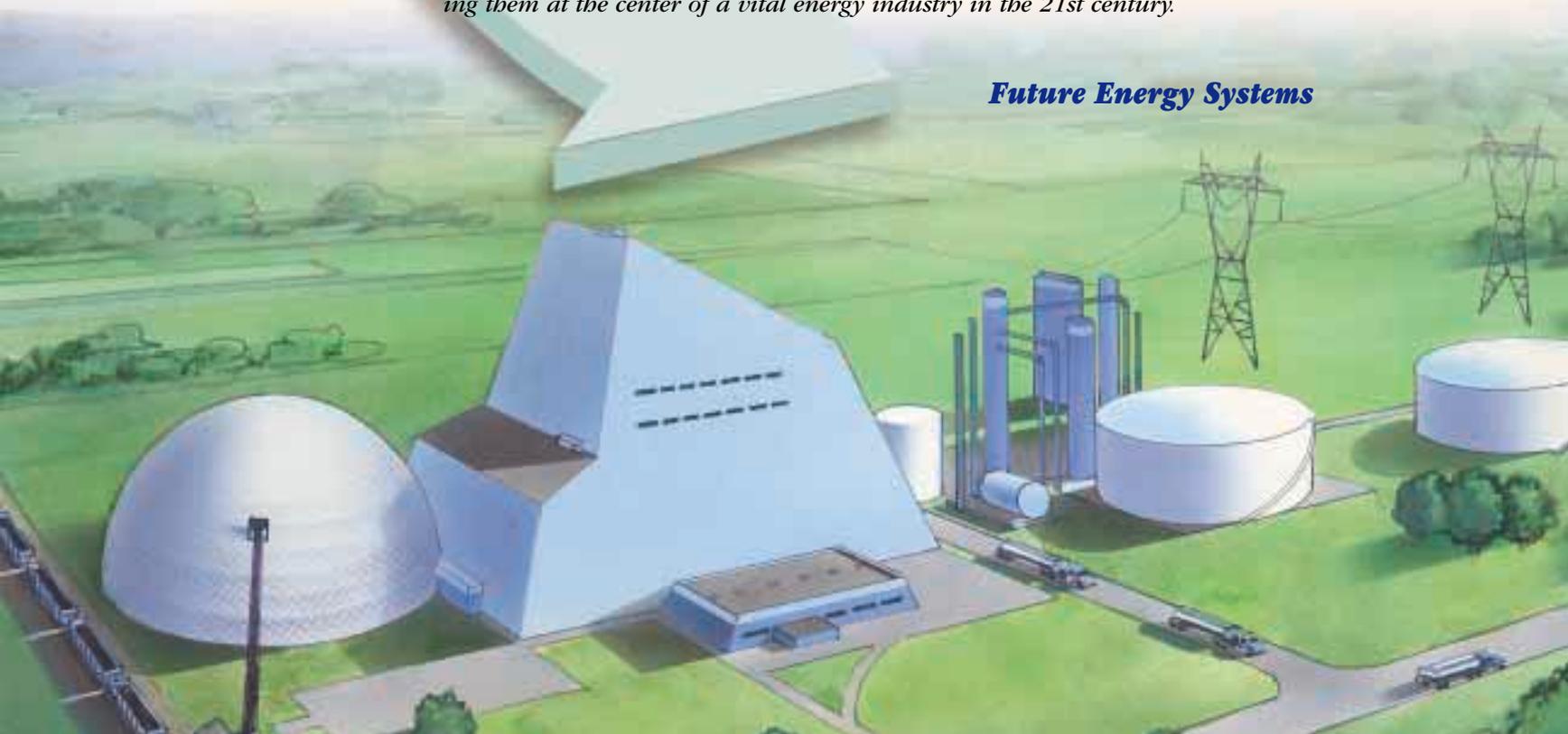


Changing market conditions, caused by utility deregulation and tougher environmental regulations, have resulted in a refocusing of the Integrated Gasification Combined Cycle (IGCC) Program. Its focus is no longer solely on electricity production but on the production of a full suite of energy and chemical products.

As IGCC continues to develop as the technology of choice for clean, efficient baseload electric power generation, this new strategy places gasification in niche markets where, because IGCC can coproduce a wide variety of commodity and premium products to meet market requirements, it is an attractive alternative to conventional power generation. Building on operating experience in industrial applications today, gasification-based technologies can be refined and improved, leading to reduced capital and operating costs as well as to improvements in thermal efficiency and superior environmental performance.

Thanks to investments in energy research, development, and demonstration by the Federal government and industry partners, U.S.-based companies are poised for leadership in emerging world markets for IGCC systems, positioning them at the center of a vital energy industry in the 21st century.

Future Energy Systems



What is IGCC?

Integrated Gasification Combined Cycle merges gasification with gas cleaning, synthesis gas conversion, and turbine power technologies to produce clean and affordable energy. This integration of energy conversion processes provides more complete utilization of energy resources, offering high efficiencies and ultra-low pollution levels. Ultimately IGCC systems will be capable of reaching efficiencies of 60 percent with near-zero pollution.

IGCC is the only advanced power generation technology capable of coproducing a wide variety of commodity and premium products.

An IGCC configuration can be built to convert

virtually any carbon-based feedstock into such products as electric power, steam, hydrogen, high-value liquid fuels, and value-added chemicals. Different technology combinations enable industry to use low-cost and readily available resources and wastes in highly efficient energy conversion options. These options can be

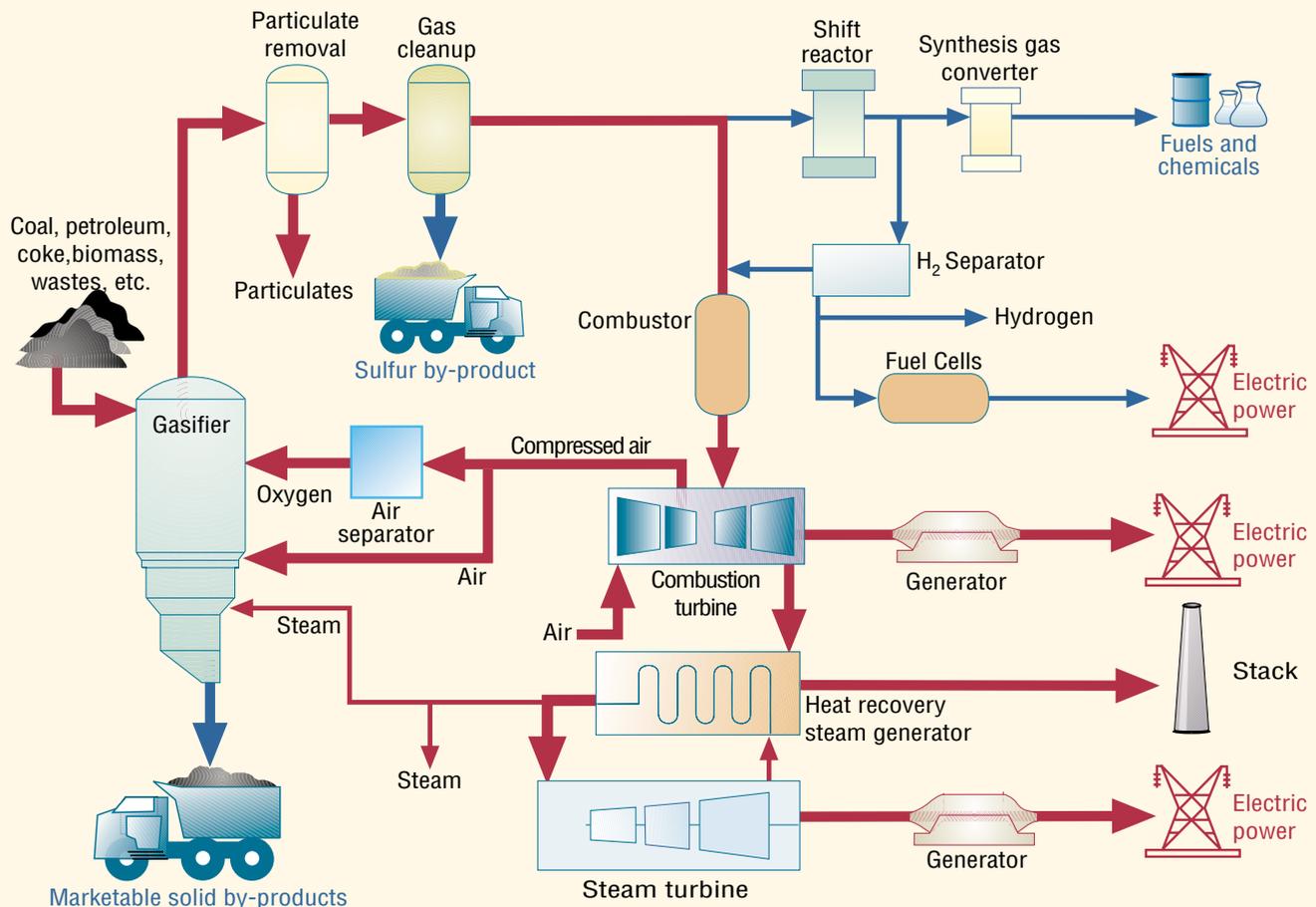
selected to meet any of a whole host of market applications; modules are combined according to the individual business opportunity. These versatile technol-

How IGCC works

The versatile IGCC plant configuration depicted has as its core the basic combined-cycle process for producing a single product, electricity (shown by the red line). IGCC uses a gasifier to convert a carbon-based feedstock into synthesis gas, a mixture of carbon monoxide and hydrogen. The synthesis gas is cleaned of particulates, sulfur, and other contaminants and is then combusted in a high-efficiency Brayton-cycle gas turbine/generator. Heat from the turbine exhaust gas is extracted to produce steam to drive a Rankine-cycle steam turbine/generator. This combination of power-generating cycles is

known as a combined cycle. IGCC can be extended beyond this basic combined cycle power generation application to serve as the backbone for modern energy plants. These plants can be configured to produce:

- High-quality steam for heating and other applications.
- Environmentally superior transportation fuels and a variety of chemicals, through catalytic conversion of the clean synthesis gas.
- Hydrogen, separated from the synthesis gas, used as an excellent feed to fuel cells for very high-efficiency electric generation, as well as for highly valued uses in refineries and chemical plants.



Why should industry be interested?

IGCC systems:
the basis of a new energy industry

The electric power industry is keenly aware that IGCC will be a leading candidate to provide clean and efficient baseload power when the next major capacity additions are needed. The industry is closely assessing the continuing Clean Coal Technology commercial-scale demonstration projects in the U.S. and also observing IGCC projects in niche markets worldwide.

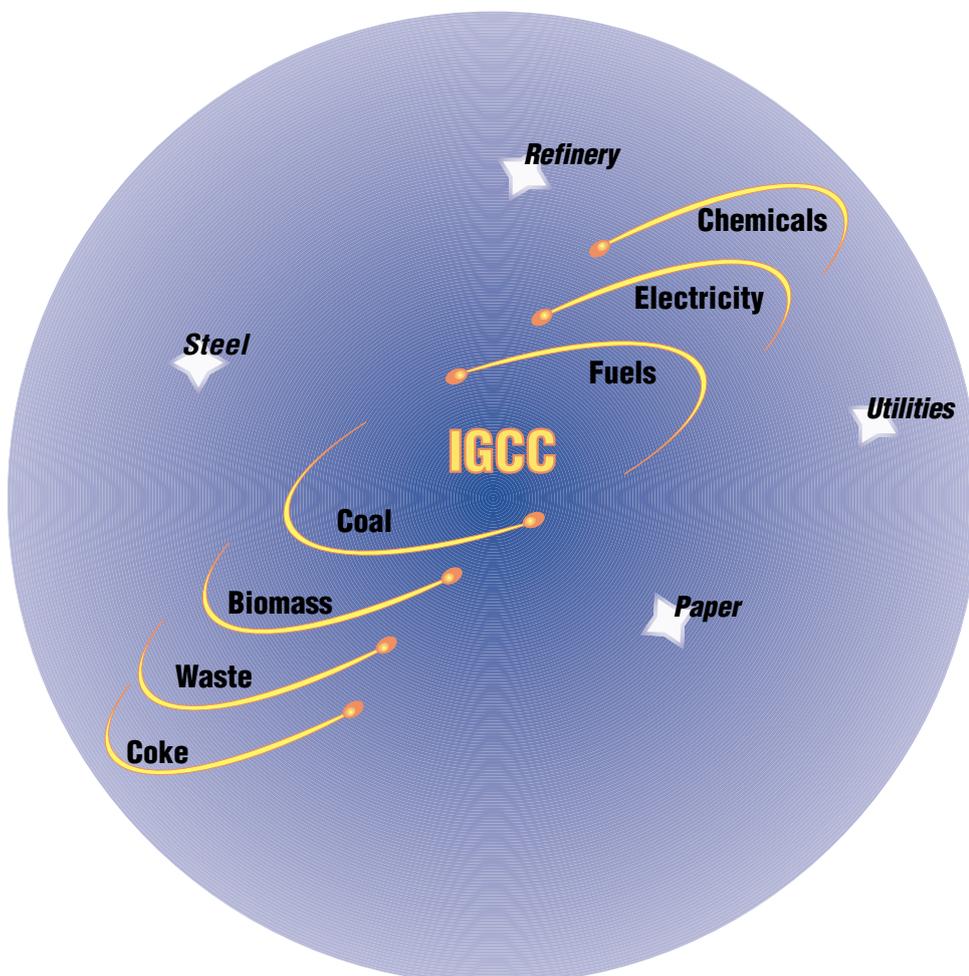
IGCC has inherent characteristics that will enable major energy industries—electric power generation, petroleum refineries, chemicals and fuels industries, and energy users—to remold their technology and business structure to meet future market needs and take advantage of new opportunities.

*“Integrated Gasification
Combined Cycle plants
are the powerplants
of the next millennium.”*

Robert S. Kripowicz
Principal Deputy Assistant Secretary
Fossil Energy

Deregulation, restructuring, and new types of cost competition are emerging along with increased environmental pressures. As a result, the boundaries of these industries and their business structures will change significantly. The inevitable result will be opportunities for lower-cost, more efficient, and less polluting energy conversion technologies. These options will enable structural changes in both the technology base and business interests of major energy industries as power generation evolves into more diverse energy production.

The unique advantages of IGCC systems have created a significant market for gasification technologies in industrial applications because gasification is the only technology that offers both upstream (feedstock flexibility) and downstream (product flexibility) advantages.



Gasification is central to future energy plants. IGCC configurations can be tailored to accept virtually any carbon-based feedstock and to provide a range of energy and chemical products. Key markets for IGCC include energy-intensive process and materials industries, as well as power producers.

**Industrial cogeneration markets
show potential for gasification**

In the refining industry, gasification has numerous important near-term synergistic applications. The gasifier can be used to process refinery wastes, avoiding waste disposal costs and improving the yield from increasingly sour crude oil. At the same time, the cogeneration portion of the cycle produces electricity and steam needed in the refinery, and the synthesis gas can generate valuable hydrogen or fuel products that are integrated in refinery operations.

In the pulp and paper industry, black liquor produced in the pulping process can be gasified to capture its energy fuel value for kiln operation and recover pulping chemicals for reuse. This increases process efficiency and reduces environmental impact by destroying potentially hazardous process wastes.

In the iron ore industry, gasification can provide synthesis gas for use both as the reactant for direct reduction and as a fuel for power generation, especially in countries where natural gas and coke are not readily available.

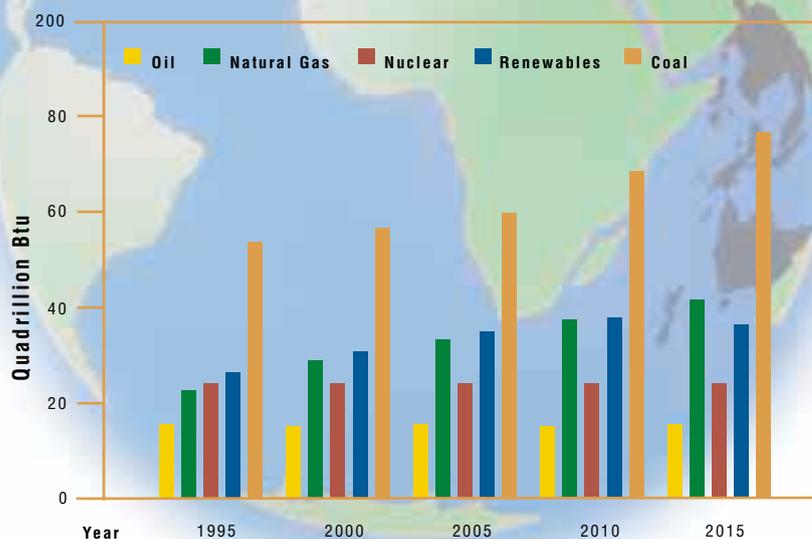
Coproduction of high-value products

Gasification can deliver a full slate of commodity products, including hydrogen, environmentally superior transportation fuels, and chemicals. Hydrogen is a particularly attractive coproduction option because it requires the lowest incremental cost beyond the initial IGCC investment (estimated at less than 10 percent of the IGCC plant cost) and has the potential to provide additional revenue. Hydrogen is a critical ingredient in refinery hydrocracking and desulfurization processes and is also a base material for ammonia production.

Methanol, higher alcohols, acetic acid, and Fischer-Tropsch liquids can be produced from synthesis gas as well. To produce these commodity fuels and chemicals, synthesis gas requires shifting to increase the H₂ /CO ratio. The additional plant and processing cost investment is offset by the high market value of the products. Some of the chemicals (dimethyl ether and alcohols) may become more prominent in future formulations of transportation fuels, increasing their value and market potential. Fischer-Tropsch fuels, with their zero aromatic content, high cetane number, and zero sulfur and nitrogen content, will be a valuable blending stock for diesel fuel to meet the requirements of the Clean Air Act Amendments of 1990.

Worldwide, energy consumption is expected to grow 75 percent between 1995 and 2020. Much of this increased demand will be for electricity. China alone expects to more than double its current electric capacity by 2015, and will turn to new technologies to reduce environmental and health challenges while making use of its abundant coal resources. The U.S. and the rest of the world will also rely increasingly on clean coal technologies to provide clean, low-cost electricity from readily available resources.

World energy use for electricity generation



Where is IGCC today?

Driving forces in a changing world

We are entering an era in which the single-purpose, single-technology powerplants of today will be less likely to compete effectively. Deregulation will completely restructure the electric power industry. Competition is forcing energy suppliers to downsize, streamline operations, and merge utilities. Successful new energy firms will capitalize on opportunities to integrate electric power generation with industrial processes.

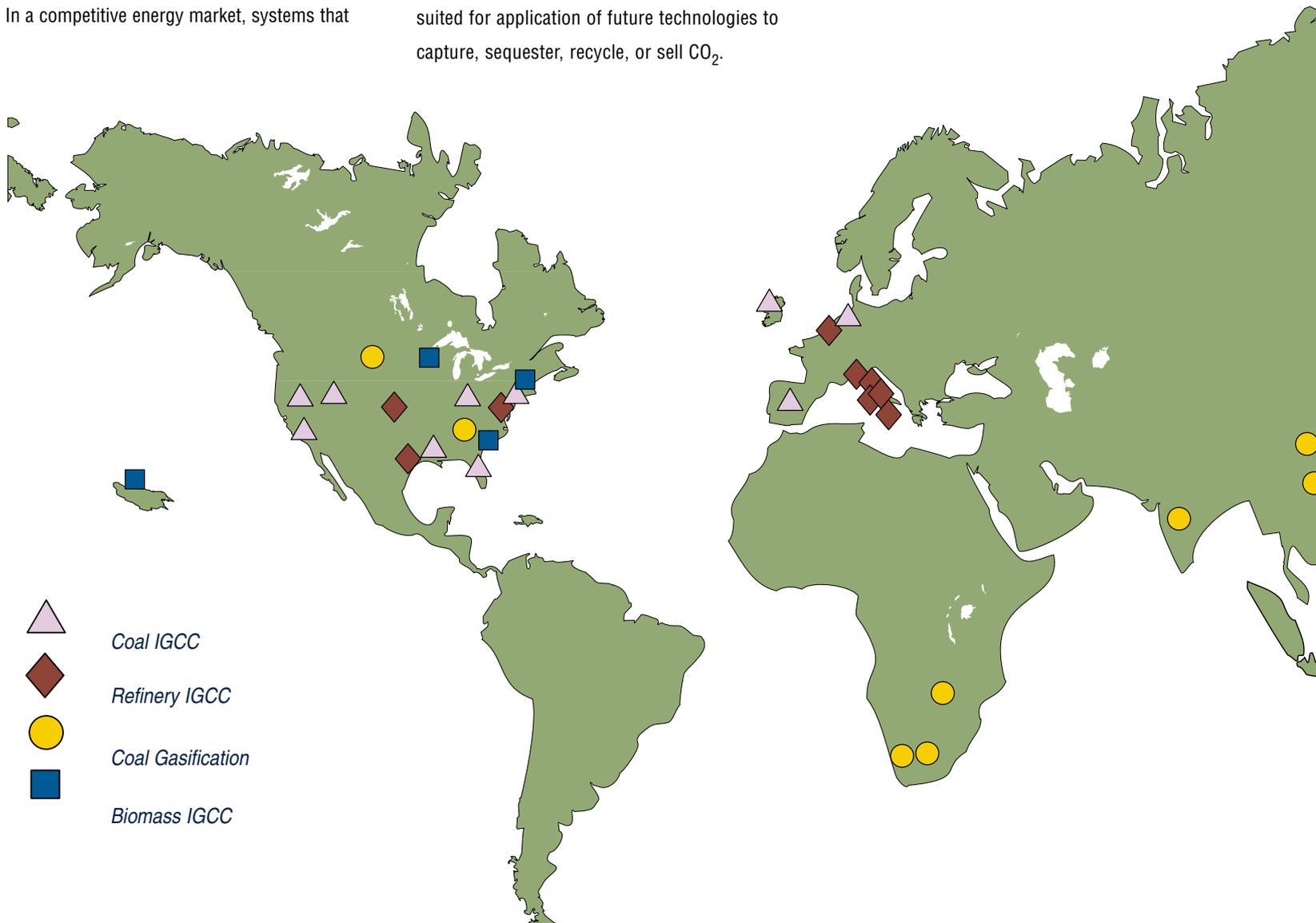
Energy firms that produce a variety of energy products such as steam, chemicals, and fuels are poised to capture an increasing volume of electricity sales in a deregulated environment. In a competitive energy market, systems that

offer the producer reduced market risk and enhanced revenues from high-value products are essential. Gasification systems will prosper in this type of environment by offering significant hedges against market and environmental risks.

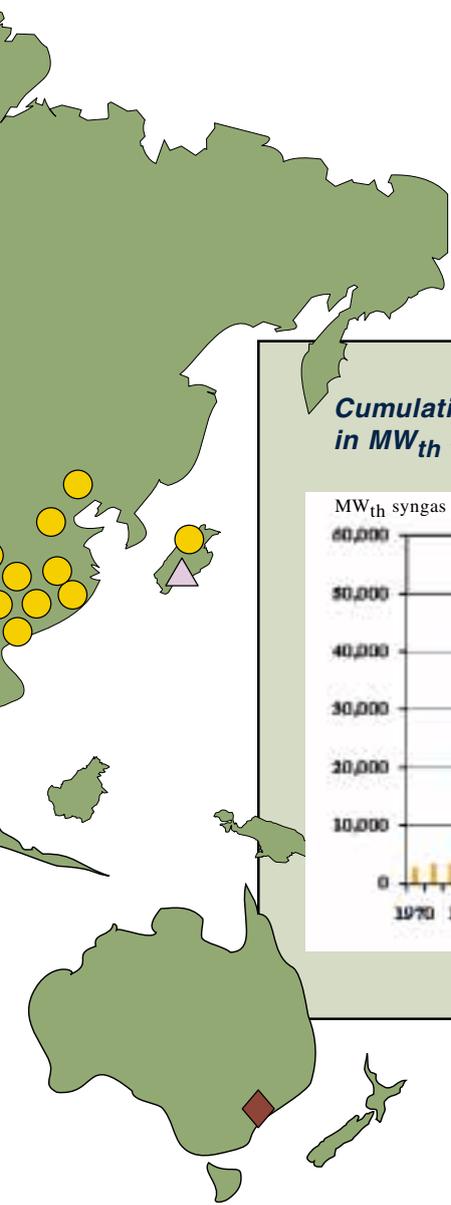
IGCC systems will be key to providing low-cost energy for continued U.S. economic growth while, at the same time, furthering national goals to protect the environment and mitigate global climate-change concerns. Because they operate at higher efficiency levels than conventional fossil-fueled powerplants, IGCC systems emit less CO₂ per unit of energy. They are also well-suited for application of future technologies to capture, sequester, recycle, or sell CO₂.

DOE's role

The U.S. Department of Energy (DOE), in partnership with industry, plays a crucial role in catalyzing long-term research and demonstrating breakthrough technologies such as IGCC. At a time when deregulation has made the power industry cautious about investment, DOE mitigates economic and technical risks by underwriting novel technologies. Public/private partnerships foster the commercialization of gasification-based processes that will give the U.S. an edge in rapidly expanding global energy markets while meeting increased domestic demand for power and fuels with superior environmental protection.



More than 350 gasification units are in operation worldwide, producing the equivalent of about 20,000 MW. More than 300 of the units are producing synthesis gas (H₂ and CO) rather than power. The largest concentration is 100 fixed-bed gasifiers at the SASOL in South Africa. China has the next largest inventory, licensing more than 20 gasifiers. There are also 14 gasifiers operating in North Dakota at the Dakota Gasification Plant.



Gasification worldwide

The stage is set for IGCC to play a major part in domestic and global energy markets. In addition to coal utility IGCC applications, gasification has been used in the conversion of petroleum coke, residual oil, and biomass to power, steam, and chemicals. In fact, residual oil and coke account for 50 percent of gasifier feed worldwide. Coal accounts for 42 percent, natural gas most of the remaining 8 percent, and biomass only a fractional percentage of all gasification. With emphasis on reducing fuel costs, waste disposal costs, and CO₂ emissions, a number of projects will soon use biomass as gasifier feed.

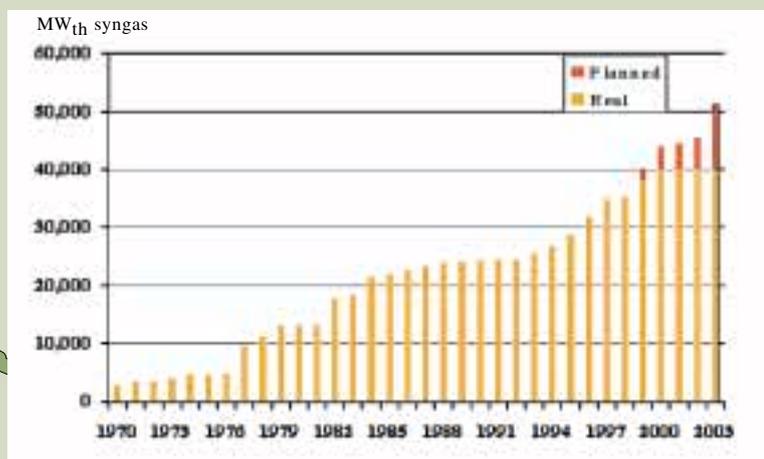
As of 1998, eight IGCC plants are in construction or operating in the domestic and international petroleum refining industry. Refinery residues are converted to synthesis gas to coproduce hydrogen for use in upgrading transportation fuel quality. In Italy, at least four projects are expected to add 1,500 MW to the Italian power grid before 2000. In Kansas, Texaco is operat-

ing a 35-MW IGCC at its El Dorado Plant, proving that small-scale gasification combined-cycle plants are economical and can convert hazardous waste into products. Two additional projects that integrate gasification with refining—the Star Refinery in Delaware and the Exxon Baytown Refinery in Texas—have awarded architectural and engineering contracts.

Competition within energy markets

During the coming years, competition between types of power systems and fuel resources will continue and, as long as natural gas remains readily available and relatively inexpensive, natural-gas-based power systems are likely to be the technology of choice. As natural gas becomes more expensive, lower-cost energy resource options such as coal and alternative fuels will become increasingly common choices. Gasification will then prove to be the best technology for providing efficient power and synthesis gas conversion technologies.

Cumulative Worldwide Gasification Capacity in MW_{th} Synthesis Gas Output



The capital cost for a natural-gas combined cycle is currently about one-half the cost of a coal IGCC plant. IGCC is capital-intensive; it needs economies of scale and fuel cost advantages to be an attractive investment option. However, IGCC costs can be lowered when integrated synergistically with industrial applications. For example, gasifiers can operate on low-cost opportunity feedstocks; be used to convert hazardous waste into useful products, reducing or eliminating waste disposal costs; and coproduce power, steam, and high-value products for use within the host plant or for export.

Fluidized-bed combustors, because of their ability to handle a wide range of feedstocks, compete with IGCC in smaller cogeneration markets. However, IGCC has the added advantage of product flexibility, which can make it a more economical option for certain industrial applications.

How is IGCC performing?

Commercial performance is proof of success

The key to commercializing technology is to demonstrate, on a commercial scale, its technical, economic, and environmental performance. DOE's Clean Coal Technology Program, a cost-shared effort with private industry, continues to be a cost-effective and successful approach for moving technologies from bench scale to the marketplace.

Tampa Electric Company IGCC Project

The Tampa Electric Company's gasification combined-cycle powerplant is one of the cleanest and most efficient coal-fired facilities generating electricity in the world. Tampa, a greenfield plant built near Mulberry, Florida, was the winner of the 1997 Powerplant of the Year Award presented by *Power Magazine*. The plant uses a Texaco oxygen-blown entrained flow gasifier integrated with a General Electric 7F gas turbine combined-cycle plant. The plant also has integrated air separation and cold gas cleanup systems. The plant achieved 80 percent availability during the high-demand months of July and August 1997, and almost 40 percent efficiency, resulting in reduced CO₂ emissions.



Wabash River Coal Gasification Repowering Project

Wabash River Coal Gasification Repowering Project

Winner of the 1996 Powerplant of the Year Award presented by *Power Magazine*, the Wabash River IGCC system demonstrates "a powerplant for the next millennium" by repowering a 1950s steam turbine with an advanced gasification system. The project is a joint venture between PSI Energy and Dynegy Power Corporation (formerly Destec Energy). A Destec oxygen-blown, two-stage

entrained gasifier, gas cleanup system, and a General Electric gas turbine were substituted for the conventional coal boiler. Through June 1998, the plant has operated more than 8,600 hours and set monthly records for operation on coal and the production of synthesis gas. The facility has averaged about 39 percent efficiency and has been more than 75 percent available in 1998. This plant has produced more than one trillion Btu of synthesis gas in a month, a record that no other single-train gasification plant in the world has achieved. The plant has also recently received the Indiana Governor's Award for Excellence in Recycling.



Tampa Electric Company IGCC Project

Liquid Phase Methanol Demonstration Project

The Liquid Phase Methanol (LPMEOH) project, which integrates coal-gasification-generated synthesis gas with chemicals production, is a partnership between Air Products and Chemicals, Inc., and Eastman Chemical Company. The new process is being demonstrated at Eastman's facility in Kingsport, Tennessee. The project is producing coal-derived synthesis gas for use as an intermediate feedstock in methanol-based chemicals production. LPMEOH technology was originally conceived to enhance the economics and efficiency of IGCC power generation by producing a clean-burning, storable liquid (methanol) from the clean-coal-derived gas during periods of low power demand. The

methanol can be used to fuel combustion turbines during peak demand.

Demonstration of the LPMEOH process expands the experience base and reduces commercial risk for all future operations, whether integrated with chemicals production or with combined-cycle power production. Together these technologies will be able to fill local needs for electric power, transportation fuels, and manufactured chemical products. The demonstration unit quickly achieved one of its initial performance targets by producing methanol at a rate of 80,000 gallons per day. The unit availability is 93 percent.



Liquid Phase Methanol Demonstration Project

Piñon Pine IGCC Power Project

The third IGCC plant is the 100-MW Sierra Pacific Piñon Pine project near Reno, Nevada. The KRW air-blown gasifier with in-bed sulfur capture has an advanced hot-gas cleanup process that includes an external transport desulfurizer and ceramic filters. Coupling this with General Electric power generation equipment provides an anticipated efficiency of

43 percent. This project will result in more efficient, less costly, and cleaner electric power generation than current commercial technologies. This plant will require approximately 20 percent less water than conventional plants operated by Sierra Pacific Power Company.



Piñon Pine IGCC Power Project

Clean Energy Demonstration Project

A 477 MWe IGCC powerplant demonstration project proposed by Clean Energy Partners Limited Partnership is under negotiation and will be the largest power producer of the IGCC demonstration projects. The project features the use of the British Gas/Lurgi (BG/L) slagging fixed-bed gasification system coupled with both a combined-cycle powerplant and a 1.25 MWe molten carbonate fuel cell (MCFC). The project will use a midwestern high-sulfur bituminous coal with a high fines content. The slagging characteristic of the gasifier produces a non-leaching, glass-like slag that can be marketed as a usable by-product.

What is the IGCC advantage?

A clean environment

IGCC plants can meet all projected environmental regulations, solving the compliance problems of both electric power generators and liquid fuel producers. Because they operate at higher efficiency levels than conventional fossil-fueled powerplants, IGCC systems emit less CO₂ per unit of energy. IGCC emissions of sulfur dioxide and nitrogen oxides, gases linked to acid rain, are a small fraction of allowable limits. The water required to run an IGCC plant is less than half that required to run a pulverized coal plant with a flue gas scrubbing system.

Feedstock flexibility

The gasifier has the flexibility to handle a variety of feedstocks. In addition to coal, possible feedstocks include petroleum coke, refinery liquids, biomass, municipal solid waste, tires, plastics, hazardous wastes and chemicals, and sludge. These alternative feedstocks are typically low-cost, sometimes even of negative expense. When a low-cost feed is used, the economics of gasification are enhanced and marketable products are created from a waste stream, avoiding disposal costs and environmental concerns.

Product flexibility

An advantage of gasification lies in its ability to operate in a coproduction mode. Coproduct options help reduce business risk by allowing the company to choose the plant configuration that best suits market demands, producing goods that have the highest value to that particular business. System efficiencies are enhanced to more than 50 percent when transportation fuels are produced and to 80 percent when some of the steam is used directly in industrial applications.

Attractive plant economics

The economic advantages of the IGCC system are its use of low-cost feedstocks, its high efficiency in resource use, its economically efficient reduction of environmental pollutants, and its integration of processes within the plant complex. In addition, it can deliver high-value products. Modularity and phased construction can distribute capital expenditures to meet financing requirements. Repowering can use existing plant infrastructure to reduce up-front expenditures. By-products, such as sulfur, are also marketable. Because IGCC uses regenerable sorbents and catalysts, the costs of replenishing these supplies as well as the costs of disposal

can be avoided. Continued operating experience and the design of additional units can further reduce capital and operating costs, increasing IGCC's economic competitiveness.

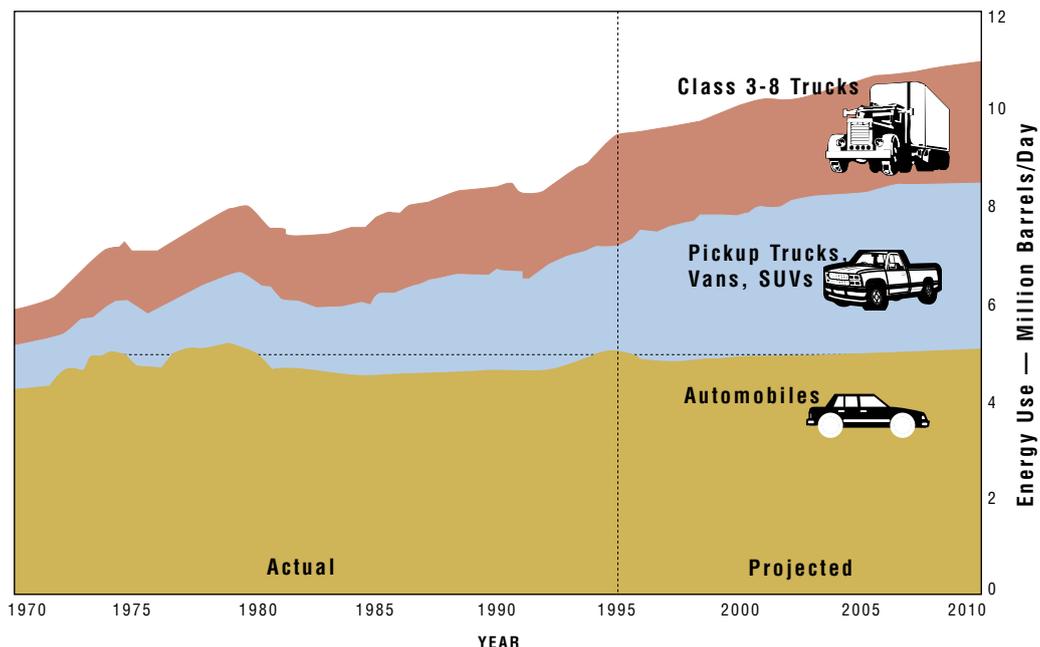
Ease of integration with advanced technologies to achieve high efficiencies

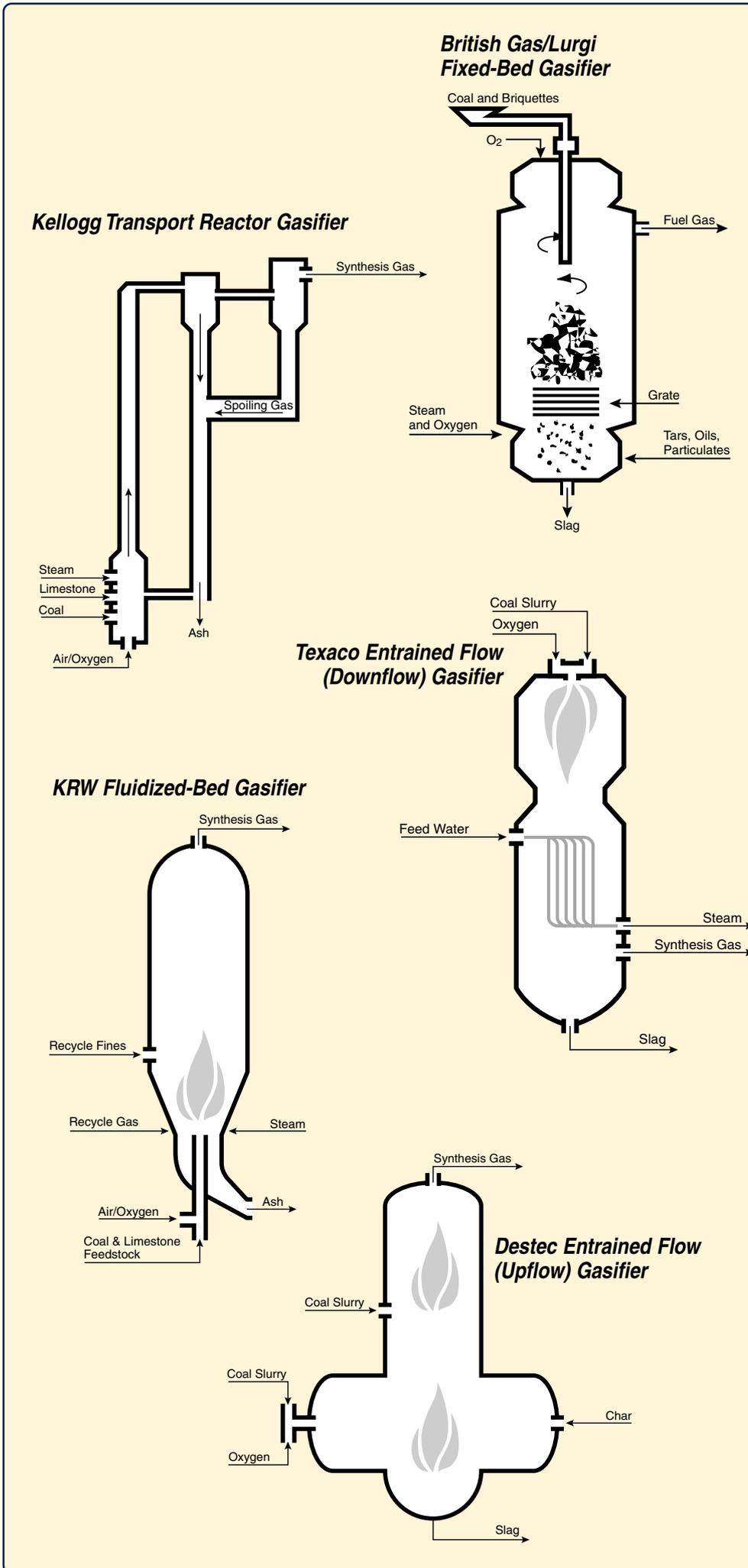
Current IGCC plant efficiencies are 40 percent or greater compared with 35 percent for conventional powerplants. The increased efficiency of the IGCC process significantly reduces CO₂ emissions and those that cause acid rain, and lowers the cost of power and products. As advanced technologies for gasification, turbines, fuel cells, coproduction, gas separation, and gas cleaning become available, each of these can be readily integrated to improve overall efficiency.

Further, both coproduction and coal gasification with gas cleaning can be readily added to existing natural-gas combined-cycle plants to attain a full IGCC system. Most important, system evaluations can determine the best combinations of components to achieve cost reductions and products of greatest value while minimizing wastes and environmental impacts.

In addition to steam and power, IGCC can produce a slate of high-value products, including hydrogen, environmentally superior transportation fuels, and premium chemicals. A domestic source of transportation fuels will increase our Nation's energy security and at the same time provide the clean fuels needed to meet the major increased demand for highway fuel as new regulations are imposed on this sector

Source: EIA Annual Energy Outlook, 1996 Federal Highway Administration, Highway Statistics





The right gasifier for any application

Because an IGCC system can incorporate any one of a wide variety of gasifiers, a configuration can be designed to handle virtually any carbon-based feedstock. DOE has demonstrated each of these major gasification technologies in IGCC configurations at its Power Systems Development Facility or in one of the demonstration plants. In industrial cogeneration and coproduction applications, initial gasification projects largely used fixed-bed technology, but entrained and fluidized-bed gasification are usually chosen for more recent coal and refinery waste applications.

The IGCC Program

Designed for success

To meet energy market demands and facilitate global commercial acceptance of gasification-based technologies, the IGCC program strategy emphasizes increased efficiencies, cost reduction, feedstock and product flexibility, and near-zero emissions of pollutants and CO₂. The strategy consists of two areas: Gasification Systems Technology and Systems Analysis/Product Integration.

Gasification Systems Technology

DOE/FETC sponsors R&D contracts with industry, academia, nonprofit institutions, and government laboratories to achieve gasification technology goals.

Research on **advanced gasifier** designs such as the transport gasifier has the potential to reduce capital and O&M costs, improve thermal efficiency, and process alternative feedstocks. Refractory-materials research and instrument development are being pursued to improve gasifier performance, operational control, and reliability. Fluid dynamic data and advanced computational fluid dynamic models support improvements to the gasifier. Use of biomass and municipal waste as gasifier feedstocks for power and coproduction applications are undergoing evaluation.

Novel technologies for **gas cleaning and conditioning** are undergoing development to reduce capital and operating costs. New technologies are needed to supply ultra-clean gas for fuel cell and catalytic conversion of synthesis gas to improve efficiency, enable effective CO₂ separation, and minimize consumables and waste products.

Research in **advanced gas separation** technologies targets capital and operating cost reductions, improved plant efficiency, and concentration and capture of CO₂. Investigations include hydrogen and CO₂ separation technologies capable of operating at high temperatures and pressures and in the presence of contaminants, and new air separation technologies for producing lower-cost oxygen.

Finally, technologies that can generate **value-added products** to minimize waste disposal and improve process economics are undergoing evaluation. Improving the quality of the ash and sulfur by-products not only enhances plant revenues, but also uses resources more effectively.

Systems Analysis/Product Integration

Demonstration of gasification-based technologies at an industrially relevant scale of operation will confirm process scale-up; provide reliability, availability, and maintainability data; and evaluate process performance. Activities will include technical assistance and R&D to ensure the success of existing IGCC Clean Coal Technology programs. The scope of demonstrations will expand to incorporate fuel cells, turbine integrations, and hybrids.

Economic analyses, process performance assessments, and market studies will provide sound engineering and economic guidance for future R&D initiatives and support domestic and international commercialization activities. For example, an IGCC optimization study will help to define the lowest-cost and highest-efficiency approaches for baseload, cogeneration, and coproduction applications. R&D can then be aimed at reducing material costs and consumables as well as total plant costs. A detailed market analysis and commercialization strategy for coproduction applications will take place along with system studies to assess control of CO₂.

As public and private RD&D funding becomes increasingly limited, DOE/FETC has implemented an aggressive **outreach program** to partner with those who have a stake in the outcome of IGCC RD&D, including power generators, industrial firms, financial institutions, environmental groups, legislators, and taxpayers. DOE/FETC will educate stakeholders on the technical, economic, and environmental benefits of IGCC systems, coordinating activities with other Federal, State, and local agencies and organizations. Formation of multinational partnerships, consortia, and user groups will ensure coordinated research and commercialization activities for gasification-based technologies.

IGCC's costs will decrease and its efficiency increase significantly by 2015

Year	Capital Costs (\$/kW)	Efficiency (HHV,%)
1997	1450	39.6
2000	1250	42
2010	1000	52
2015	850	>60

Development Facilities

Dedicated development facilities demonstrate technology feasibility, system integration, component scale-up, product improvement, feedstock testing, advanced gasifier designs, and advanced gas separation concepts. Each facility provides opportunities to partner with industry in technology research, development, and demonstration.

Engineers at the **Power Systems Development Facility**, a showcase multi-module test facility operated by Southern Company Services in Wilsonville, Alabama, integrate power system components, including hot-gas particulate control devices, and evaluate their performance using fuel gas produced by a 38-ton/day transport gasifier. Engineering-scale testing and development of IGCC processes, components, and equipment, as well as testing of devices to remove contaminants, are conducted with industrial partners.

Power Systems Development Facility



Alternative Fuels Development Unit

At the **Alternative Fuels Development Unit** operated by Air Products & Chemicals, Inc., at LaPorte, Texas, researchers are demonstrating low-cost methods of making liquid fuels and chemicals from synthesis gas, using a wide variety of feedstocks. This unit is large enough to generate engineering performance data for the slurry-phase reactor system and to make products for use in application demonstrations.

Using a 150,000-cubic-foot/hour synthesis gas generator at the **Gas Processing Development Unit (GPDU)** in Morgantown, West Virginia, FETC researchers test new, attrition-resistant sorbents in fluidized-bed and transport-bed reactors. Working with contractors and industrial partners, these researchers can develop information and evaluate processes, sorbents, and catalysts in support of larger-scale testing in other units or in CCT projects.

Achieving the Vision

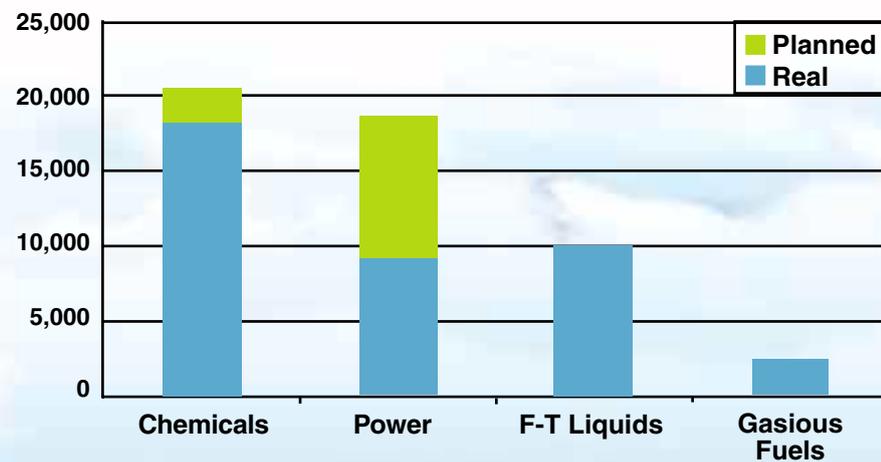
Global Acceptance—

Worldwide Power Generation Markets

By the year 2015, gasification-based technologies will have gained global acceptance and, as a result, will have penetrated worldwide power generation markets, achieved widespread use in the petroleum refining market, and been deployed in the fuels and chemicals market. Gasification-based processes will be the technology of choice because of their low cost and superior environmental performance and because their modularity of design and fuel flexibility provide easy integration.

Commercial guarantees and financing will be readily available, minimizing the need for government incentives. This ease of access will result in increased use of domestic resources, improving U.S. industrial competitiveness and enhancing U.S. energy security. Beyond 2015, the Federal government will continue to develop advanced low-cost zero-emissions technologies to achieve America's goals of economic prosperity, energy security, and environmental quality.

MW_{th} syngas



Early Entrance Coproduction Plants

The versatility of producing some combination of power, steam, hydrogen, fuels, and chemicals accelerates deployment of both IGCC and synthesis gas conversion technologies, increases capacity factor, and reduces risks. Coproduction would allow a reduction in oil imports by producing significant quantities of ultra-clean fuels from domestic resources with little or no carbon emissions. However, private investors and process developers are hesitant to invest in the design and construction of coproduction plants until technical, economic, and technology integration risks are acceptable. DOE's Early Entrance Coproduction Plant strategy can mitigate these risks.

These plants are small-scale commercial facilities that will demonstrate successful operation of integrated technologies. They will be constructed adjacent to existing infrastructures and be capable of processing multiple feedstocks and delivering more than one product. They will be built by industrial consortia in partnership with State and Federal governments. Once the identified risks have been shown as acceptable by successful operation, future commercial plants would not require Federal funds for construction and deployment.

Gasification by Application

Vision 21

Ultimately, gasification will be the cornerstone technology for a new fleet of energy plants for the 21st century, the Vision 21 energy systems. These will be highly efficient systems coproducing low-cost electric power, transportation fuels, and high-value chemicals, all tailored to geographic energy market demands. The feedstock and product flexibility of gasification-based technologies, coupled with their high efficiency and ultra-low emissions, make them a core part of the Vision 21 concept.

Vision 21 is DOE's strategy for advancing the research and development of technologies critical to creating the integrated energy systems of the coming century. R&D by DOE and industry partners will focus on issues that are key to improving the efficiency, versatility, and cost-effectiveness of IGCC components and systems, and to furthering synergies between IGCC and other advanced energy and environmental control technologies.



Visit additional information **FETC** online



- *Product Line Overview*
- *Integrated Gasification Combined Cycle*
- *Clean Coal Compendium*
- *Hardgrove Grinability Index*
- *Natural Gas Supply & Storage*
- *Natural Gas Processing*
- *Coal Liquefaction Technology*
- *Solid Fuels*
- *International Programs*
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FETC is a field facility of the U.S. Department of Energy's Office of Fossil Energy

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