

TM

FPU LTD



# Direct Carbon Fuel Cell Meeting

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# Agenda

- **Overview**
- **Process Description**
- **History**
- **Markets**
- **Commercialization Effort**
- **Discussion**

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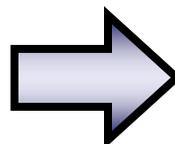
# The Carbon Supply Challenge

- High cost (>\$500 per metric ton)
- 2001 graphite production was only 873,000 tons
- Coal by comparison is low in cost (< \$35 per ton) but low in quality



# CENfuel™ Product Characteristics

Input Coal Sample	
Ash	25%
BTU/lb	11,077
Moisture	13.6%
\$ per MMBTU	< 0.5
\$ per tonne	\$12



Output CENfuel™ Product	
Ash	0.59 %
BTU/lb	15,186
Moisture	0.3 %
\$ per MMBTU	< 3.0
\$ per tonne	\$100

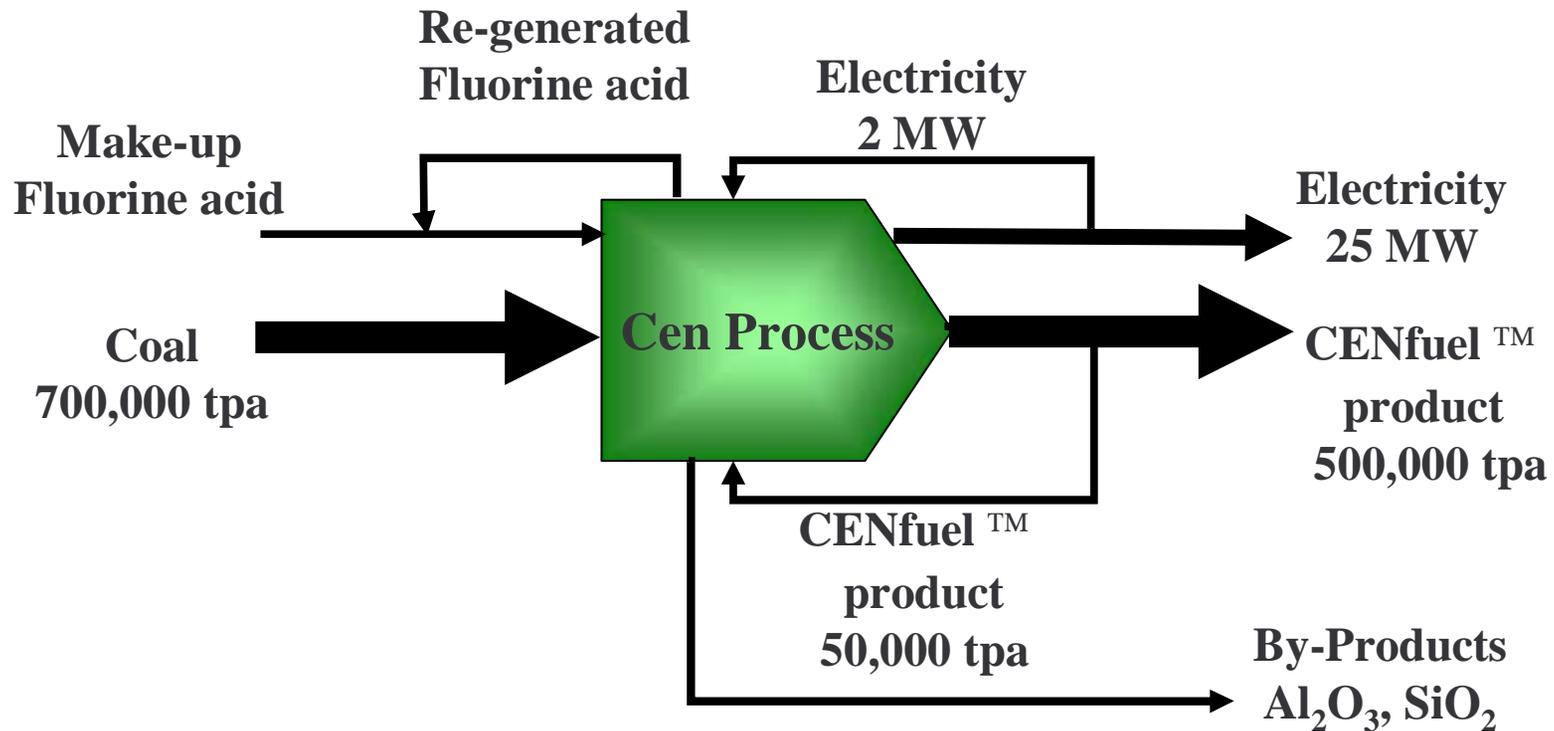
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# CENfuel™ Process Key Features

- CENfuel™ Product:
  - Under 0.5 percent ash
  - Created by removing coal's impurities such as ash and heavy metals, including mercury
  - Prior to combustion or use
- Flexible:
  - Works on all varieties of coal and coal waste
- Uses:
  - Power plants
  - Industrial boilers
  - Specialty carbon
  - Carbon fuel cells

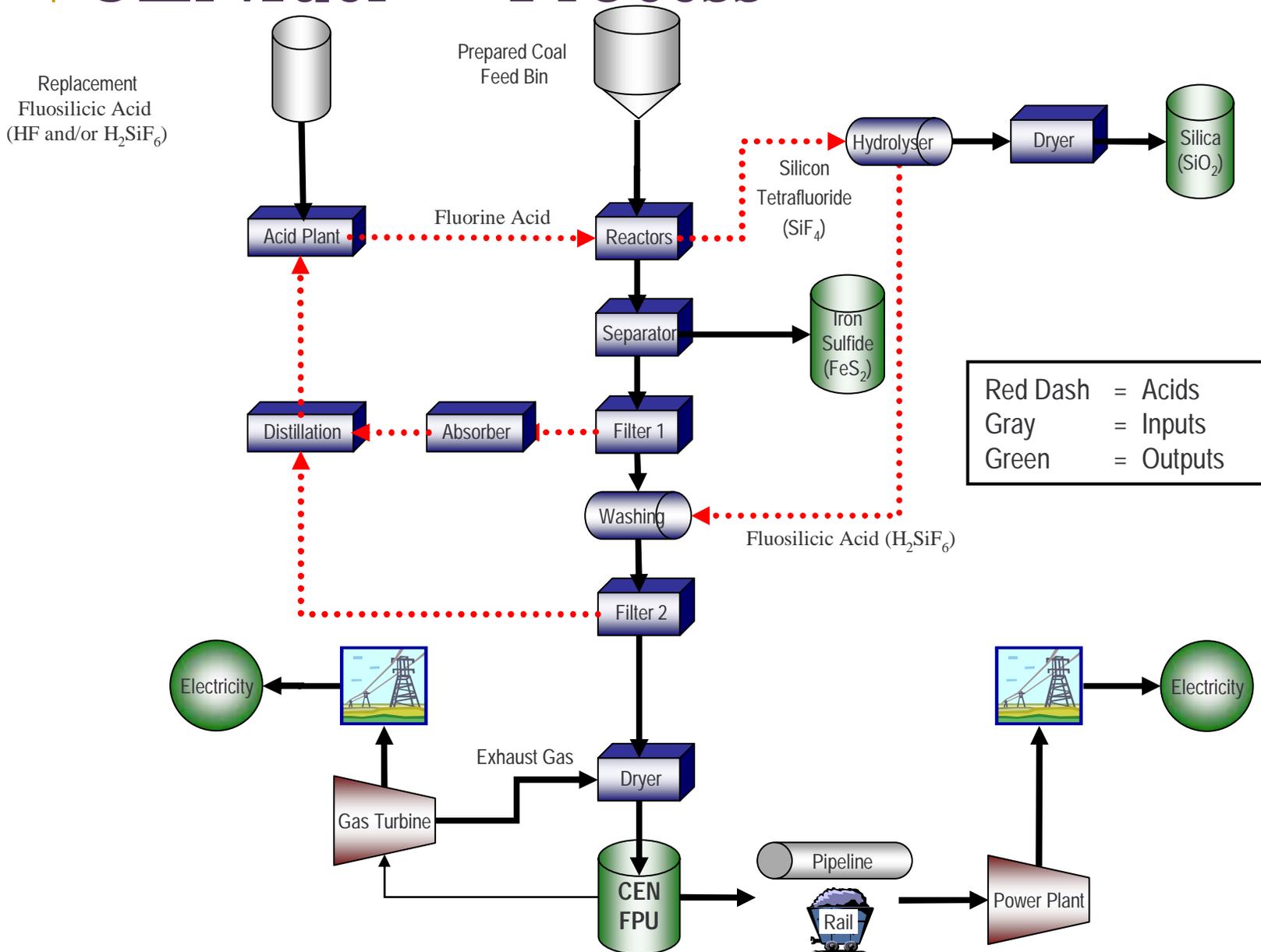


# CENfuel™ Commercial Scale Plant



*Low capital investment, Low temperature and pressure process*

# CENfuel™ Process



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# History

- **Process developed throughout the 1980's and 1990's by Max Turner and Robert Lloyd**
- **U.S. company founded in 2001 to commercialize product in North America, backed by Australian investors**
- **Application tested by companies such as General Motors and Brown Boveria (now ABB)**
- **Process reviewed by leading chemists and process engineers**
- **Patents include: U.S. patent #4,780,112, Australia Patent No. 577,686; new patents currently being registered**

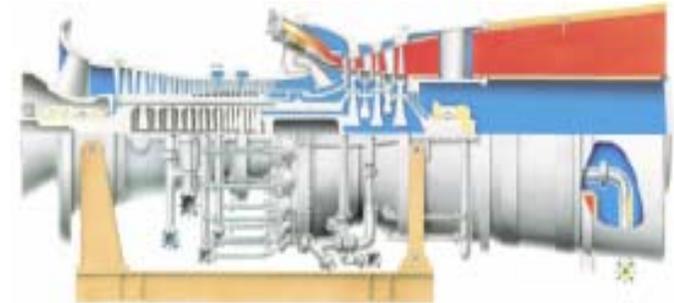
***Highly Tested***

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# Markets

- **Industrial Fuels:**
  - \$30 to \$40 B market today, high margin opportunities
  
- **Power Plant Fuels:**
  - \$50 B market today, expected to grow by \$30B over the next 20 years
  - Large volume, moderate margin opportunities
  
- **Industrial Specialty Carbons**
  - \$7 B + market today, rapid growth in segments
  - Very high margin opportunities



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# Opportunities

—————→ 1 to 3 years  
Industrial Carbons, Boilers

—————→ 3 to 5 years  
Utility Scale Power Plants,  
Combustion Turbines,  
Combined Cycle

—————→ 5+ years  
Carbon Fuel Cells

# Commercialization

Goal: *Sufficient demonstration, engineering, and certification of costs and performance to satisfy project investors*

- West Virginia batch production plant operational
- Planned Near-term Enhancements:
  - ❑ Complete commercial plant design
  - ❑ Continuous process
  - ❑ Silica and alumina recovery
  - ❑ Acid recovery
  - ❑ Iron and sulfur removal
- Next Step:
  - ❑ Full-scale (50,000 to 500,000 tpy) plant



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# Testing Program

- **Fuel and carbon characterization**
- **Polymer and other carbon use products**
- **Combustion**
- **Carbon Fuel Cells**

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# Discussion