The potential use of Lignite and Petcoke for Louisiana Electric Power Generation Rev. 1

A study by:

The Louisiana Department of Economic Development
and
Tulane University's Entergy-Tulane Energy Institute

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Executive Summary

This project examines the prospects for using locally produced lignite, mined in Desoto and Rapides Parishes, and locally available petroleum coke (Petcoke) produced by 13 active refineries located throughout the State. While some progress is being made in the incremental use of Petcoke in power generation, most notably at the NISCO plant in Lake Charles, as well as at two new plants under construction, less progress is apparent with Louisiana Lignite. We believe that both of these solid fuel carbon sources are significantly underutilized and that effective State action can create additional jobs, a higher GDP and lower power costs for State consumers.

One recent development designed to use Petcoke involves the expansion of Cleco's Rodemacher site. The new unit #3 is being built to use Petcoke as its primary fuel, but will also be able to use Louisiana Lignite and Wyoming sub-bituminous coal. Also, Entergy Louisiana has announced the $1 billion, 500 mw conversion of an existing gas fired unit to utilize Petcoke. Significantly, barge delivery is being incorporated into both sites.

In the case of Lignite and Petcoke, the State needs to foster the use of new generation technology coupled with an overwhelming marine transportation advantage vs. the current approach of hauling in sub bituminous coal from Wyoming by unit trains. These trains are made up of 150 cars, each carrying 100 tons of coal. While they represent the most efficient rail system, they are still roughly twice as expensive as waterborne transportation.

With petroleum coke, the object is to use this material in a more effective manner. Several options currently exist, including the use of calcined coke in the production of high purity carbon anodes for Aluminum smelting. This consumes about one third of available Petcoke supplies. However, the major domestic potential is for electric power generation. Unfortunately, most Gulf Coast Petcoke production is exported, either to other states or internationally, at significant, double digit price discounts to coal prices. The marginal consumers are Mediterranean area cement kilns.

Long term growth in domestic Lignite and Petcoke consumption for power production, both in Louisiana and elsewhere, will require conversion of these fuels in pressurized, oxy-fuel boilers and gasifiers. Newer power units using such technology are similar to units found at major refineries and Petrochemical plants. Two such units are located at the Nelson cogeneration plant which is owned by NISCO and operated by Entergy. In the short term, viable transshipment capabilities allowing rail car delivery to Louisiana power plants would improve utilization of the two target fuels, both in Louisiana and in neighboring states.

This report relies on numerous secondary sources including a report prepared in 1993 by Alan Troy and Michael French, both with the Louisiana Department of Natural Resources. Other sources include the US Energy Information Agency, General Electric, The National Energy Testing Laboratory, Jacobs Consultancy, a new report by MIT, and Wikipedia.

Primary sources we would like to acknowledge include Franz Vogt of CII, Bill Mohl of Entergy, John Blankin, formerly with Thyssen, Larry Barbish of Canal Barge Company, and Ben Ziesmer of Jacobs Consulting.

Lignite availability and alternates

Louisiana has significant deposits of Lignite, a naturally occurring relatively low rank (read low heat content) coal produced from open pit mines in two central Louisiana parishes, De Soto and Rapides. A key to Lignite's use for power generation is its relatively low sulfur content and its proximity to a purpose built power generation plant. Typically this unit includes Fluidized Bed Boilers as opposed to the more common super critical, pulverized coal boilers.

For context, Lignite can be divided into two categories based on heat content. Lignite "A" has a heat content between 6,300and 8,300 Btu/lb. Lignite "B" is less than 6000 Btu/lb. The typical sub-bituminous low sulfur coal imported from Wyoming for power generation has a heat content of 8,300 - 11,500 Btu/lb. However, it is also relatively high in ash content as well as in water content, in some cases over 30%. All of the Wyoming coal consumed in Louisiana uses rail transport, a transportation system that is approximately 50% more expensive than barge transportation.

Current and Future Solid fuel Power Plants in Louisiana

Current and Future Solid Fuel Power Plants in Louisiana

Parish	Company	Plant Name	Existing Construction	Gen ID	Sum. Cap.	Mover	Energy Source 1	Energy Source 2	Vintage
Desoto	Cleco	Dolet Hills	E	1	650	Steam	Lignite	Natural Gas	1986
Rapides	Cleco	Rodemacher	E	2	523	Steam	Sub Bituminous	Natural Gas	1982
Rapides	Cleco	Rodemacher	C	3	600	Steam	Pet Coke	Lignite	2009
Pointe Coupee	La. Gen. LLC	Big Cajun 2	E	1	580	Steam	Sub Bituminous	Distillate Fuel Oil	1981
Pointe Coupee	La. Gen. LLC	Big Cajun 2	E	2	575	Steam	Sub Bituminous	Distillate Fuel Oil	1982
Pointe Coupee	La. Gen. LLC	Big Cajun 2	E	3	575	Steam	Sub Bituminous	Distillate Fuel Oil	1983
Calcasieu	Entergy Gulf States	R.S. Nelson	E	6	550	Steam	Sub Bituminous		1982
Calcasieu	Entergy Gulf States	R.S. Nelson	E	1	107	Steam	Pet Coke	Natural Gas	1959
Calcasieu	Entergy Gulf States	R.S. Nelson	E	2	106	Steam	Pet Coke	Natural Gas	1959
St. Charles	Entergy Louisiana	Little Gypsy	C	3	530	Steam	Pet Coke	Sub Bituminous	2012

Source EIA and company announcements

About 16% of the state's power is generated at 5 imported coal fired units located at three generating locations. The locations are Big Cajun plants 1,2, and 3, in Point Coupee Parish, Rodemacher 2 in Rapides Parish , and the R.S. Nelson unit 6 in Calcasieu Parish. The total summer generating capability at these coal based locations totals 2,723 megawatts. To our knowledge, all of these plants operate using imported sub bituminous, principally low sulfur coal, from Wyoming's Powder River basin.

In addition, the 650 mw Dolet Hills #1 plant, near Mansfield, burns locally produced Lignite and accounts for about 4% of power produced in Louisiana. The Dolet Hills plant burns 3.5 to 4 mm tons of lignite yearly.

Petcoke is currently burned at the R.S. Nelson plant in units 1 and 2, together generating a little over 1 % of state power. An expansion plant, Rodemacher 3, is being built and is designed to consume Petcoke with Lignite and/or Wyoming coal as back ups. It will produce 660 mw of electricity, on a par with Dolet Hills in output. Finally, Entergy Louisiana has announced a re=powering of Little Gypsy, a gas fired plant which will be converted to use Petcoke to produce 530 mw.

Coal Imports

According to the EIA, we currently import about 7.6mm tons of coal annually, virtually all from Wyoming.

Lignite Mining

A total of 3.147 mm tons of Louisiana Lignite was minded in 2006.
Although Louisiana Lignite deposits were discovered as early as 1812, commercial mining only began in 1986 when a joint venture mine began to supply coal under a multiyear contract to a power plant owned by CLECO-SWEPCO, the Dolet Hills plant.

Louisiana Lignite destined for the Dolet Hills power plant is surface mined after the removal of 20 to 140 feet of overburden. The Lignite is then removed, by off road trucks with a capacity of 85 tons per load, to a central location where the coal begins a 7 mile conveyor belt journey which terminates at the power plant. The main mine site is dominated by a large walking dragline which includes a 77 cubic yard bucket used to remove overburden. Once that is accomplished, the Lignite seam is drilled in sections and explosive charges used to separate the Lignite from the seam. These large pieces are then moved by off road truck to the "tipple" for storage and milling. The Lignite is crushed to a more manageable size, then, fed to a conveyor for the trip to the power plant. At the power plant the coal is pulverized into a fine powder which is used to fire the power plant boilers. In 2002, the mine produced 2.7 mm tons of coal. This mine has recoverable reserves of 130-150 mm tons.

A second mine, the Oxbow mine, was commissioned by Phillips Coal Company in anticipation of supplying a proposed power plant to be built by Cajun Electric. The Cajun Lignite unit was never constructed, but CLECO eventually reached an agreement for supplemental supplies from the new mine to feed the Dolet Hills plant. Initial production began in 1989 under a contract that should have expired in January of 2005. Although this mine has larger reserves, at 180 mm tons, than the Dolet Hills mine, production is limited to no more than 750,000 tons per year.

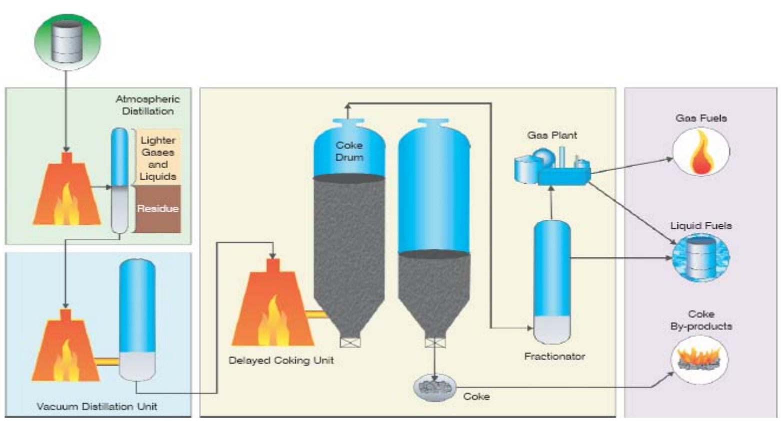
The more expensive transportation system for this mine involves delivery via standard tractor trailer rigs over a 19 mile route with 30 tons delivered on each 38 mile round trip.

Petroleum Coke Availability

Petroleum Coke Ovens

Petroleum coke is a by product of refinery operations and is literally "the bottom of the barrel". Marketable coke is a residue high in carbon content and low in hydrogen that is the final product of the thermal cracking of residual oil. After virtually all light and medium weight hydrocarbons have been removed from crude oil, a heavy residual oil remains. This material is then thermally cracked in a "coker" at roughly 930 degrees F to recover more hydrogen rich oils for use as gasoline and diesel precursors. The remaining solid material is sold as petroleum coke. The most prevalent method for coking is the delayed coking process illustrated above and below.

PETROLEUM COKE PROCESS SCHEMATIC



Source: Foster Wheeler

Cleco estimates that Louisiana produces approximately 10 mm tons of Petcoke annually. Louisiana and Texas use about the same amounts of Petcoke for power generation, about .6 mm tons each. Somewhat surprisingly, Florida uses four times as much as either Texas or Louisiana, despite having no refineries within the State. Kentucky is the number two consuming state with about 1 mm tons/year of consumption. We believe that Kentucky is an opportunistic market which buys and transports Petcoke when export prices are weak. Like Florida, their coal burning power plants are geared to utilizing higher sulfur local coal.

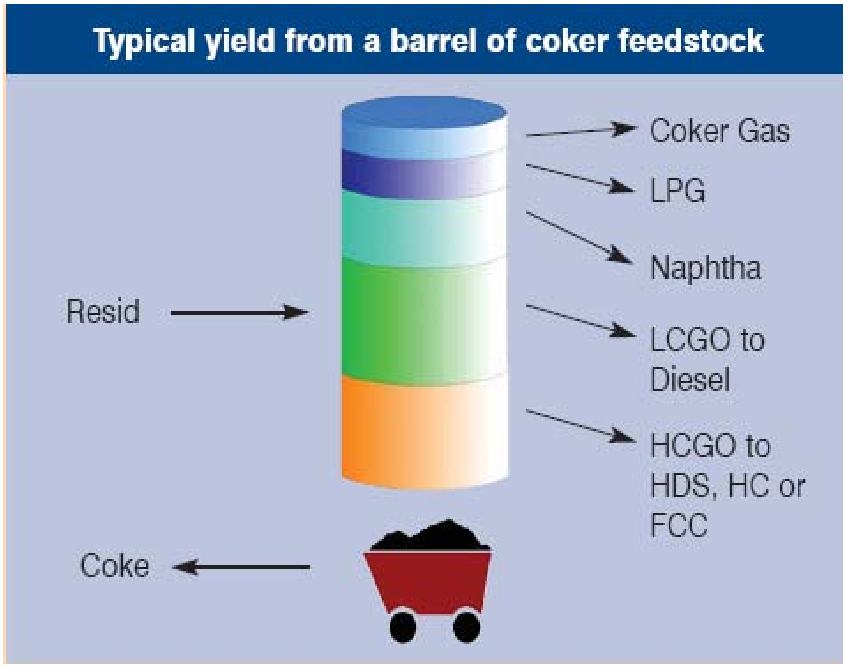
World production of petroleum coke is approximately 91 mm tons per year. World wide about 160 of a total of 700 refineries are capable of producing Petcoke.

Beyond the basic coking units, BP and others operate calciners. CII Carbon, the second largest supplier of calcined coke in the world, operates four plants in Louisiana (Chalmette, Norco, Gramercy and Lake Charles). The largest supplier, Great Lakes Carbon, operates a large plant in Baton Rouge. Alcoa also operates a plant in Lake Charles. These units are basically rotary kilns which remove the last traces of hydrocarbons from “green” Petcoke intended for conversion to carbon anodes for Aluminum smelters and other anode type applications.

The rationale for adding a new coker at a refinery is based on a major long term trend. That is, a significant price difference between heavy crude oils vs. more desirable light crude oils. While the discount varies, it is always significant and tends to widen as crude prices increase.

In the US and in Europe, has also been a marked decline in the need for heavy residual oil. This unwanted “Resid” can be fed to a coking unit and thermally cracked to produce incremental amounts of lighter materials which are easily salable, leaving a solid residual of carbon with low volatiles content, otherwise known as Petroleum Coke.

During 2006, the U.S. generated 62 mm tons of Petroleum Coke, or 2/3rds of the world supply. Of that amount 45.1mm tons was considered “marketable” coke while 16.9 mm tons was classified as “Fluid” coke. As mentioned earlier, marketable coke comes from coking units and can be used for either anode production or as a fuel. “Fluid” coke is generated from an older process and can only be used as a fuel. In the US, in 2005, roughly 8.7 mm tons of petroleum coke was consumed for electricity production. Of this amount, 4.2 mm tons of Petcoke was used by electric utilities and 3.2 mm tons, was used by independent power producers. In 2006, the combined total increased to 9.1 mm tons or about 15% of total production.



2005 production of Petroleum Coke

	in millions of Barrels			in millions of Tons			in % of total		
	Total	Marketable	Catalyst	Total	Marketable	Catalyst	Total	Marketable	Catalyst
US	304.7	217.5	87.2	**60.9**	**43.5**	**17.4**	**100%**	**100%**	**100%**
PADD III	163.8	122.7	41.1	**32.8**	**24.5**	**8.2**	**53.8%**	**56.4%**	**47.1%**
Texas Gulf Coast	92.9	68.6	24.3	**18.6**	**13.7**	**4.9**	**30.5%**	**31.5%**	**27.9%**
Louisiana Gulf Coast	66.6	53.1	13.4	**13.3**	**10.6**	**2.7**	**21.8%**	**24.4%**	**15.4%**
Inland Texas	3.0	0.3	2.7	**0.6**	**0.1**	**0.5**	**1.0%**	**0.1%**	**3.1%**
North La.-Ark.	0.9	0.7	0.2	**0.2**	**0.1**	**0.0**	**0.3%**	**0.3%**	**0.2%**
New Mexico	0.4	0.0	0.4	**0.1**	**0.0**	**0.1**	**0.1%**	**0.0%**	**0.4%**

Source EIA-Refinery and Blender Net Production 3/24/07
PAD III includes Alabama, Mississippi, Louisiana, Arkansas, Texas and New Mexico
Louisiana Gulf Coast includes coastal Louisiana, Mississippi and Alabama
The Texas Gulf Coast is coastal Texas. Inland Texas is all of Texas ex the Texas Gulf Coast
North La.-Arkansas includes inland Alabama, Mississippi Louisiana and the state of Arkansas
New Mexico is the state.
The conversion for barrels to tons is 5:1. Each barrel has a heating value of 6.024 mm btu.

Roughly one third of all Petcoke ends up in these higher value markets while two thirds is consumed as fuel which would suggest that approximately 4.5 mm tons of domestic Petcoke ended up in the Anode markets.

Of total US production in 2005, 54% or 32.8 mm tons was generated within PADD III. This includes the Gulf Coast States, excluding Florida and includes Arkansas and New Mexico. Within these six states, the Texas Gulf Coast generates the greatest share, 18.6 mm tons, followed by the Louisiana Gulf Coast with 13.3 mm tons. The “Louisiana Gulf Coast” category also includes coastal facilities in both Mississippi and Alabama. Inland regions of the six states produce the balance of .9 mm tons.

Historical Production of Petroleum Coke (1996-2006)

in millions of Tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Compound Growth Rate
US	48.6	50.3	52.0	52.0	53.2	56.0	57.0	58.3	61.2	60.9	62.0	2.5%
Marketable	31.8	33.5	34.8	34.7	35.6	38.6	39.6	40.6	43.5	43.5	45.1	3.6%
Fluid	16.8	16.9	17.2	17.4	17.6	17.4	17.4	17.7	17.8	17.4	16.9	0.1%
PADD III	23.1	24.2	25.0	25.8	26.1	29.4	30.9	31.8	33.9	**32.8**	**34.1**	**4.0%**
Marketable	15.0	16.1	16.8	17.5	17.6	21.1	22.5	23.3	25.2	**24.5**	**25.9**	**5.6%**
Fluid	8.1	8.1	8.2	8.3	8.5	8.4	8.4	8.5	8.8	**8.2**	**8.1**	**0.1%**
Texas Gulf Coast	**11.7**	**12.8**	**14.0**	**13.6**	**14.0**	**16.4**	**17.5**	**18.3**	**19.9**	**18.6**	**19.6**	**5.3%**
Marketable	**7.1**	**8.3**	**9.2**	**8.7**	**9.1**	**11.5**	**12.6**	**13.1**	**14.4**	**13.7**	**14.8**	**7.6%**
Fluid	**4.6**	**4.6**	**4.8**	**4.9**	**4.9**	**4.9**	**4.9**	**5.2**	**5.4**	**4.9**	**4.8**	**0.4%**
La. Gulf Coast	**10.4**	**10.4**	**10.0**	**11.3**	**11.2**	**12.1**	**12.6**	**12.6**	**13.2**	**13.3**	**13.7**	**2.8%**
Marketable	**7.7**	**7.6**	**7.4**	**8.6**	**8.4**	**9.3**	**9.8**	**10.0**	**10.6**	**10.6**	**11.0**	**3.7%**
Fluid	**2.7**	**2.8**	**2.7**	**2.7**	**2.9**	**2.8**	**2.8**	**2.6**	**2.6**	**2.7**	**2.7**	**-0.2%**
Inland Texas	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	-2.4%
North La.-Ark.	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.0%
New Mexico	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5.0%
Subtotal	1.0	0.9	1.0	0.9	0.9	0.9	0.9	1.0	0.9	0.9	0.9	-1.2%
Marketable	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	-6.2%
Fluid	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.7	-0.5%

Total US production grew at a rate of 2.5% per year for the 11 year period starting in1996 and continuing through the end of 2006, with Marketable Coke growing at an annual compounded rate of 3.6% while Fluid Petcoke remained constant. Within PADD III overall growth was higher at 4% with annual Marketable Petcoke growth exceeding 5.6%. Here again, Catalyst Petcoke remained stable. The highest compounded annual growth rate was the Texas Gulf Coast, showing an aggregate rate of 5.3% and Marketable Coke growing by 7.6% annually. Louisiana was number two with aggregate growth of 2.8% and Marketable Coke growth of 3.7% annually. Louisiana and the inland portions of all states except Texas actually showed declines in Fluid Coke, while Coastal Texas showed a .4% annual increase

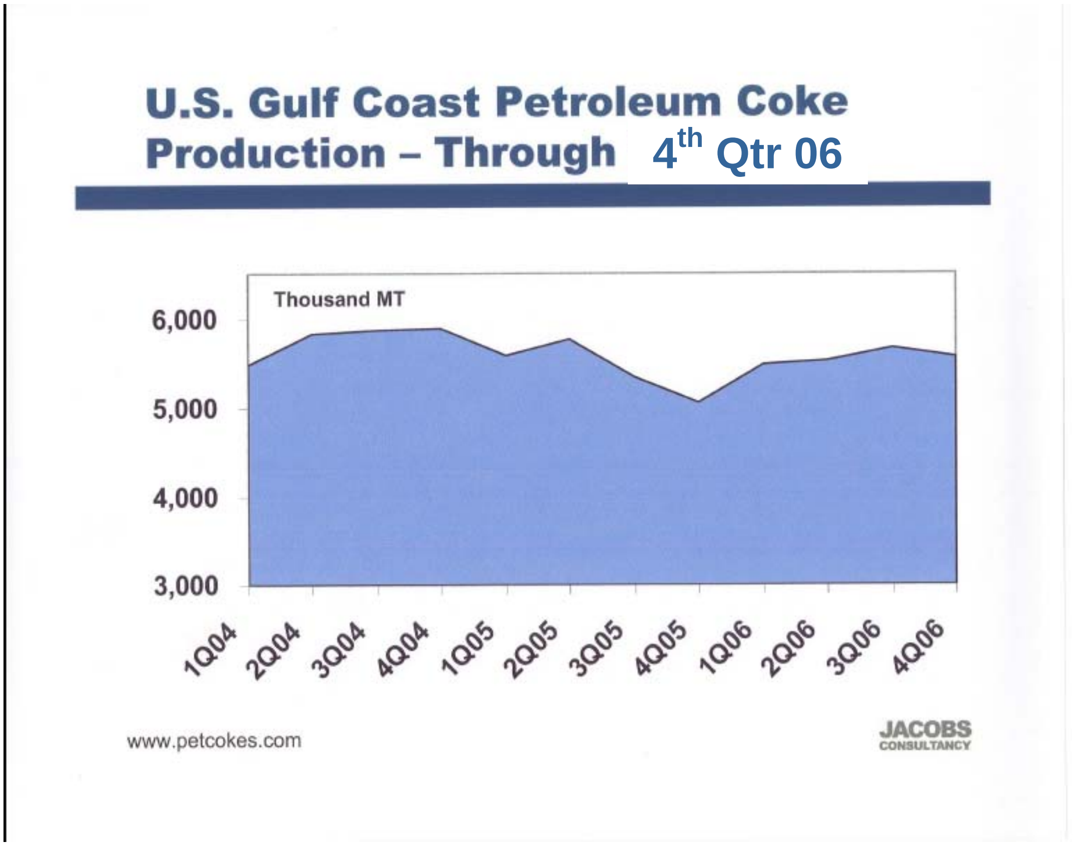
While the “share of market” data and growth rates may be startling, we need to remember that Texas and Louisiana have a concentration of refineries along their coasts (together about 50% of US capacity) and that those refineries are geared to processing heavy crude from Mexico and Venezuela. These refineries generate disproportionate amounts of Petroleum Coke. Other U.S. sources include refineries in the Midwest as well as some production in Colorado and on the West Coast. With the growth in heavy crude production from Canadian Tar Sands, this alternate production should grow in the future. Relevant Gulf Coast refinery owners are listed below.

US Gulf Coast
Petcoke Producers – 2006

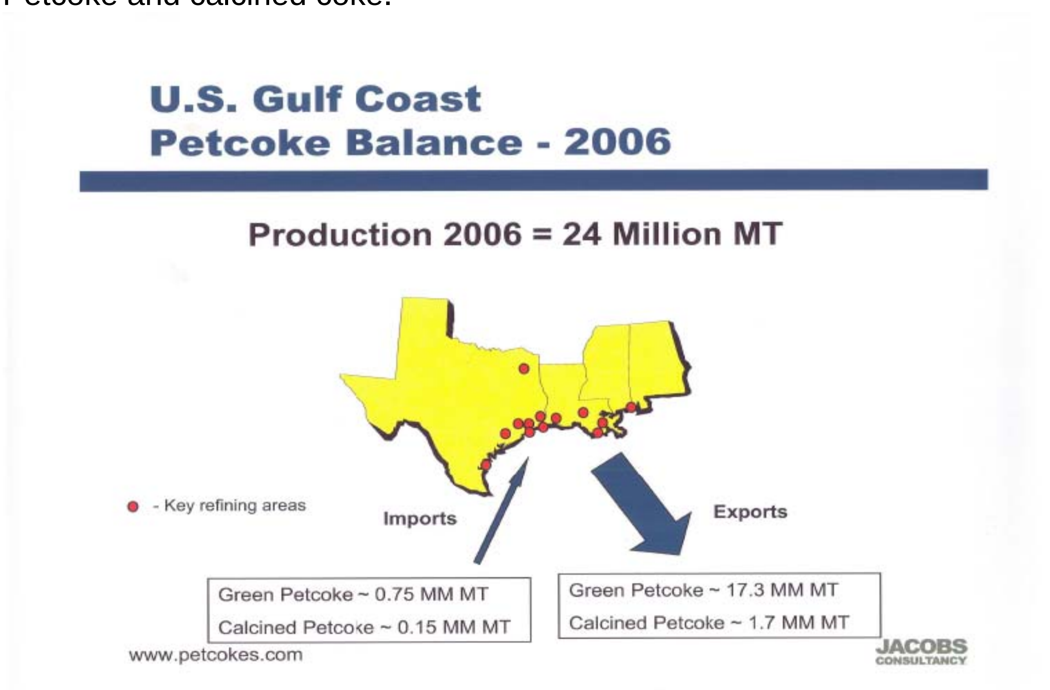
	Thousands MT	
ExxonMobil	4,512	20%
ConocoPhillips	2,677	12%
Valero	4,108	18%
Citgo	2,592	12%
ChevronTexaco	2,053	9%
Lyondell-Citgo	1,719	8%
Shell	1,678	8%
Motiva	1,346	6%
Others (7)	1,546	7%
TOTAL	22,231	

www.petcokes.com JACOBS CONSULTANCY

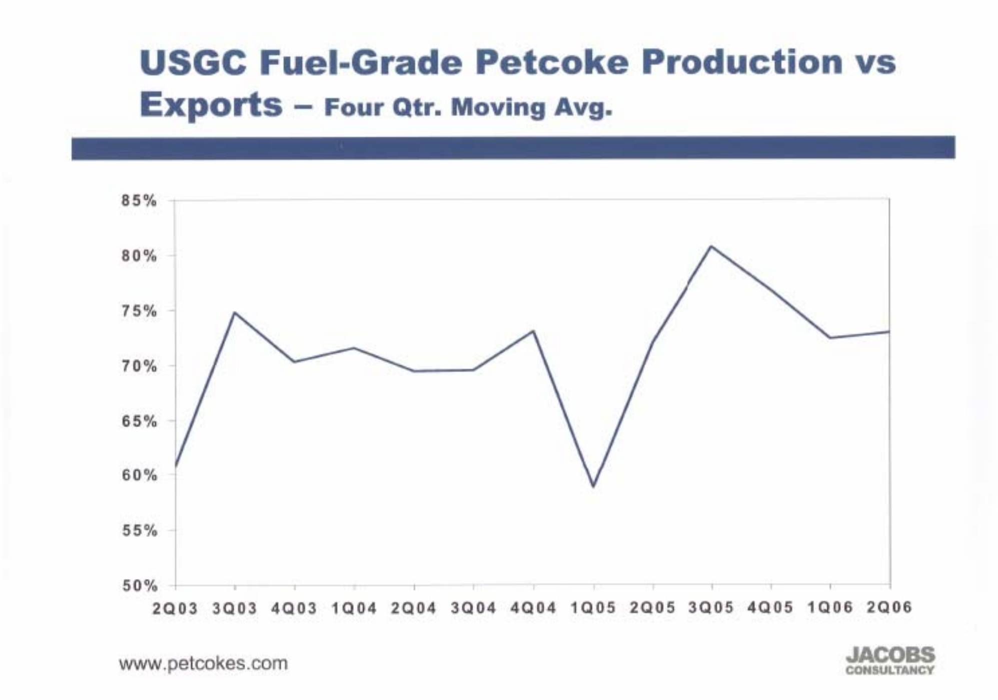
The following chart tracks Gulf Coast Petcoke production over several quarters. It is important to note that this material is an “ultimate” by product with very limited control over the amounts produced. From a refinery perspective, Petcoke will be priced so that it moves, with the primary focus on transportation fuel volumes and the crack spread, not on the price realized for Petcoke. That said, the refiners will seek the highest price possible through selective marketing. So, they work with all potential consumers of the material including domestic power plants, calciners, anode manufacturers and export resellers.



Of the Gulf Coast production, 19 mm tons is not used locally, but is exported, either to other states or internationally. Of this amount, 17.3 mm tons leaves from refineries while 1.7 mm tons departs as upgraded calcined coke destined for international anode markets. This represents almost 80% of regional production. As the following chart illustrates, we also import small amounts of both "green" Petcoke and calcined coke.



While production volume changes are relatively predictable, the proportion exported is more volatile. The following chart gives some idea of the volatility in US exports of Petroleum Coke. We typically export over 70% of produced Petcoke, but the proportion varies from 60% to a high of 80%. Kentucky is the domestic "swing" consumer. When the export market is strong, sales to Kentucky are reduced. When export sales are weak, Kentucky picks up the slack.



A total of seven resellers handle Petcoke exports. They are identified below along with their recent market shares. The three largest, TCP, SSM and Oxbow, account for over 50% of exports.

Top US Gulf Coast Petcoke Exporters – 2006

TCP Petcoke	27%
SSM Petcoke	16%
Oxbow	8%
Cemex	7%
Energy Coal	6%
Koch Carbon	5%
ConocoPhillips	4%
TOTAL	73%

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New Orleans and Lake Charles are major Louisiana export locations with both handling about 2.5 mm tons/year. Other Gulf Cost export locations are Houston, Port Arthur and Beaumont, Texas.

Of total domestic Coke consumption, the EIA estimates that roughly 35% is consumed in non-power generating channels, mostly in the manufacture of aluminum anodes, furnace electrodes and liners, and in shaped graphite products.

World Wide Petroleum Coke Customers

The following section contains details on major customers for Petcoke, worldwide. The data is sorted by application

Aluminum Consumption (10 companies)

Alcoa operates 27 smelters worldwide, Aluminum Bahrain produces 500,000 tons of Aluminum annually, Alcan is the world's second largest Aluminum producer, Alcoa is the largest, BHP Billington has smelting interests in South Africa, Brazil, and Mozambique, CVG is a Venezuelan conglomerate that operates three smelters, Dubai Aluminum company operates a single smelter, Kaiser Aluminum operates in the US and Wales, Norsk Hydro operates four smelters in Norway and one in Australia, Rio Tinto has smelters in North America, Europe, South America, Africa, Australia and South East Asia. The typical smelter requires .5 ton of Anode material (Petcoke) for every ton of Aluminum produced.

Cement (4 companies)

Cemex operates in 30 countries with 77mm metric tons of capacity. CIMPOR Based in Portugal operates in seven countries, Holcim delivers 82mm metric tons annually, Lafarge has capacity of 150 mm metric tons world wide and Votarantim operates in Brazil and in Canada.

Titanium Dioxide (7 companies)

Cristal operates in the Middle East and Africa and is a JV between Middle East investors and Kerr McGee. Dupont is the world's largest producer of TIO2. Huntsman Tioxide is one of the world's largest producers of pigments. Kemira Pigments operates in Finland. Kerr McGee operates as a TIO_2 producer on three continents. Kronos operates six plants in North America and in Europe. Millennium Chemicals operates on five continents.

Needle Coke (2 plants)

Graphite India Ltd. and Seadrift Coke LP both provide specialty graphite products made from Needle Coke, a special crystalline form of the material.

Power Generation (8 companies)

AES Corporation has their deepwater plant in Pasadena, Texas. Other consumers include Entergy, First Energy, JEA, LG&E Energy, RWE (Germany), and TECO as well as Seminole Electric Cooperative, both in Florida.

The EIA produces a monthly report entitled "Consumption of Petroleum Coke for Electricity Generation by State by Sector, year to date". The latest available report is for October of 2006. In that table, total consumption in 2006 for 10 months is 6.5 mm tons with utilities consuming 3.5 mm tons and Independent Power Producers were responsible for 2.6 mm tons. Industrial consumers using Petcoke for power generation account for the balance of .4 mm tons. Scaled up figures for 12 months would be 7.8, 4.2, 3.1 and .5 mm tons respectively.

The top five states consuming Petcoke for power production consumed almost 80% of the available supply. The top 5 are Florida 2.2 mm tons; Kentucky, 1.1 mm tons; California, .7 mm tons; Texas, .6 mm tons and Louisiana, .6 mm tons. Of these states, Florida and Louisiana are the only states where the preponderance of Petcoke consumption for power production is concentrated in regulated utilities. In Kentucky, Texas and California consumption is predominantly by Independent Power Producers (IPPs).

We believe the large share going to Florida is a result of Florida Power and Light, TECO and Seminole being early adopters of Petcoke as a power plant fuel. We're also informed that a large proportion of their coal fired units were built in the late 70s and were designed to be able to handle higher sulfur coals. This allowed them to switch to Petcoke with minimum modifications to the existing generating plants. As a result, they were the first to perfect its use in solid fuel power plants.

Moreover, they have not simply converted existing plants. They are leaders in the development of advanced plants specifically designed to consume marginal fuels such as Petcoke. In these initiatives, they have had the full backing of the Florida Power Commission which is supportive in allowing the recovery of development costs through the regulated power rate bases.

According to the recent MIT study ""The Future of Coal", four 275 to300 mw IGCC power plants are in operation world wide. In addition, 6 such plants between 180 and 550 mw are currently operating in refineries gasifying asphalt, refinery waste streams, and in the smallest case, Petcoke. The motivation is the potential for better environmental performance at lower marginal cost, higher efficiency and easier capture of various pollutants. The offsets are higher capital cost and total unit availability.

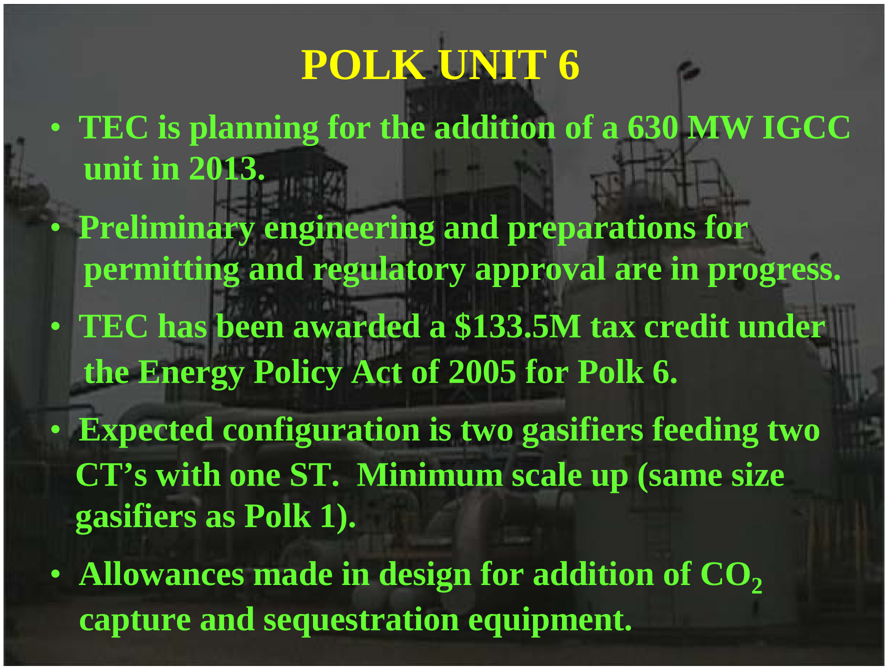
The following illustration is of a 1996 Florida plant, the Polk plant, located on Tampa Bay and owned by the Tampa Electric Cooperative (TECO).

Tampa Electric Coop's Polk Plant (IGCC)

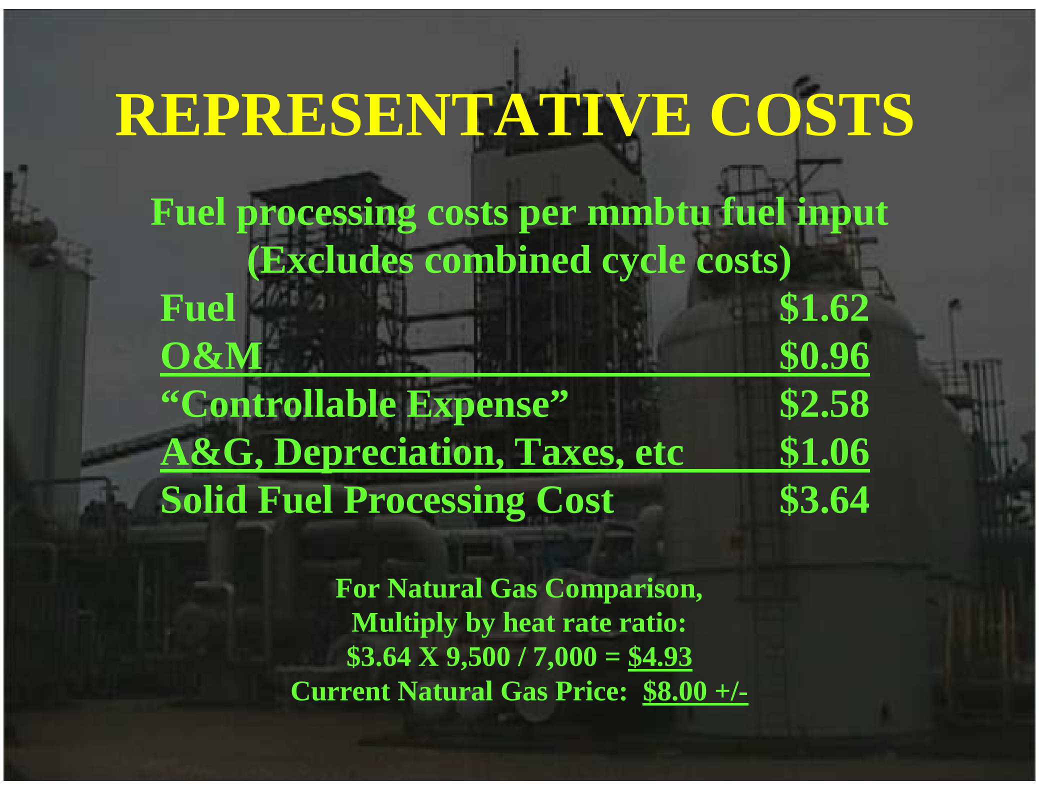
Source FPL and DOE-NETL

The Polk plant includes 312 mw of IGCC capacity and has been in operation since 1996. Two single cycle combustion turbines were added in 2000 to provide peaking capacity, increasing site capacity to a total of 650 mw. Two more combustion turbines at 165 mw each will come on stream in 2007, increasing peaking capacity by another 330 mw.

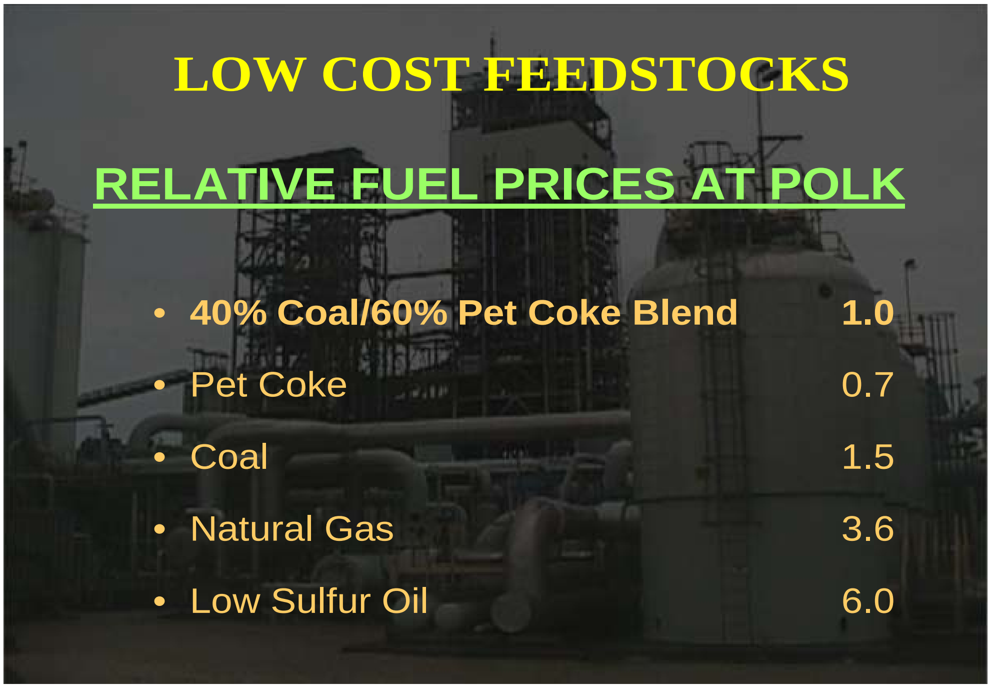
This will be followed in 2013 by the addition of POLK Unit 6 which includes two new gasifiers, equal in capacity to the existing unit, two gas turbines and one steam turbine. This will add another 630 mw of base load capacity at the site, and triple the installed IGCC capacity.



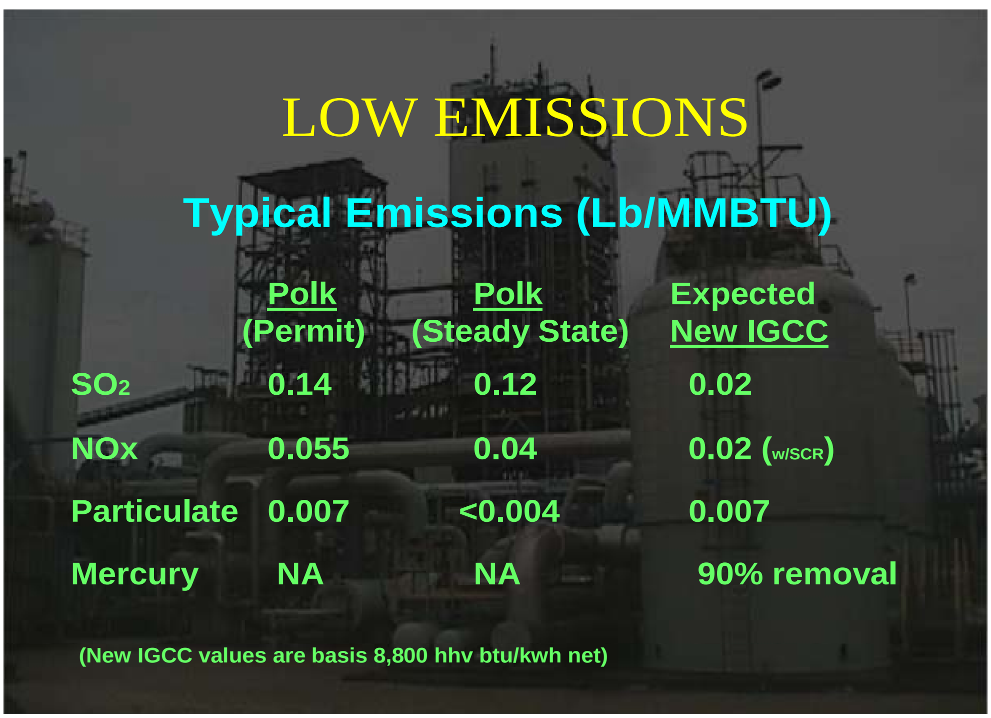
The final plant configuration will include three gasifiers with capacity for 950 mw of base load, along with 660 mw of combustion turbine peaking capacity. As the following chart illustrates, fuel costs for the IGCC are very competitive at $3.64/mmbtu which is equivalent to paying $4.93/mmbtu for natural gas.



Even making adjustment for the difference in heat rates between the two types of units, the operating cost is significantly less than a natural gas fired boiler and one sixth that of a distillate fired boiler. This chart ranks various fuel choices.



These fuel costs exclude the relative savings of the Combined Cycle Gas Turbine over the standard steam cycle plant operation. In addition to low fuel costs the plant also has extremely low levels of air pollution, outperforming the permit allowances for all four regulated pollutants. Furthermore, MIT believes that the units will be CO2 sequestration friendly. That is, the addition of sequestration will be relatively easier than on other solid fuel power plants.



Transportation

Another possible Florida advantage is that their power plants frequently require barge docks for fuel delivery. We suspect that Florida's Petcoke supplies originate at Mississippi, Louisiana and Texas refineries which have barge docks. The material is then transported by inland and ocean going barges from Louisiana terminals such as Devant (controlled by TECO) on the Mississippi to Florida. There is a more complete discussion of transportation options later in this report, for the moment just note that barge transportation is an extremely efficient transportation method and that Florida leads the nation in the waterborne import of Petroleum Coke.

The Pros and Cons of Petcoke as a fuel source

One advantage of Petcoke is that it is almost free of ash which makes up a significant portion ~11% of Lignite and western coals.

A second advantage is that refineries producing Petcoke are equipped with dock facilities making waterborne transportation the preferred method for shipment.

Unfortunately most power plants on the Gulf Coast do not have that same capability, being geared to receiving natural gas by pipeline or solid fuels via unit train. To our knowledge, no refineries possess rail car Petcoke loading facilities although at least one Florida transshipment terminal is reported to have this capability. Such a facility can receive coal or Petcoke by water, blend it, and ship it to power plants by rail.

A second disadvantage with Petroleum Coke is that it is difficult to ignite given the lack of volatile components. For this reason, plants using Petcoke as a fuel typically blend some low sulfur coal into the fuel mixture to promote combustion.

That brings up a third disadvantage. Petcoke can be high in Sulfur. That Sulfur can become entrained in the ash associated with the natural coal portion of the blended fuel mix. This triggers limitations on the use of that ash as a binder in various cement products, the basic market for coal ash.

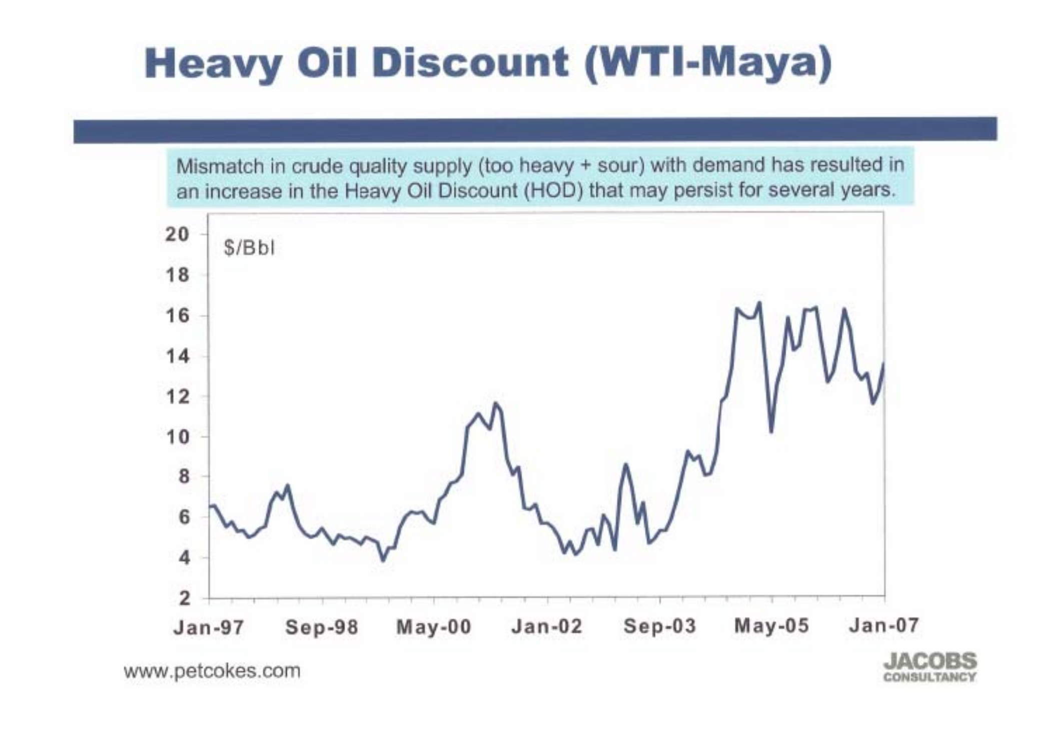
Petcoke Pricing

Petcoke pricing is not related to oil prices directly, but rather is influenced by the discount between light sweet crude and heavy sour crude such as that produced in Mexico and Venezuela and widely used by Gulf Coast refineries. When the discount widens, there is a greater incentive for refiners to expend capital on coking ovens and to import the less expensive heavy crude. When this happens, the quantity of Petroleum Coke produced increases. In a static market, this would imply a drop in prices for the Petcoke. However, when coal prices are also increasing, the Petcoke price follows coal, with the marginal price being set by international customers such as cement kilns in the Mediterranean, chiefly in

Spain and Italy. They will buy either US Petcoke or South African steam coal for their operations on a delivered price basis.

Currently the heavy oil discount is as much as $10-12/barrel and Coal prices are elevated with the result that Petcoke prices are historically high.

As an illustration, the following chart provides perspective on the trade off between West Texas Intermediate, a light “sweet” crude and Maya Crude, from Mexico. Since May, 2005, the discount has fluctuated abound $14/ barrel.



Generally, higher quality Petcoke is calcined (cooked in a rotary kiln to drive off the last traces of volatile hydrocarbons) and then used in the manufacture of Aluminum anodes. In this case, feed stock prices are typically as much as twice the value of fuel grade Petcoke or as much as $80-100/ton.We believe that as much as one third of the to US Petcoke output ends up in this premium application. For example, Shell’s Motiva plant at Norco dedicates one of three coking units to producing a higher quality Petcoke to produce Aluminum anodes.

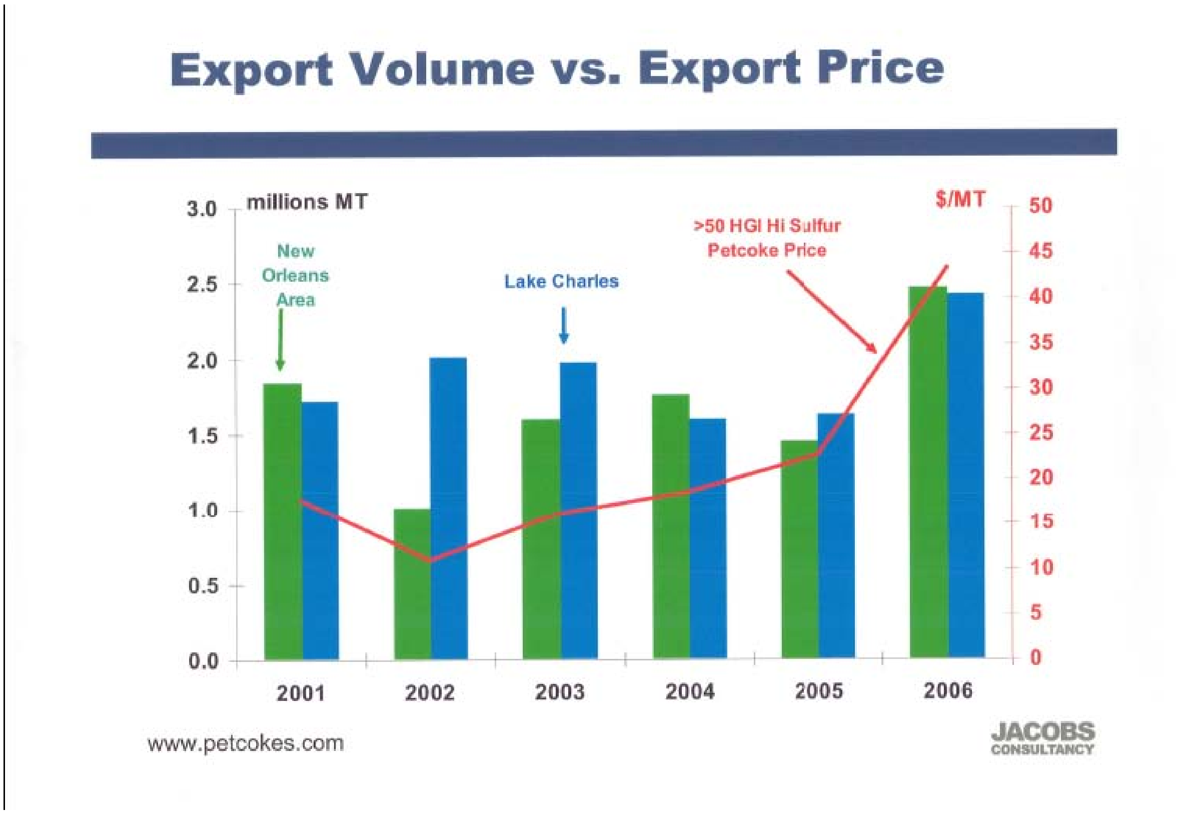
Roughly two thirds of domestically consumed Petcoke is used as power plant fuel. Currently it is priced $10/ton below the price for Wyoming low sulfur coal. Larger Gulf Coast refineries run on heavy crude oils from Mexico and Venezuela, both of which can have high Sulfur content. This limits the use of the resultant Petcoke to specialized power plants that can meet EPA restrictions on stack gas emissions.

Domestically, fuel grade Petcoke typically sells at a 10-20% discount to Coal. On occasion, along the Gulf Coast, that discount increases to 40% due to Coke-on-Coke competition for export markets. Recently, Petcoke prices have increased by 81% while Wyoming low sulfur coal prices have only increased 50%, narrowing the discount. In December of 2006, the overall Petcoke discount on a btu basis was 14%.

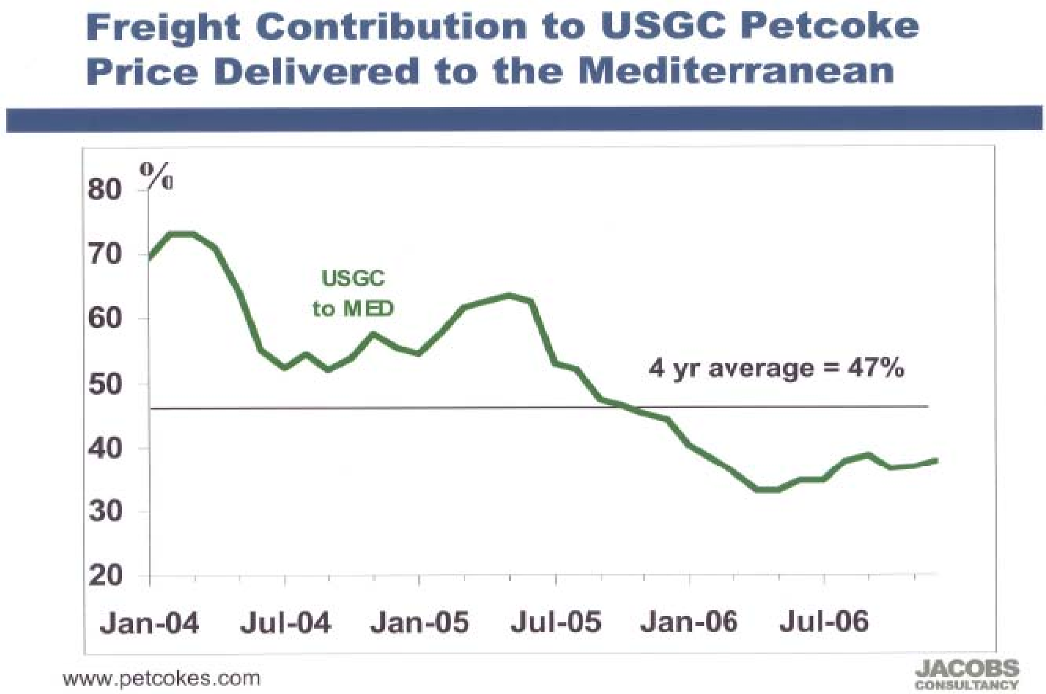
Other pricing issues include discounts for quality, chiefly Sulfur content and with "grindability". Typically, all solid fuels are reduced to a powder prior to processing and Petcoke requires specialized grinding techniques.

Finally, like coal, transportation charges are a significant share of the total cost of delivered Petcoke averaging 35% of the final price, but subject to significant variability. In one Florida case, the transportation component of the delivered Petcoke was fully 60% of the delivered price at the power plant.

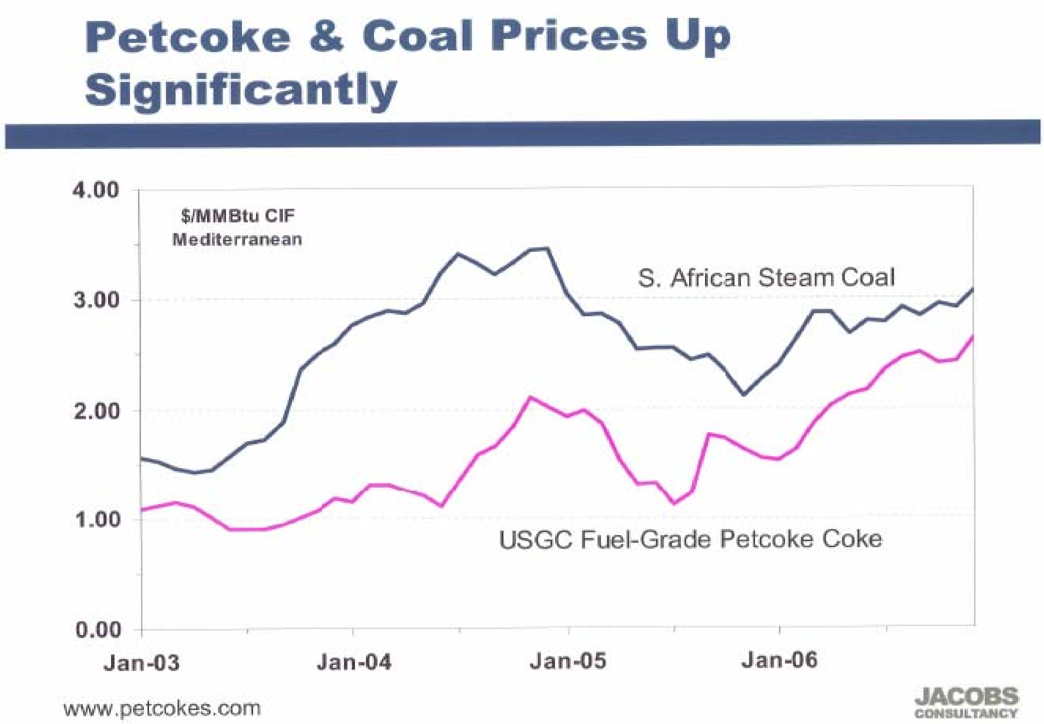
Ultimately domestic Petcoke prices are driven by the largest volume market, fuel Petcoke exports, which are in turn dominated by the international cement market mentioned earlier. Production from both Lake Charles and the New Orleans area remains roughly equal, a result of the inelasticity of supply associated with "by product" Petcoke.



For the key Mediterranean cement kiln market, transportation cost has been trending downwards but has averaged 47% of delivered price over the last four years with a range between 60% and 30%.



The export price differential on a $/mmbtu basis has been narrowing and is now in the$.40/mmbtu range. At the margin, the cement plants arbitrage between South African steam coal and U.S. Petcoke, both on a delivered basis. While the spread has been narrowing the overall price trend has been up for both fuels.



Transportation methodology

Louisiana has a long history of handling coal and Petcoke exports with several transshipment points in place along the lower Mississippi river. Coal comes from mines in Missouri, Illinois, Indiana, Ohio, Kentucky, West Virginia and Pennsylvania. It is barged down river where it is not consumed in local power plants but is exported. Petcoke follows a similar pattern except the bulk of the material is Louisiana and Texas sourced, with the Texas material leaving from Houston and Port Arthur. Lower Mississippi river exports primarily leave through two Mississippi river terminals near the mouth of the river.

Louisiana terminals include sites at Baton Rouge, the IC terminal at Burnside, and the IMT terminal at Myrtle Grove. TECO operates a transshipment terminal at Devant for loading oceangoing ships and barges both for domestic across-the-Gulf shipments to Florida and for export shipments to southern Europe.

In the Florida case, TECO operates oceangoing US flag Tug-Barge units for deliveries. They also operate Inland barges which move material through the inter-coastal waterway to a local transshipment terminal at St. Mary's, Florida where the material can be off loaded from barges to railcars for ultimate delivery to Power plants without navigable water access. This technique could be a model for Louisiana if we were to arrange for barge delivery and rail car loading at a local terminal, for example at the proposed facility at Donaldsonville or through redevelopment of the now idle bulk terminal on the Mississippi River Gulf Outlet.

Heading upriver, Petcoke is delivered by barge to a terminal at Paducah Kentucky for ultimate delivery to TVA power plants. Kentucky Electric is also a major consumer of Louisiana sourced Petcoke. St. Louis also has a river based coal transshipment terminal.

Other coal transporters include Kinder-Morgan Energy Partners, which operates bulk and liquid terminals in addition to product and natural gas pipelines. Pabtex Bulk Commodity Handling, located in Port Arthur, is owned by KCS and Savage Gulf Services Ltd. and receives product by rail and truck and then loads out ships for ocean export.

TECO Transport, mentioned earlier, operates a U.S. flag oceangoing fleet, an inland water barge line and a deep-water transfer and storage terminal near the mouth of the Mississippi river, at Devant, La. This facility stretches 3 miles along the river and has the capacity to store up to 5 mm tons of coal at any one time. Barges bring mined coal down river, as well as petroleum coke. At Devant, the products are blended and then reshipped, either to TECO's power plant in Tampa, via oceangoing barges, or by ship to international destinations.

In general, Petcoke competes with Western Coal which can enter the Mississippi River system at St. Louis. When international prices are high, Petcoke is preferentially shipped overseas and western coal is used domestically. When international prices are low, Petcoke displaces western coal at upper Mississippi valley power plants. TECO transportation, Ohio Barge Lines, Canal Barge, and others make those deliveries.

If local Louisiana power plant sites can be modified to receive interstate barge transported coal, they should also be able to accept intrastate barge deliveries of Petcoke or Louisiana Lignite. The key determinant will be the availability of suitable barge docks. Virtually all relevant refineries have barge docks so the really issue revolves around delivering Petcoke to power plants. Even if plants are not near navigable water and currently receive Wyoming coal via rail delivery, shipments could be possible from existing terminals if they were equipped to load rail cars after receiving barge deliveries.

Rather than each refinery building rail loading facilities or each power plant building barge facilities, a less capital intensive option would be to develop strategic transshipment sites in Louisiana capable of receiving barges and loading out unit trains either with lignite or with Petcoke.

The future of Lignite and Petcoke use in Louisiana are tied to high prices and rationed supplies of natural gas, to continuing growth in electrical power demand and to a concomitant rise in the price of alternate solid fuels, primarily domestically produced sub bituminous coals delivered by rail from Wyoming or by ship from international locations like Columbia and Indonesia. We believe that of these options, western coal will be most vulnerable to continuing rail infrastructure constraints.

In 1997, according to the US DOE, rail transportation rates were $.0136 per ton mile for coal transportation in the US, $.0093 for barge, $.14 for truck, $.0114 for multimodal systems e.g. the Dolet Hills conveyor system and $.0263 for all other methods. The average transportation rate including all systems was $.0134 per ton mile reflecting the preponderance of rail transportation~77% in the coal supply chain. Of these choices barge freight is the only one with single digit pricing and while impractical for Wyoming coal mines, unless the coal is transshipped at St. Louis, is eminently practical for Louisiana based operations. The following table provides historical comparisons of the various freight rates for the period 1979-1997. While this is admittedly old data, we would not expect the 1997 price rankings to change dramatically. Note that these prices are in mills/ ton-mile, not in dollars/ton-mile.

The important point is that barge freight rates were the least expensive in every year covered by the following chart compiled by the EIA.

Average Utility Contract Coal Transportation Rate per Ton-Mile by Transportation Mode, 1979-1997 (Mills in 1996 Dollars)						
Year	Rail	Barge	Truck	Multimode[1]	Other[2]	All Modes
1979	28.1	15.9	124.8	27.0	40.3	27.8
1980	28.3	15.6	123.1	28.2	38.8	28.2
1981	29.3	18.5	164.5	28.4	40.7	29.2
1982	31.2	17.3	149.1	38.4	31.5	32.1
1983	31.1	17.9	197.5	37.8	67.1	32.4
1984	33.3	24.2	359.2	30.1	49.0	32.9
1985	30.1	13.6	150.0	28.6	48.8	29.5
1986	30.4	12.4	228.0	30.2	25.2	30.4
1987	29.0	11.8	208.7	26.6	35.6	28.9
1988	23.2	11.7	204.7	24.7	25.9	23.2
1989	21.6	12.9	194.6	21.6	34.2	21.7
1990	21.9	10.4	192.0	15.8	35.3	20.7
1991	20.3	10.2	127.3	14.8	32.9	19.3
1992	19.0	10.7	141.0	13.7	31.7	17.8
1993	16.9	10.5	109.6	13.1	28.4	16.3
1994	16.0	10.5	120.1	13.2	33.9	15.7
1995	15.4	10.2	123.7	12.0	30.5	14.8
1996	14.8	9.5	145.3	11.1	21.7	14.3
1997	13.6	9.3	140.0	11.4	26.3	13.4

[1]Includes shipments that use any combination of rail, truck, barge, and collier transportation.

[2]Includes shipments for which mode is unknown, including conveyor, tramway, and slurry pipeline.

Note: Import records are excluded. One mill equals 0.1 cent. In computing the average rate per ton-mile, shipments for which the rate, distance, or tonnage was not reported were not used

Regional Solid Fuel Use

As of 2004, the EIA reports that the following volumes and transportation preferences were evident in the Gulf Coast States and Wyoming. These volumes ignore international shipments.

Florida: A total of 16.3 mm tons of coal were transported of which water transportation accounted for 4.7 mm tons or approximately 29%. Railroads accounted for the balance. Of the total, fully 15.8mm tons of coal was used in power generation.

Alabama: this state moved 32 mm tons of coal. Water transportation accounted for .9 mm tons and railroads handled 15.9mm tons. Trucks were responsible for 2.5mm tons and other modes covered 12.8mm tons. Of the total, 15.8mm tons were consumed in power generation with railroads moving 14.9mm tons and water accounting for .8mm tons. Truck and Other modes were concentrated in the industrial sector.

Mississippi: The state moved 7.6mm tons with rail accounting for 4.0mm tons and Trucks accounting for 3.6mm tons. Of the total 6.7mm tons was transported for power generation and of that, 3.1mm tons moved by rail while 3.6mm tons moved by truck. Water movements were negligible.

Louisiana: A total of 11.6mm tons were transported with 7.6mm tons moving by rail, .1mm tons by water and 1.9mm tons moving by truck. Other modes accounted for 2.0 mm tons. Virtually all of this coal was used in power generation.

Texas: Moved 112.3mm tons of coal in 2004 with 107.7mm tons going to power generation. Of the total, 85.4 mm tons moved by rail, .1 mm tons by water, 14 mm tons by truck and 12.8mm tons by other methods. Industrial usage was approximately 4.6mm tons.

During 2006, Wyoming exported 446 mm tons of coal, something in excess of 25% of all US coal production. Today, 80 trains a day leave Wyoming with each train containing 150 cars, each car loaded with 100 tons of coal. Only two railroads handle 100% of the transportation. Of the states facing the Gulf of Mexico, Florida does not import any coal from Wyoming. Mississippi, while it imports .5mm tons from Wyoming, brings in the bulk of its coal from Colorado and Kentucky. However, Alabama imports 11.2mm tons out of 32.6mm tons transported. Louisiana imports 7.6mm tons out of 11.6mm tons, while Texas brings in 61.6 mm tons of Wyoming product out of a total of 112.3mm tons transported.

How can Gulf Coast power plant operators diversify away from the Wyoming railroad duopoly? Perhaps, by emphasizing more local lignite production and more internal consumption of Petcoke at the expense of Wyoming imports. With the proper infrastructure in place, we might also expand our usage of eastern coals from Kentucky, Illinois and West Virginia, all of which currently use river transportation in addition to rail service.

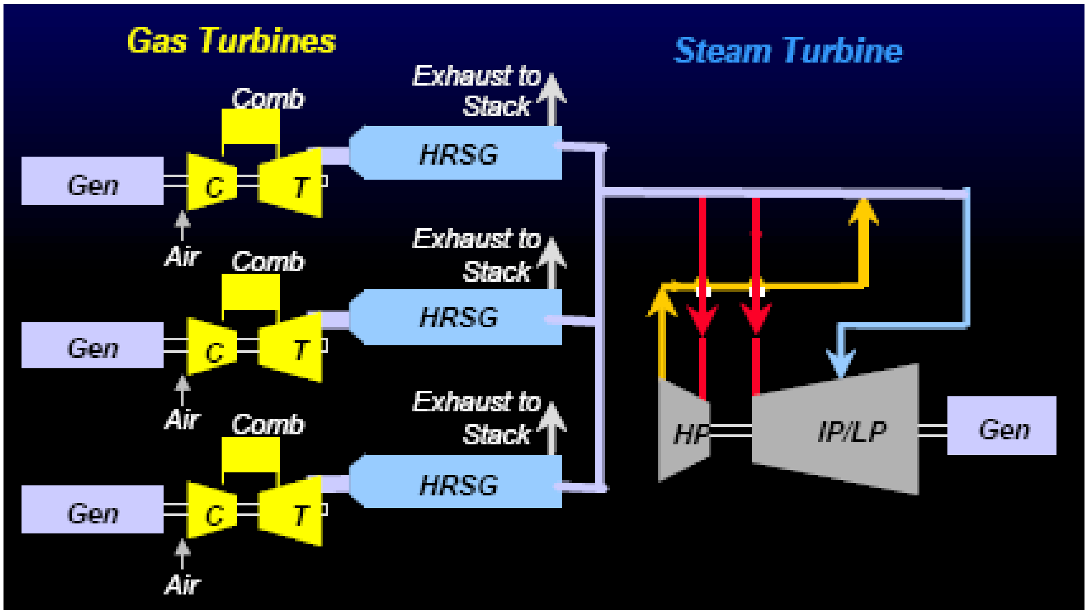
We believe a major opportunity for Louisiana involves exploiting not only our Lignite and Petcoke supplies but also our marine transportation system for bulk delivery of Lignite and Petcoke from local sources to power generation facilities in the state, few of which have water access, but all of which have rail access. Jump starting the process will involve modification of the existing delivery system for both fuels to allow barge and rail delivery to existing and new power plants.

Power Plant Process Technology

Natural Gas Fired Combined Cycle Plants…

Before discussing solid fuel power plant technologies we should just touch on the development of natural gas fired combined cycle plants, the last great technological improvement in the evolution of power generation. These units use a natural gas fueled turbine to power a generator with the exhaust gases then used to produce steam which drives a second, steam turbine powered generator. While quick to build, scalable over a wide range of outputs, relatively cheap in capital cost, clean and very efficient, combined cycle plants require an increasingly scarce (and expensive) fuel, natural gas.

The following chart from GE and the NETL illustrates a generic facility with 3 gas turbines generating electricity followed by 3 Heat Recovery Steam Generators providing steam to a single steam turbine powered generator.



Source GE and NETL-DOE

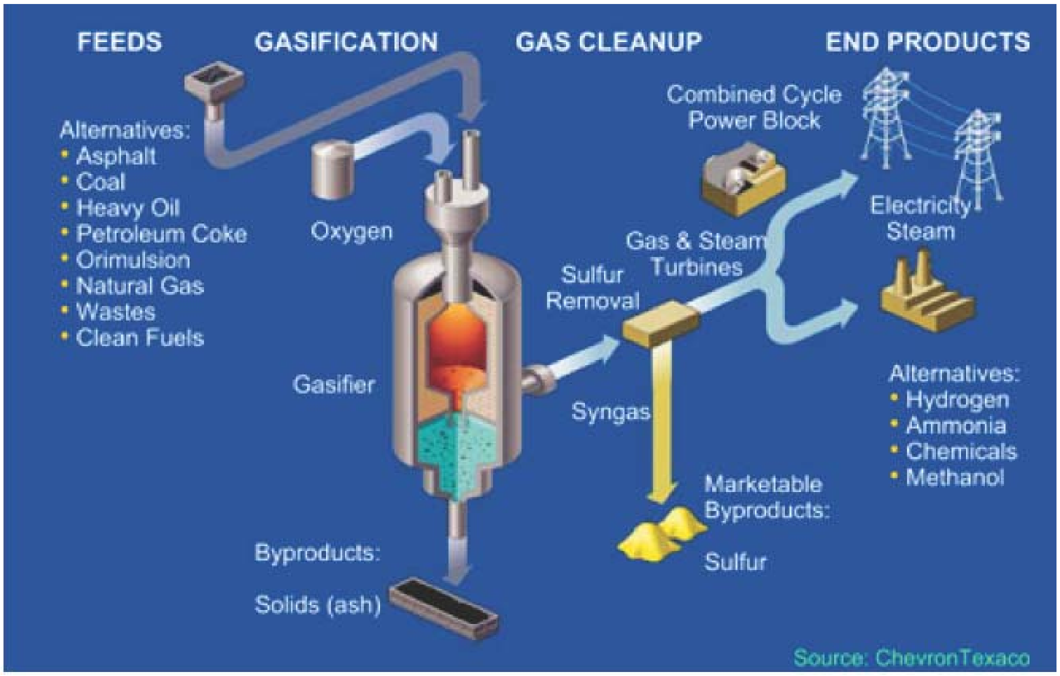
…Evolve into New Solid Fuel Technologies

The coal gasification process was originally developed in the 1800s to produce town gas for lighting and cooking. Natural gas and electricity soon replaced town gas for these applications, but the gasification process has been utilized for the production of synthetic chemicals and fuels since the 1920s, most notably in Germany during WWII and in South Africa during Apartheid.

Newer solid fuel technologies focus on extending the efficiencies of the natural gas combined cycle approach. They start with a solid fuel which is converted to a gas which is then combusted in a gas turbine prior to using the exhaust to boil water for a steam turbine. These newer designs remedy the fuel cost problem by adding a new "front end" onto the existing natural gas combined cycle plant.

The new front end package, called a "gasifier", converts coal, lignite, petroleum coke or a host of other carbonaceous materials into "Syngas" a mixture of Hydrogen and Carbon Monoxide. Integrated Gasification Combined Cycle (IGCC) units successfully incorporate the front end gasifier with the gas turbine/steam turbine duo which makes the natural gas fired combined cycle plants so thermally efficient.

The following diagram from the National Energy Testing Laboratory, a unit of DOE illustrates the new front end facilities (in the left foreground) needed to gasify coal or other carbonaceous fuels. In this design pressurized oxygen is introduced as the oxidizer rather than using air at atmospheric pressure.

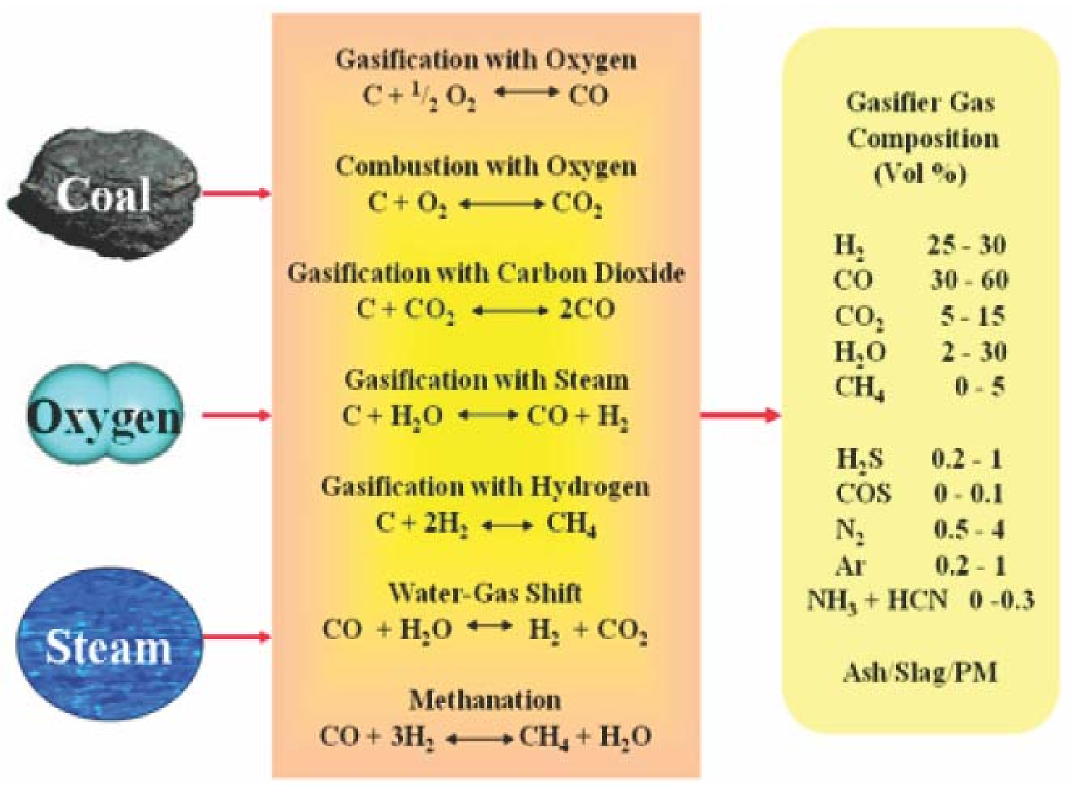


Source: NETL-DOE

High pressure Syngas exiting the gasifier is run through a purification step to remove Sulfur and other contaminants prior to combustion and then is fed into the gas turbine combined cycle generator plant in the right upper background of the diagram where electricity is produced. Removing Sulfur at lower temperatures and under pressure is much more efficient than attempting to remove it from the stack gas using post combustion scrubbers.

Also shown in the illustration is another use of Syngas, i.e. in gas-to-liquids technology (GTL). In this case, Syngas is fed into a chemical plant which converts the feed into useful hydrocarbon materials such as Methane, Ethane, Propane and Butane. Ultimately these materials are converted in to the feed stock for Ammonia, Methanol and a host of petrochemical based plastics and rubbers. This option is illustrated in the lower right hand portion of the diagram.

The following NETL chart details the various chemical conversions that occur in a typical gasifier



The following process explanation is from the Wikipedia web site under Gasification.

Gasification is a process that converts carbonaceous materials, such as coal, petroleum, petroleum coke or biomass, into carbon monoxide and hydrogen. In a gasifier, the carbonaceous material undergoes three processes:

1. The *pyrolysis* (or de volatilization) process occurs as the carbonaceous particle heats up. Volatiles are released and char is produced, resulting in up to 70% weight loss for coal. The process is dependent on the

properties of the carbonaceous material and determines the structure and composition of the char, which will then undergo gasification reactions.
2. The *combustion* process occurs as the volatile products and some of the char reacts with oxygen to form carbon dioxide and carbon monoxide, providing heat for the subsequent gasification reactions..
3. Gasification of char occurs as the char reacts with carbon dioxide and steam to produce carbon monoxide and hydrogen. The resulting gas is called syngas and can be more efficiently converted to electricity than would be possible by direct combustion of the fuel, as the fuel is first combusted in a gas turbine and the exhaust heat is then used to produce steam to drive a steam turbine. Also, sulfur oxides and corrosive ash elements such as chloride and potassium can be removed during the gasification process, allowing higher temperature combustion of the gas without violating EPA air quality standards.

In an IGCC plant, once the syngas is produced and purified, the H2 and CO from the gasifier are used as fuel in a gas turbine, with the downstream equipment very similar to that seen in the Natural Gas fired Combined Cycle power plants. The hot exhaust gas from the turbine is used to create superheated steam that powers a steam turbine driven generator. One characteristic of both the natural gas combined cycle plant and the coal fired IGCC is improved thermal efficiency.

Our Options Today

Most existing Louisiana coal fired power plants use a conventional steam cycle where coal is crushed, pulverized into a powder and then burned in a conventional super critical boiler to create high pressure steam. That steam is then used to power steam turbines linked to electric generators. The flue gas from the boiler is then cooled, particulate matter is removed and the gaseous exhaust is scrubbed at near atmospheric conditions to remove sulfur compounds before it exits to the atmosphere. This standard “super critical” power plant technology has two major limitations.

The major issue is relatively low thermal efficiency, something less than 40%. Thermal Efficiency is commonly measured in terms of the heat rate, i.e. the number of BTUs necessary to generate 1,000 watt hours of electricity. Conventional plants operate in the 10,000 to 13,000 BTU range. This compares unfavorably to the 7,000 BTU heat rates typical of combined cycle power plants. Natural gas plants also produce no sulfur compounds and hence require little in the way of stack gas clean up. Finally their exhaust typically contains less CO2 than does the exhaust from conventional plants.

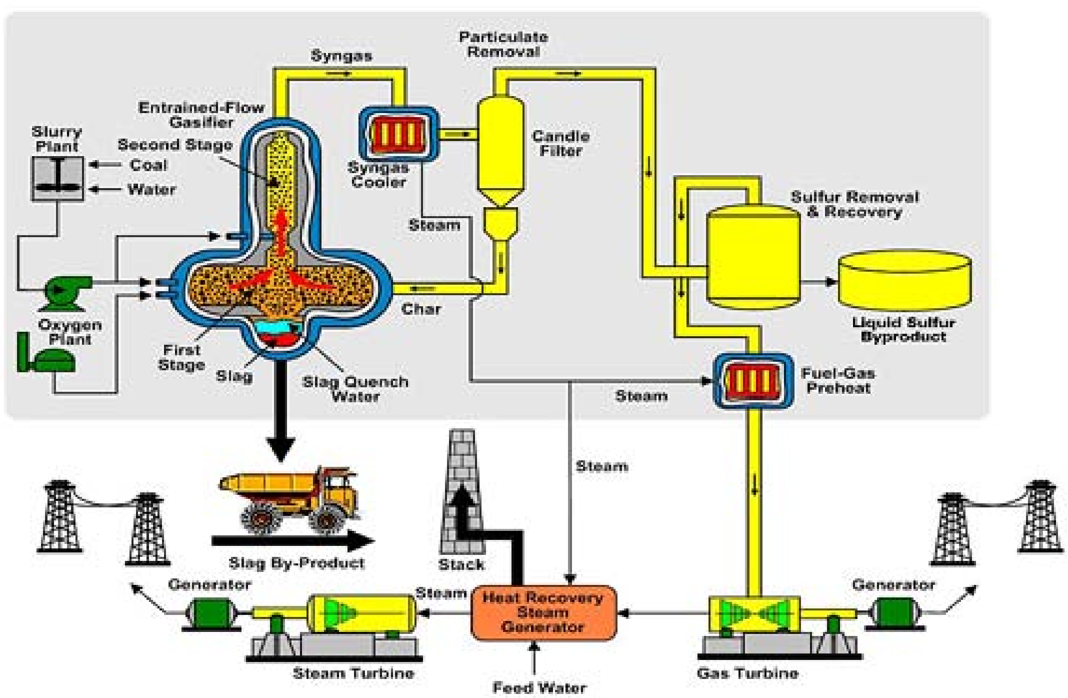
The second issue with conventional plants is that, depending on the solid fuel used, relatively high levels of air pollution can result. Various pollutant precursors are contained in coal and, as a result of combustion, become airborne pollutants which are subject to rigorous constraints by the US EPA.

Chief among these pollutants are sulfur oxides, nitrogen oxides and mercury. Because these materials exit the system at atmospheric pressure, they require large bag houses and scrubbers for removal. The new solid fuel technologies remove the pollutants in the higher pressure-lower temperature (~1000 degrees F.) regime of the gasifier. This simplifies the challenge of meeting EPA air pollution standards when combusted gases exit the steam generator.

Major dislocations have occurred in US power production as a result of the inability of existing plants to meet EPA air pollution standards. For example, Alabama, half of which sits over a major bituminous coal field, now imports 62% of its coal for power generation from Wyoming. This is due to the lack of adequate sulfur removal technology at its many older coal fired power plants.

The major technical response to the EPA challenge has been the development of circulating fluidized bed (CFB) boilers such as two units operated by Entergy at the Nelson (now NISCO) plant. These units operate at lower combustion temperatures and allow the capture of sulfur oxides under high pressures prior to exhaust gases being vented to the atmosphere. Crushed limestone is sometimes added to CFBs to capture SO2 produced in the plant. Lower operating temperatures act to limit the production of Nitrous oxides, another EPA regulated pollutant. More recent variations on the Fluidized bed concept include pressurized circulating fluidized bed (PCFB) units that include oxygen injection to limit NOX emissions. By having an enriched supply of oxygen, beyond that naturally occurring in air, the carbon molecules preferentially combine with the oxygen before Nitrogen oxides can be created in any volume.

The following chart illustrates a state of the art pressurized circulating fluidized bed combined cycle power plant. Source: NETL-DOE



The following discussion details various CFB power plant designs and can be found on the NETL web site under Circulating Fluidized Bed Boilers.

Fluidized-bed combustion (FBC) technology offers a viable power generation option for the post-2000 time frame. Commercial FBC units operate at competitive efficiencies, cost less than today's units, and have NOx and SO_2 emissions below levels mandated by Federal standards. FBC systems fit into essentially two major groups, atmospheric systems (FBC) and pressurized systems (PFBC); and two minor subgroups, bubbling and circulating fluidized beds.

FBC. Atmospheric fluidized beds use a sorbent such as limestone or dolomite to capture sulfur released by the combustion of coal. Jets of air suspend the mixture of sorbent and burning coal during combustion, converting the mixture into a suspension of red-hot particles that flow like a fluid. These boilers operate at atmospheric pressure.

PFBC. The first-generation PFBC systems also use a sorbent and jets of air to suspend the mixture of sorbent and burning coal during combustion. However, these systems operate at elevated pressures and produce a high-pressure gas stream at temperatures that can drive a gas turbine. Steam generated from the heat in the fluidized bed is sent to a steam turbine, creating a highly efficient combined cycle system.

PFBC 1-1/2 A 1-1/2 generation PFBC system increases the gas turbine firing temperature by using natural gas in addition to the vitiated air from the PFB combustor. This mixture is burned in a topping combustor to provide higher inlet temperatures for greater combined cycle efficiency. However, this option does require natural gas, usually a higher priced fuel than coal.

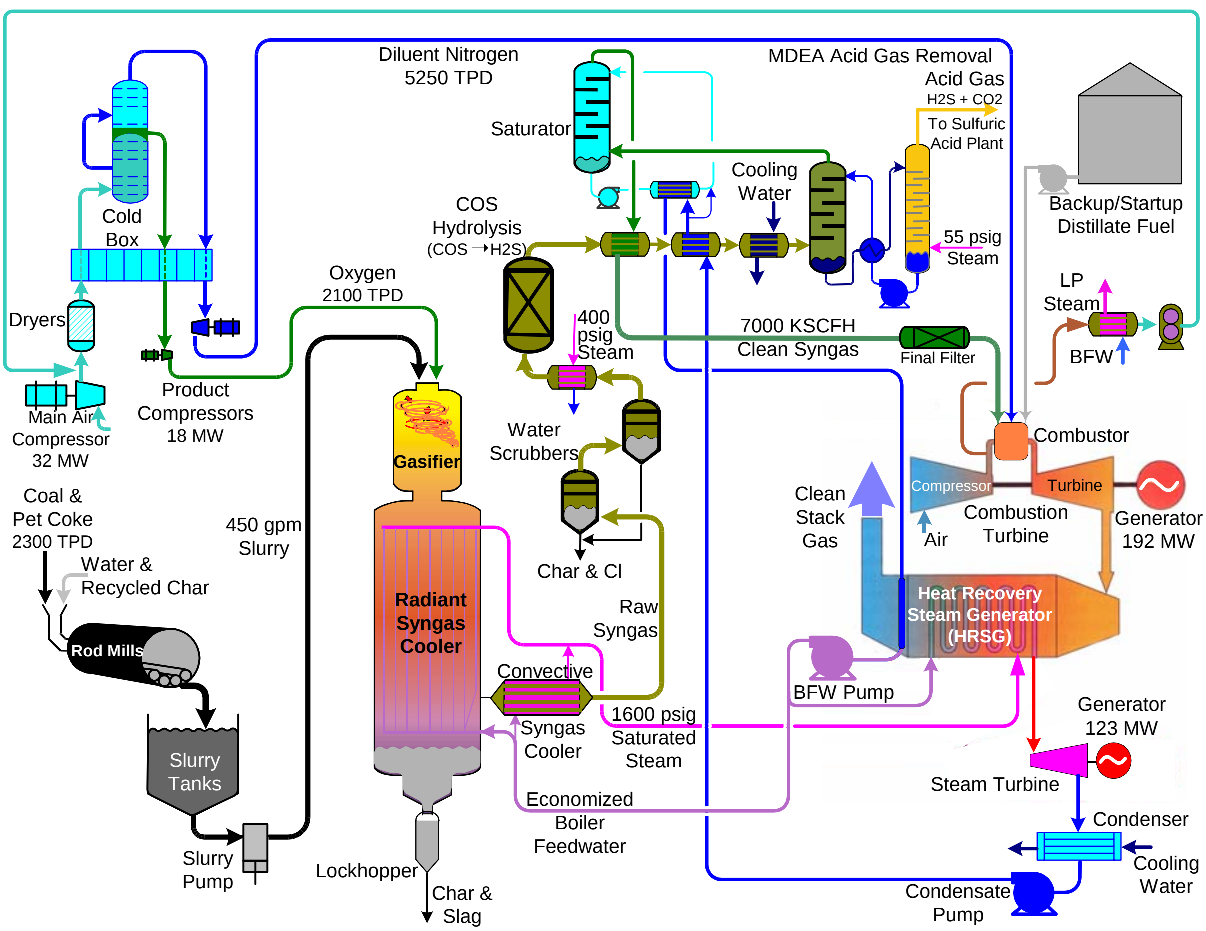
APFBC. In more advanced second-generation PFBC systems, a pressurized carbonizer is incorporated to process the feed coal into fuel gas and char. The PFBC burns the char to produce steam and to heat combustion air for the gas turbine. The fuel gas from the carbonizer burns in a topping combustor linked to a gas turbine, heating the gases to the combustion turbine's rated firing temperature. Heat is recovered from the gas turbine exhaust in order to produce steam, which is used to drive a conventional steam turbine, resulting in a higher overall efficiency for the combined cycle power output. These systems are called APFBC, or advanced circulating pressurized fluidized-bed combustion combined cycle systems. An APFBC system is entirely coal-fueled.

Here in Louisiana, Entergy has plans to convert one of their existing gas fired units, Little Gypsy, to burn Petcoke. This will include a CFB boiler that will be fueled with a combination of Petcoke and Illinois basin coal barged in to this river side facility near La Place. The reason for adding conventional coal to the fuel mix is because Petcoke is almost pure carbon and is relatively difficult to ignite without the addition of a solid fuel containing more volatile hydrocarbons.

Longer term, over the next 5 years, Entergy sees the need to add 2-3000 megawatts (2-4 units) of new base load, solid fuel fired power generating capacity. When determining fuel supply, they will examine Lignite, Petcoke, and imported low sulfur coals from locations as diverse as Colorado, Columbia and Indonesia. They believe that “new builds” are a more likely outcome than gas plant conversions. They see EPA and LPSC regulatory approval hurdles for cases that posit the conversion of existing gas fired locations to coal fired operations, even using the newer technologies. In essence, this is a triumph of emotion over science.

New units produce lower levels of airborne pollution (NOX, SOX and Hg), a result of the capture of these sources of pollution in the gasification step prior to using the Syngas for combustion in the gas turbine. Environmental groups are now arguing that IGCCs are the only acceptable coal fired plants going forward. Unfortunately, from a capital standpoint, these plants are approximately twice as expensive as standard coal fired “super critical” designs due to the expensive “front end” equipment. Not only do you need the gasifier, but you also need plants to produce the required oxygen and to remove the sulfur.

The following schematic presents the 320 mw IGCC Polk facility near Tampa discussed earlier. This unit burns a 60/40 mixture of Petcoke and coal at a rate of 2200 tons/day.



Source: Tampa Electric Cooperative

These units are sometimes criticized as being a “chemical plant that generates electricity”, the point being that like most chemical plants, they are very sensitive to changes in steady state conditions and can only operate as base load power plants. This is the same criticism leveled at Nuclear power plants. Given volatility in demand, particularly in the residential and commercial sectors, a lack of output flexibility is seen as a distinct disadvantage by many utility companies. However, this could be an advantage in Louisiana where over 35% of power produced is for base load refinery and petrochemical plant consumption and where upwards of 80% of capacity is gas fired, providing more flexible peaking capacity.

There is currently a debate in Texas between TXU, one of three major utilities in that state, and the environmental community. TXU wanted to build 11 new conventional coal fired “super critical” power plants in order to relieve their overdependence on gas fired power generation. (Currently approximately 75% of Texas power is generated using natural gas which has increased in price by 73% resulting in increases to homeowners’ bills of roughly 70%. TXU argued that the only near term solution to an impending electricity shortage in Texas is the expedited approval of new conventional plants. The utility was opposed by the environmental community and many municipalities that argued that the new plants should use “best available technology” i.e. the new IGCC process.

TXU maintains that while a few semi-commercial power plants are operating using IGCC, that the process is not sufficiently “proven” to qualify as “best available technology”. TXU maintained that the conventional “super critical” technology with new post combustion atmospheric pressure scrubbers can meet existing pollution specifications. Most recently, TXU has been acquired by private equity firms who have “cut a deal” with the environmental opposition by agreeing to reduce the build out to three conventional units, to also build 2 IGCC units and to begin the process to add two to six new generation nuclear plants to the production mix.

Louisiana does have at least two plants using fluidized bed technology. These circulating fluidized bed boiler systems are located at the Dow NISCO facility in Lake Charles, aka the “Nelson” plant. The plant produces power and superheated steam for use by neighboring petrochemical plants. Although jointly owned by a syndicate of petrochemical companies, the plant is operated by Entergy. Fuel sources include Petcoke and Coal. A Texas facility also uses circulating fluidized bed technology at a two unit 300mw power station in Robertson, Texas. It is fueled with Lignite from a mine 3 miles from the power plant. The unit has been in operation since 1990. Louisiana also has a single Lignite fired mine mouth plant at Dolet Hills.

Non Utility uses of Lignite, Coal and Petcoke

Non utility consumption of coal is a fact in Louisiana with the bulk of consumption being two cogeneration facilities aka CHP (Combined Heat and Power) units. The first of these is the Petcoke/Coal fired NISCO-Dow facility in Lake Charles discussed above. A second plant is at an International Paper Company mill located in Mansfield Parish. While the paper mill's primary fuel is wood waste, it can be co-fired with coal. Despite being in Mansfield, the coal used is bituminous coal from Kentucky.

Large quantities of higher grade Petcoke are purchased and calcined (cooked at even higher temperatures) to create a material that is used for producing carbon anodes used in the process of producing Aluminum. This higher grade material typically sells for $100/ton or twice the price for Petcoke destined for use as a power plant fuel. In at least one case, the Shell Motiva facility at NORCO, has three coke ovens. This includes one dedicated unit which produces only the higher grade material, all of which is purchased by CII, a formerly local company, for use in Aluminum anodes. Approximately 35% of all Petcoke is utilized in the Aluminum industry where 1 kg of Aluminum production requires .5kg of Petcoke.

Small quantities of Petcoke are also used in paint, as pigment. In practice, there are a number of grades of Petcoke ranging from $25/ton material which contains significant metallic impurities to $500/ton "needle coke" a particular grade produced for consumption by the petrochemical industry.

Most recently a Chinese group has proposed building an IGCC facility in Geismar, La. The plant would consume Louisiana Lignite barged to the site from mines in Desoto and Rapides Parishes.

Once gasified and converted to Syngas, a portion would be used for creating petrochemical feed stocks using proven Gas-to-Liquids (GTL) technology. These liquids would support existing chemical operations in the Geismar area. The balance of the Syngas will be used in a combined cycle power plant to generate electricity and steam to support these same industrial consumers. In essence, this is an IGCC design that produces petrochemical feed stocks, electric power and salable steam as co products.

One Gulf Coast IGCC plant exists and is seeing its capacity tripled. A new one is also being built in Florida. Another new gasification facility has been announced by Indiana's Governor. The latter plant will produce 40 bcf of pipeline quality SNG (substitute natural gas) per year, or about 15-20% of Indiana's annual requirement.

Report Conclusions

We believe combining

1) Our local marine transportation advantage with
2) Louisiana based Lignite and Petcoke while utilizing
3) New PCFB, IGCC, GTL and possibly clean coal technology

will allow Louisiana to create a structural advantage while retaining wealth and jobs within the State's borders. This is preferred to the current situation where we lose economic value on Petcoke exports sold at double digit discounts, while simultaneously paying premium prices for imported Wyoming coal. A few tactical options could help such an effort.

1) The Louisiana Public Service Commission (LPSC) could come out publicly as being in favor of using Louisiana based Lignite and Petcoke as fuels of choice, expediting approvals and approving rates for the development and construction of these plants. The same incentives being discussed for Nuclear plants should be offered for new plants and for conversions where re-powering is an option. The rationale would be a desire to get Louisiana's cost of power generation back in line with neighboring states. Like Texas, we generate a preponderance of our power with natural gas and have the same disadvantage as Texas in that regard.

2) Unlike Texas we tax the natural gas entering our power plants. That tax is being reduced and should be phased out as quickly as possible.

3) A rate structure that allows a tax exemption or re-development credit for utilities and industrial consumers who switch to one or both of these two local solid fuels would also be a step in the right direction.

4) Louisiana might consider an investment credit similar to that available in Alabama to facilitate building new Petcoke or Lignite fired plants or converting existing gas fired plants from natural gas and imported coal to the two favored fuels.

5) We could provide similar credits for the construction of terminals and docks at waterside plants and for the barges used in moving these Louisiana products to Louisiana power generators. Such projects would help the recovery of local engineering and construction companies as well as of local shipyards capable of building hopper barges and tugs. We might extend this credit to cover new Lignite mining operations.

5) We need to create credits to support at least one Louisiana based transshipment terminal which could receive barged coal or Petcoke and ship out unit trains that can be unloaded at existing power plants already equipped to handle this type of solid fuel delivery. While not as cost effective as a pure marine route, this hybrid system has worked well for Florida and Missouri.

Talking Points

1) ***Over 75% of all the power generated in Louisiana uses natural gas as fuel.*** As gas prices have escalated, so has the price of electricity. Texas has same problem, but is aggressively pursuing alternate solutions including the use of locally available solid fuels to support new power plants.

2) ***Today, Louisiana is barely self sufficient in terms of natural gas production.*** Our gas exports to other states are natural gas supplies we import from Texas and from the shallow Federal waters of the Gulf of Mexico. Both Texas and Federal shelf production in the Gulf are in long term decline. While U.S. gas consumption continues to increase.

3) ***In addition to the high cost of gas, Louisiana has aggravated the situation by adding a sales tax to gas entering local power plants.*** This provides a "perverse incentive" to export gas to other states rather than to use it here at home. There are plans in the upcoming legislative session to reduce or eliminate this tax.

4) ***Unfortunately, the same "sticker shock" we all see on our home electricity bills has already caused the departure of numerous chemical plants.*** In each case, the local Louisiana tax base is diminished and the local economy suffers from a loss of premium jobs. We need to preserve these jobs, both agricultural and industrial, as well as our quality of life. The plants are being driven away by the higher costs of our electricity because natural gas is used to generate most of our power. Gas also serves as the raw material for the chemical plants. **Something has to be done about the costs of electric power/natural gas.**

5) ***Our best hope is to convert a portion of our base load power generation from Natural Gas to solid fuels.*** Petcoke and Lignite are both locally available solid fuels which are underutilized. By shifting "base load" production to these less expensive fuels. Louisiana's power producers can reduce their costs and hence their prices to both residential and industrial customers. We will also pick up temporary construction jobs as these plants are built.

6) ***In 2006, Louisiana produced about 13.7 mm tons of Petcoke, second to Texas at 19.6 mm tons. However, each state only used about 600,000 tons for power generation.*** To put that in context, total US production of Petcoke is about 62 mm tons. Gulf Coast refineries produce over 50% of the U.S. total.

7) ***Some Louisiana production is profitably processed and converted to electric anodes used in Aluminum production***. It takes ½ ton of Petcoke to produce 1 ton of Aluminum. This product can only use "Marketable" Petcoke as a feed stock. We should manage the process to insure that these needs are adequately met.

8) ***However, much of the Gulf Coast's Petcoke production is exported, at steep discounts, to other states, and to other countries.*** International exports from Louisiana (about 5.6 mm tons in 2006) are split evenly between New Orleans and Lake Charles. Cement kilns in the Mediterranean are the largest international consumer of our Petcoke. That price is set by the price they pay for importing coal from South Africa. This material plus the domestic equivalent, each without any value added component in Louisiana, should be our targeted source of Petcoke.

9) **Louisiana also uses about 11.5 mm tons per year of coal and Lignite but only produces and uses about 3.9 mm tons/year of Lignite.** We import 7.6 mm tons of coal from Wyoming via rail. The majority of the Wyoming coal is consumed at the Rodemacher #2 plant with smaller amounts consumed by the Nelson plant and other facilities. Some coal is always mixed with fuel Petcoke to promote ignition.

10) We are in the embarrassing and costly position of selling local material (Petcoke) at a discount, while paying a premium to import western coal to fuel the few solid fuel power plants we currently operate. This wouldn't be critical if we had our historical natural gas price advantage, but those days are over.

11) ***Within the US, Florida is the major user of Gulf Coast Petcoke for power generation,* consuming over 2.2 mm tons or almost 4 times as much as either Louisiana or Texas, the two largest producers.** Florida produces no Petcoke. The next largest customer is Kentucky which imports 1.1 mm tons/ year of Petcoke despite having ample coal supplies in state.

12) ***Currently, Louisiana has one power plant consuming Louisiana produced Lignite provided from two Louisiana mines. We also have Petcoke consumption in Lake Charles and will use barge delivered Petcoke at Rodemacher #3, and at Montz, both plants currently under construction.*** There are a number (4-6) of new solid fuel plants in the planning phase which will add total capacity for 2-3,000 megawatts. We need to expedite the approval of these plants and to provide incentives to guarantee that they use locally available, lower cost solid fuels.

13) In addition to the plants and their fuel, the solid fuels, both Petcoke and Lignite, need to be delivered using Louisiana based barges, tugs and terminals. We have been lax in the use of solid fuels, but even more lax in the use of marine delivery. Our refineries already have docks from which to ship Petcoke by water. Unfortunately, our solid fuel power plants depend on more costly land based conveyors, railroads and trucks for fuel delivery. Because up to half of the value of delivered solid fuels involves transportation, we need to encourage water or water-rail delivery. This requires new barges and tugs as well as at least one water-to-rail transshipment facility to allow for Petcoke delivery to inland power plants in Louisiana and in surrounding States.