

Carbon Technology Company (CTC)

Dec. 11 , 2018

Process to Convert Coal into High Value Carbon Products of
Carbon Char, Coal Oil Liquids, Synthetic Gas By a Mild
Gasification Process

Presented to: TRAP meeting, Thessaloniki Greece

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“May you live in Interesting Times”....

Chinese Proverb





The Evolution of Technology and Humanity



Muscle Power



10,000 Years Ago

Steam Power



1,800

Digital Power



Now

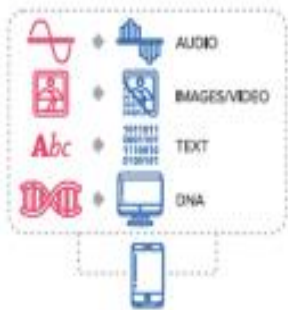




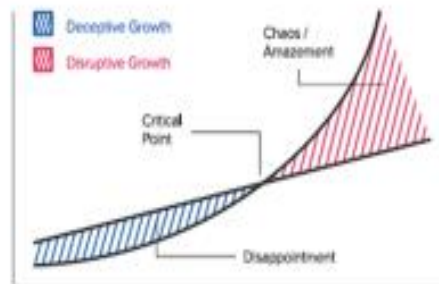
Impact of Exponential Technologies



Artificial Intelligence
 Internet of Things
 Robotics
 3D Printing
 Biotech
 Augmented Reality
 Virtual Reality
 Autonomous Vehicles



Digitized



Deceptive • Disruptive



Dematerialized

	ENIAC	iPhone 7
YEAR	1946	2016
SPEED	1 x .001 Ghz	4 x 2.38 Ghz
WEIGHT	30 Tons	138 grams
COST	\$500,000	\$890

Demonetized



Democratized

Coming back to Greece after 35 years

- <https://youtu.be/e3RdgsxweuA>

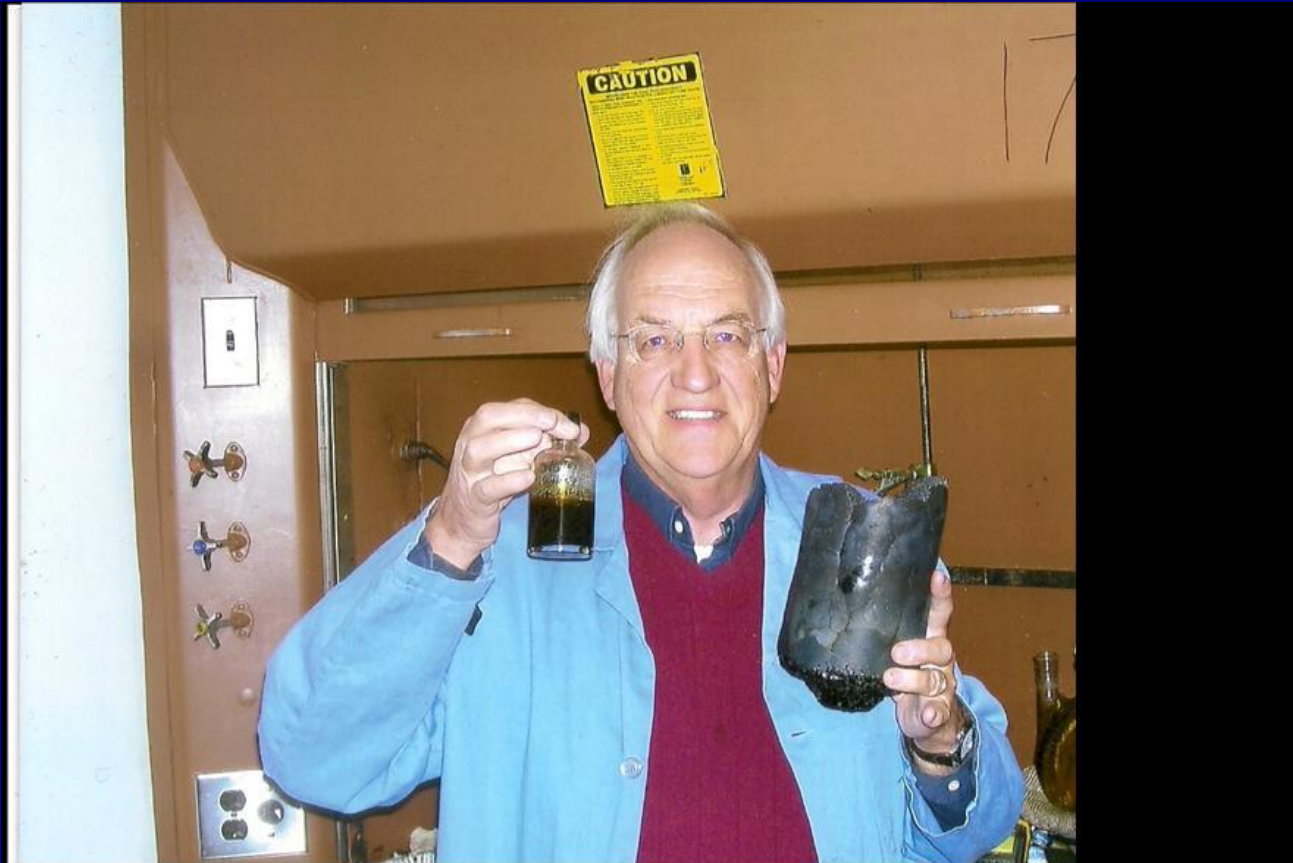
CTC's COAL CONVERSION PROCESS

- Is a mild gasification process (Pyrolysis)**
- Blend of Coal and Biomass Materials**
- Yields 70 % Carbon Char per ton of coal**
- Yields one barrel of oil per ton of coal**
- Removes deleterious materials from coal**
- Reduces from 5-25% of carbon dioxide depending upon the type of coal**

Industrial Applications of CTC's Carbon Char

- **Briquetted into Formed Coke for the Steel Industry**
- **Low Cost Alternative to Activated Carbon**
- **Absorbent for Oils, Mercury, Selenium and other metals in waste water**
- **Alternative to Anthracite Coal**
- **Carbon Reductant for Ferro-Alloy Industry like at Elkem Metals and Globe**
- **Carbon as nutrients in agricultural applications such as BioChar made from Coal by the Wolfe's Mild Gasification Process**

Lab Testing at WVU in 2011-18 with VA-WV Coal
Prior to Building First Commercial Demonstration
Plant in Norton, VA and Now Ready for
Commercial Plant



CTC's Mild Gasification Pilot Plant Designed by Dr. Wolfe's Team Directed by Son, Mr. Eric Wolfe, and Operated for 8 years in Bristol, Virginia 1987-1997 with funding provided by the US Department of Energy and CTC's Private Equity



CTC's Mild Gasification Pilot Plant Designed by Dr. Wolfe for Nucor Steel Plant testing in Conway, Arkansas 2005-2007



Nucor Steel Company's Carbonite Pilot Plant designed and operated by Dr. Wolfe in Conway, Arkansas in 2007-2008 at 300 pounds of coal per hour to prove out the process.

The Figure 7 shows the fracturing of the larger run of mine one inch top size samples after the mild gasification process. During the carbonization process, fractures did occur as expected in the larger sizes which indicates that depending upon the size product desired in commercial operation, various top sizes of PRB coals could be used.



Figure 7. Fracturing of the larger top sized PRB coals along with the one-quarter inch top size coal product.

The technical data obtained on the initial PRB coal and the char produced during the mild gasification process is shown in Table 1.

Table 1. Proximate Analysis of PRB Coal and Char Produced at 650 C

Physical Parameters	PRB Coal (%)	PRB Char (%)
1. Moisture	24.53	0.48
2. Ash	7.39	12.34
3. Volatile Matter	38.10	3.87
4. Fixed Carbon	29.98	83.79
5. Sulfur	0.35	0.44
Heat Value in Btu/#	8,772	13,006
Hargrove Grindability Index(HGI)	47	37.6

CTC's Mild Gasification Pilot Plant Testing with PRB Coal at Nucor Conway Site 2005

EVALUATION OF THE COKING PROPERTIES OF THE K-FUEL COAL PRODUCT UTILIZING THE "WOLFE FORMED COKEMAKING TECHNOLOGY"

August 23, 2005



Submitted to:
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Dr. Wolfe collecting a coal liquid sample at the Nucor Steel Co. Pilot plant in 2007



Photos of the Coal Liquids collected from the first and second condenser

CTC'S COMMERCIAL DEMONSTRATION PLANT IN NORTON, VIRGINIA 2011-PRESENT



CTC's Patented Clean Coal Conversion Process (The Iphone X)

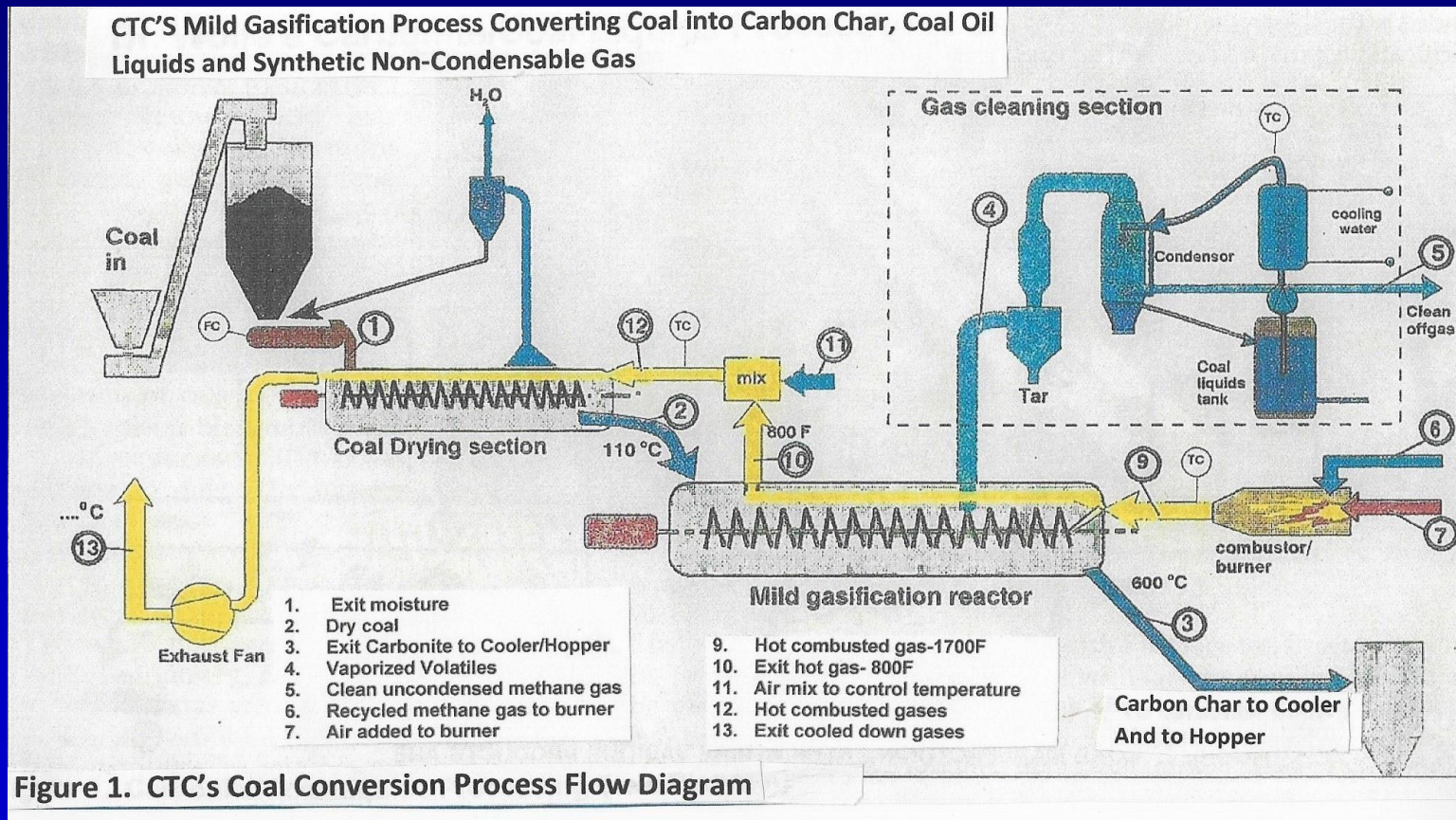


Figure 1. CTC's Coal Conversion Process Flow Diagram

CTC's Mild Gasification Reactor converting coal Continuously into High Value Carbon Char at VA Plant in Norton, VA



CTC's Continuous Formed Briquetted Coke Making Process (Again The Iphone X) THE NEXT GENERATION OF COKE MAKING TECHNOLOGY

CTC'S FORMED COKEMAKING PROCESS-Second Processing Step

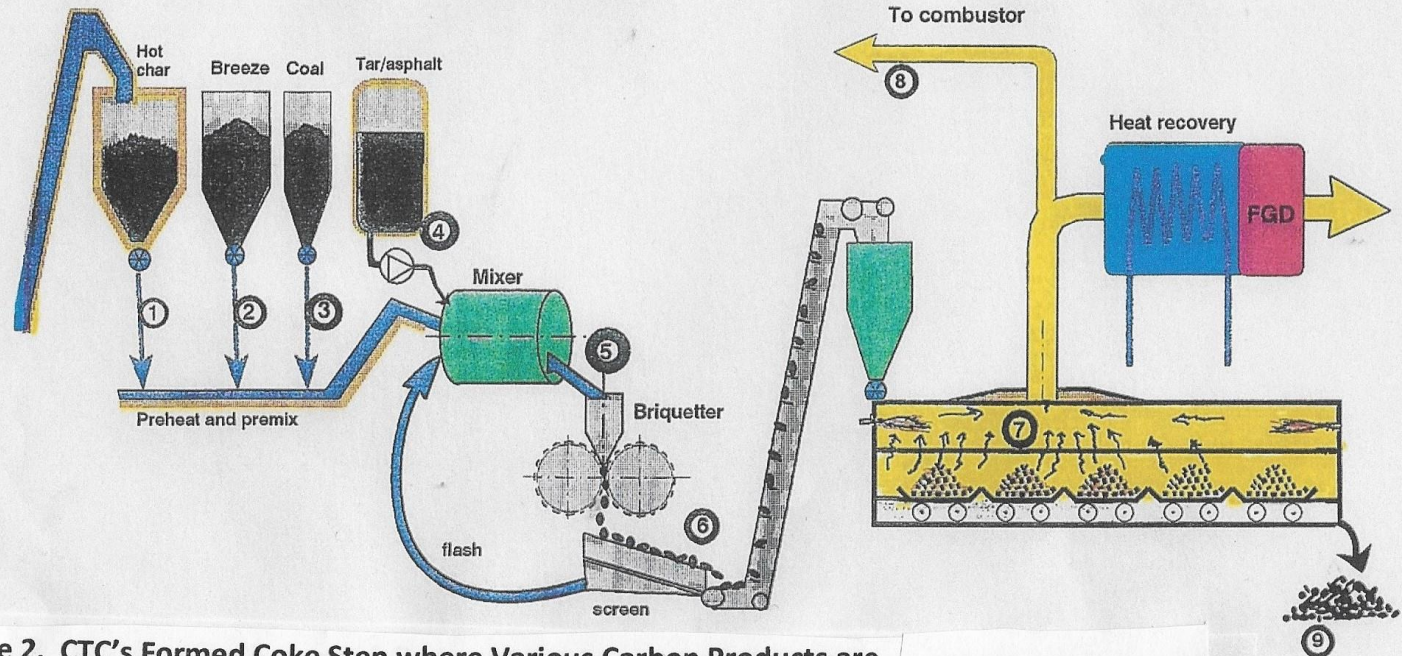
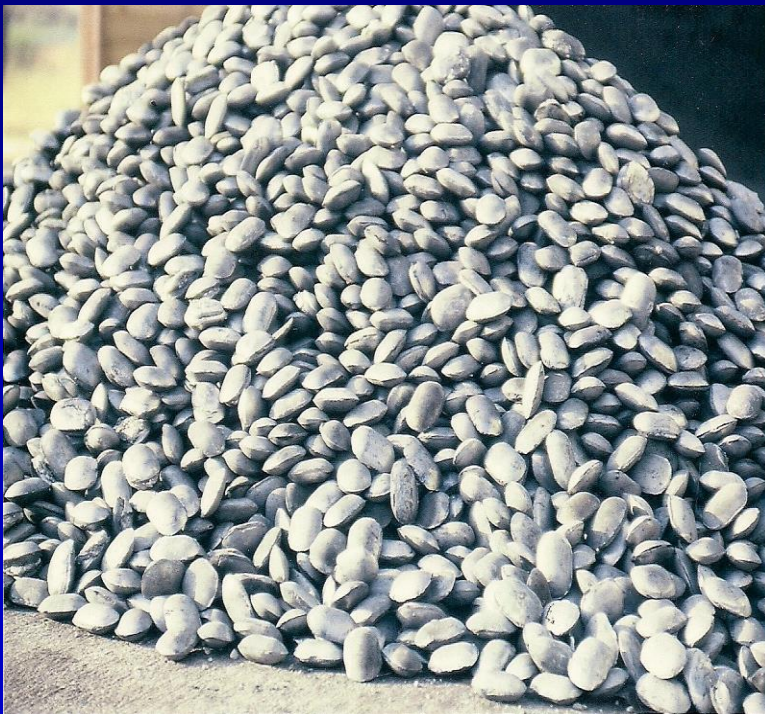


Figure 2. CTC's Formed Coke Step where Various Carbon Products are Blended and Calcined Continuously in a Tunnel Kiln Furnace at 1100 C

CTC's Briquetted Formed Coke for the Foundry Industry From Pilot plant in 2007 to Commercial Demostration Plant in Norton VA 2012- Present



CTC's Briquetted Coke for Blast Furnace Application made in Continuous Tunnel Kiln in 4 hours compared to Coke made in Coke Oven Batteries in 20-24 hours used today.



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COMPARATIVE COKE QUALITY ANALYSIS USING ONE TON SAMPLE OF SAME COAL BLEND

*Test Completed
1996*

Physical Characteristics	Formed CTC Coke Briquettes %	Conventional Coke Produced in Movable Wall Oven (MWO) %
Ash	7.65	8.23
Sulfur	0.72	0.74
V.M.	0.63	0.80
Stability	60.5	59.3
Hardness	71.5	65.1
Bulk Density (Lbs./Ft. ³)	38.0	26.6
Porosity	50.0	55.8
CSR	64.9	63.2
CRI	22.7	20.0
Alkali in Coke	0.19	0.22
Phos. in Coke	0.013	0.011

10/29/10 - This coal blend was provided and supervised by Bethlehem Steel Engineers. Bethlehem Steel then invested \$100,000 for supporting further testing at CTC.

CTC Unique Features

- 50-70% reduced Capital Expenditure per Module compared to conventional coke plant
- Sulfur can be reduced by at least 25%all organic Sulfur will dissipate during gasification and only the mineral part will remain
- Carbon Dioxide by more than 65-70% since no combustion is taking place.
- Modular systems that offer economies of scale as Integrated Systems use 1 Liquids condenser per 2 Gasification Units and combined storage space and easy redeployment
- Processing of the Coal dust and Coal Ash will greatly enhance the Environmental Impact & the bottom line of the whole process

SUMMARY and CONCLUSIONS

- 1. The CTC Continuous Coal Conversion Process converts coal into Value-Added Carbon Char, Coal Oil Liquids and Synthetic Gas**
- 2. The CTC Process has been proven in two separate Pilot Plants co-funded with the US Department of Energy 1986-1996 and Nucor Steel 2005-2007 and one commercial demonstration plant privately financed in Norton, VA 2011-Present**
- 3. Several Commercial Size Plants are now being considered to be located at a several sites including coal preparation plants and/or customers site**
- 4. The CTC Continuous Process is the next generation of Coke Making Technology in converting coal into formed coke briquettes in an environmentally friendly closed loop system that will ultimately replace existing batch coke oven batteries currently used around the world.**
- 5. All ranks and types of Coal can be converted continuously into high-value Carbon Char in less than 20 minutes at internal coal temperature of 600C**
- 6. Coal can be converted into high quality Foundry Size and Blast Furnace Size coke briquettes continuously in less than 4 hours at 1100 C as compared to present day batch coke oven batteries requiring a minimum of 20 hours.**

Why in Greece?

- New uses for Greek lignite, the only national strategic fuel, through a **new and proven technological solution**
- , **low risk investment with high returns**
- Modular plants provide **new jobs** in a **multiple locations**
- Contributes to more **Greek exports**
- Generates **low carbon footprint and low sulfur fuels**
- Greek industrial manufacturers can have access to **low cost domestic materials**
- **Agriculture benefits** : Promotes high value in cultivating organic fruit and produce and provides **solutions to the critical desertification & soil remediation issues**

FUTURE OF THE COAL INDUSTRY

- 1. CONVERTING COAL CLEANLY INTO NEW VALUE ADDED MARKETS, SUCH AS;
 - A. COAL INTO HIGH VALUE CARBON CHAR FOR THE ALLOY AND STEEL INDUSTRY
 - B. COAL INTO COKE BY THE WOLFE'S CONTINUOUS ENVIRONMENTALLY CLEAN PROCESS IN 4 HOURS VERSES EXISTING POLLUTING COKE BATTERIES IN 20 HOURS
 - C. COAL INTO GASOLINE LIKE NOW DONE IN SOUTH AFRICA. USE GREEK LIGNITES TO MAKE OUR GASOLINE NOT OIL FROM TEXAS OR MID-EAST.
 - C. Char to High tech materials such as Graphene
 - D. LET'S MAKE GREECE GREAT AGAIN