



Green Paper

Integrated Gasification Combined Cycle

An environmentally responsible coal energy production method

OEC's Position

The Ohio Environmental Council supports the expansion and implementation of Integrated Gasification Combined Cycle (IGCC) technology in coal-based energy production.

IGCC is a bridge technology - it is a substantial environmental improvement over current coal-based options and its adoption in the U.S. could have vast, positive global impacts.

The evolution toward clean energy

production is occurring fast in the U.S. but for a number of reasons coal as an energy source will not be abandoned anytime soon. The goal then is to promote the adoption of coal power production methods that produce the most minimal environmental impact.

IGCC achieves this goal and the OEC supports its continued adoption as a more environmentally responsible coal energy production method.

Assumptions



IGCC promotes the adoption of the coal power production methods that produce the most minimal environmental impact. (IGCC plant at Wabash, IN, pictured above)

Several reasonable assumptions must be adopted before support for IGCC can be considered. First, we must assume that coal will not go away anytime soon. The U.S. possesses vast coal reserves, enough to supply current and growing energy needs for centuries. The business community, the coal and mining lobby, manufacturers, and the general public will not abandon coal wholesale. It is seen as a secure domestic source of energy that does not require foreign adventures to ensure its supply.

Second, we must assume that it is better to replace existing, outdated coal plants (largely grandfathered out of the Clean Air Act requirements) with IGCC, rather than continue their use or build new plants with the same old technology. Old plants pollute more than new plants and are far less efficient, dumping significantly more carbon in the atmosphere. There needs to be a reasonable alternative to relying on grossly outdated coal plants.

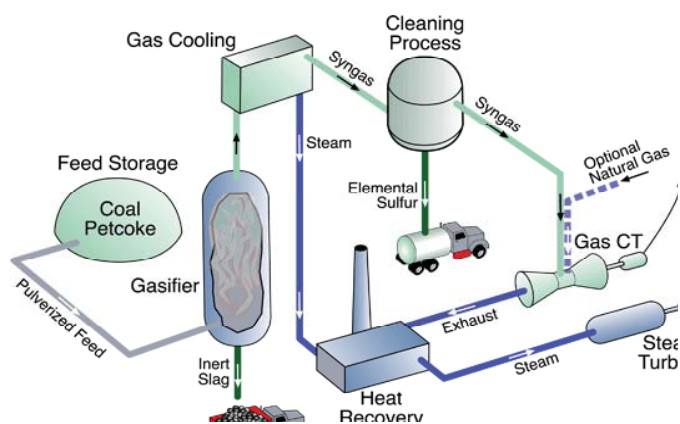
Third, we must assume that baseload power requirements are significant and currently cannot be met completely with today's alternative or renewable fuels. Baseload power needs to be easily adjustable and transmittable.

Right now, alternative and renewable sources can't provide reliable baseload power on a large scale. This may change but this reality has not yet arrived. Therefore, while the OEC strongly supports an intensive investment in renewable power, we must address cleaner solutions for existing baseload energy sources during this transition.

Once these assumptions are accepted, IGCC becomes an essential part of a future solution to the energy problem. IGCC technology is efficient, has far less harmful emissions, and is largely carbon-capture ready. IGCC is also an important stepping stone in the development of market conditions that will make carbon dioxide production a financial liability.

IGCC captures harmful emissions that pulverized coal releases into the atmosphere

How IGCC Works



The IGCC process, originally developed to produce greater efficiency in the normal coal burning process, has environmental benefits: it can be combined with carbon capture technology and it can utilize environmentally friendly feed stocks such as municipal sludge and biomass crops.

IGCC converts coal in a complex rendering process. Two steps in the conversion process lead to IGCC's efficiency in creating coal based electricity. First, coal is converted by gasification into a

synthetic gas. Heat from the gasifier is then captured as steam for use in power generation.

Next, cleaning captures much of the harmful emissions that traditional pulverized coal plants release into the atmosphere. Traditional pulverized coal plants have high rates of heat loss due to evaporation. This is wasted energy, which IGCC captures and uses to a greater extent.

Conversion, though complex, produces manifold benefits. Compared with traditional pulverized coal, IGCC requires less water and produces far less waste

and the form of waste produced is much more environmentally friendly.

Increased efficiency and reduced harmful emissions are not the only benefits of IGCC. Another tremendous advantage of IGCC energy production is the variety of fuel stocks that can be processed in the system. For the future of energy use evolution in the U.S., this point is central.

The list of possible fuels is long, including petroleum coke, heavy fuel-oil, municipal sludge, liquid feedstocks, solid feedstocks, low-quality feedstocks, solids/water slurry, low-opportunity fuels such as petroleum coke, and, most importantly, biofuel and biomass.

IGCC can be converted to capture carbon dioxide. It also can be modified to feed disposal units. The carbon capture advantages of IGCC are significant over pulverized coal. IGCC plants can be modified to capture more carbon in a cheaper manner than traditional pulverized coal.

The options for modification are a positive point for industry, environmentalists, and government to focus upon. These options include plants designed for a generation or more that can be fundamentally altered to run on very different fuels and can be modified to capture harmful carbon emissions.

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IGCC for Carbon Capture



Traditional coal-burning power plants will become less profitable as the U.S. develops a cap-and-trade market for CO₂ emissions.

IGCC vs Conventional Coal, by the Numbers

- 40% less water
- 90% less mercury
- 80% less sulfur dioxide
- 35% less nitrogen oxide
- 30% less solid waste
- 80% less carbon dioxide (with carbon capture)

As carbon becomes more of a financial liability, and carbon markets or a carbon tax system is developed, IGCC will be the least-cost option when compared to traditional pulverized coal. Studies have shown that at a certain carbon price threshold, IGCC begins to be competitive with traditional pulverized coal, even without direct or indirect subsidy. This means that the power industry must rethink how it does business.

If a power company believes future carbon emission prices will be low or that there will not be a market at all, that company will construct a traditional pulverized coal plant. If the company believes, as is most likely, that there will be a viable carbon market and that the price of carbon will be higher, then that company should construct an IGCC plant. Both AEP and Duke Energy have embraced IGCC technology, anticipating its importance in a carbon-constrained world.

Currently, the U.S. carbon offset price is about \$4 a ton, without a carbon cap or carbon liability. According to a range of studies, at somewhere between \$13 and \$27 a ton with a cap or liability, IGCC, as it is technologically formatted today, will be a more profitable method of energy production than traditional pulverized coal.

In this carbon-constrained economy, increasing the amount of required carbon abatement will be achieved by eliminating the most polluting, least-efficient process. If carbon emission is a business liability, then traditional pulverized coal will face significant

competitive pressures, and IGCC will pick up the slack. Any probability of future carbon emission regulations bolsters the case that IGCC is the most profitable choice despite a higher initial capital cost. Energy producers today must consider the very likely scenario that there will be a future U.S. carbon cap and trade market, and that the costs of emitting high levels of CO₂ could be very significant, even prohibitive.

IGCC already has competitive advantages in today's market over traditional pulverized coal. Several factors, including reduced NO_x and SO_x, marketable by-products of production, and high thermal efficiency, are already making IGCC somewhat commercially competitive. Energy producers and regulators must look into the future to determine if their plant and model will be viable 50 or even 75 years down the road; mercury may be a liability, along with other emissions not currently fully regulated.

Ohio is unusually reliant upon older, inefficient coal plants. In Ohio's current power market, a carbon cap or tax could cripple the state's economy. Ohio would be far behind the rest of the country in renewable and IGCC energy production, and would have to spend considerable resources to catch up.

Alternatively, because of coal and intellectual resources and advantages, Ohio is poised to become a leader in IGCC and alternative energy production. Ohio could be leader in IGCC energy production, making the state a center of the new economy.

IGCC for Ohio's Economy



IGCC will create the need for more jobs, at all levels of production.

IGCC will create the need for more jobs at all levels of production. At least initially, IGCC systems will require larger work forces to run plants. Pulverized coal as an energy production method has been refined for operational simplicity.

IGCC has many more processes and requires an altogether different degree of organizational complexity. More capital investment is needed for plant development and startup, along with additional finances for education of the highly skilled work force that must develop the plans and construction/operational techniques that will make the

technology a success.

Coal will remain a dominant energy production method in the global economy, but nations will look to mitigate environmental impacts. They are actively looking to IGCC, and eventually carbon capture, to address these concerns.

Ohio can keep its economy competitive on a global and national scale by aggressively supporting and adopting IGCC technologies, cultivating the expertise and industrial strength necessary to export IGCC.

IGCC for Ohio's Future

IGCC is a transitional technology, and will help to bridge current markets to future ones, where environmental impacts are well considered. IGCC represents a strong step towards future technology and future regulatory landscapes. IGCC plants result in significantly less harmful emission output than pulverized coal plants and IGCC plants can be readily modified to accept and clean the emissions of a variety of fuels, including municipal waste sludge and biomass. This is important for any transition away from traditional sources. Flexibility will be paramount and IGCC is certainly a flexible, dynamic technology.

There also is, and will continue to be, large-scale federal support for IGCC technology. The federal Department of Energy has committed to a decade-long, \$2 billion IGCC clean coal research initiative. It is reasonable to expect

that this investment will produce IGCC technology advancements, which will find their way to private production, improving the profit margins of IGCC and decreasing the competitive advantage of traditional pulverized coal.

The shift to IGCC as a preferred method of coal energy production over traditional pulverized coal will come, due to two factors:

- 1) knowing its environmental benefits and importance as a reliable baseload domestic power source, cleaner coal initiatives are a reasonable alternative to traditional coal subsidy;
- 2) the creation of a carbon market will make IGCC economically viable. Once carbon emissions hit a threshold price, traditional pulverized coal production will no longer be able to compete.