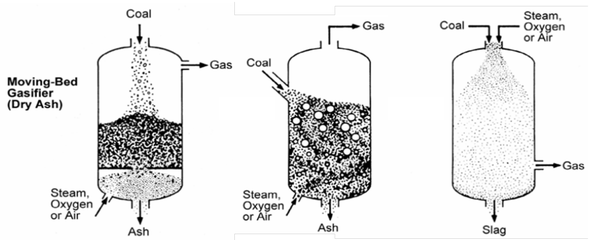
Modularization of Coal Gasification

University of Kentucky Center for Applied Energy Research

Staged OMB for Modular Gasifier/Burner
DE-FE0031506

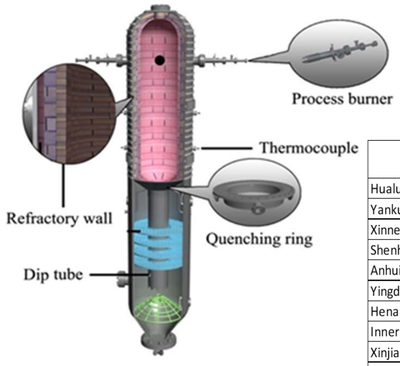
Background

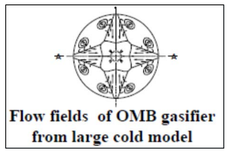
Why Entrained Flow Gasification?



Process	Operation Temperature (°C)	Oxidant Demand	Steam Demand	Carbon Conversion	CH_4 concentration/ tar	H_2/CO (mol/mol)
Moving/fixed bed	425-650	low	/	low	>4% / high	2
Fluidized bed	900-1050	moderate	moderate	moderate	>2%/ low	0.6~0.7
Entrained flow	1250-1600	high	low	High>95%	<1000ppm/No tar	0.7

OMB Technology

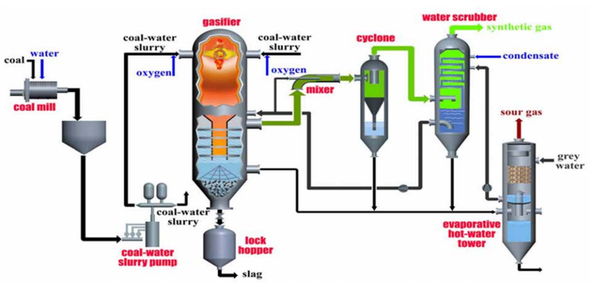




Coal Types	Fuel Conversion, %
Hualu Hengsheng Coal	98.3
Yankuang Cathay Coal	98.8
Xinneng Fenghuang Coal	99.2
Shenhua Ningxia Coal	98.9
Anhui Huayi Coal	98.9
Yingde Anyang Coal	99.3
Henan Xinlianxin Coal	98.7
Inner Mongolia Rongxin Coal	99.6
Xinjiang Xinlianxin Coal	99.1
Ordos Guotai Coal	99.2

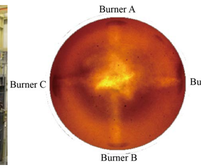
- oResidence time independent of the gasifier size
- oEspecially suitable for small-scale modular application
- oScale-up demonstrated but small scale modular study needed

UKy-CAER Gasification Unit



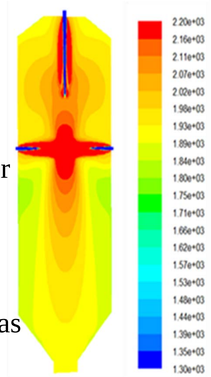
Designed and fabricated by China Ministry of Education's Key Laboratory of Coal Gasification East China University of Science and Technology (ECUST)

- oGasification, quench chamber and water scrubber
- oDry coal consumption: 1 ton/day
- oSyngas production: 179 lbs/hr
- oH/CO: ~0.75/1



Objectives

1. Modify existing OMB unit to a staged OMB gasifier
   - Demonstrate flexibility in fuel/load
   - In-situ WGS and partial sulfur removal
   - Improved T profile
2. Standardization
   - Modularize burner design
   - Match ASU, burner and syngas turbine.
3. Techno-Economic Analysis

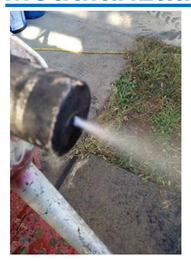


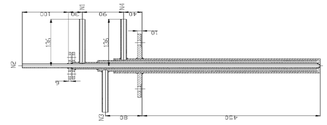
Technical Approach

Fuel Preparation Flexibility

Average particle size (μm)	Mass concentration	Viscosity (mPa·s)
<50	<60%	<250

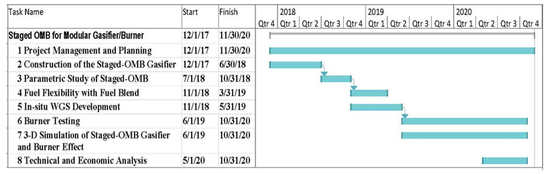
Burner Standardization and Modularization





Structure and Schedule

Project Participant	Scope of Work
UKy-CAER	• Project lead • Schedule and overall project management • OMB pilot modification design and construction • Develop testing plan • Staged-OMB operation and testing • Data analysis • Feed characterization • Develop final staged-OMB design based on test and model results
East China University of Science and Technology (ECUST)	• 3-D modeling of the staged-OMB gasifier based on results from testing • Utilize 3-D model to optimize the staged-OMB process • Provide suggestions for process and unit modifications to improve flexibility and efficiency • Technical support on operation of UKy-CAER OMB pilot unit based on knowledge and experience from previous operations and development
Trimeric Corporation	• Perform techno-economic analysis • Estimate construction costs • Estimate operating costs • Economic comparison to commercial scale • Determine economic viability of system



Acknowledgements

- o DOE-NETL: Arun Bose, K. David Lyons, Steve Markovich
- o UKy-CAER: Andy Placido and Don Challman
- o ECUST: Qinghua Guo
- o Trimeric: Andrew Sexton

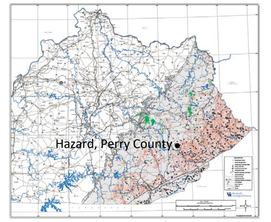
Gasification Combined Heat and Power from Coal Fines
DE-FE0031520

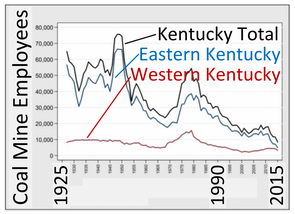
Objectives

- •FEED study for a 5 MWe equivalent polygenerating unit to be located at an Eastern KY utilizing nearby waste coal fines and biomass
- •Identify technology selection and operating conditions

Background

- •Refuse coal impoundments are throughout the entire Appalachian Region
- •Would benefit from local polygeneration units
  - •Encourage industry location in industrial parks
  - •Economic development
  - •Secondary environmental benefit of recovering coal fines
- •Use local sites in Perry County as representative of sites throughout Appalachia

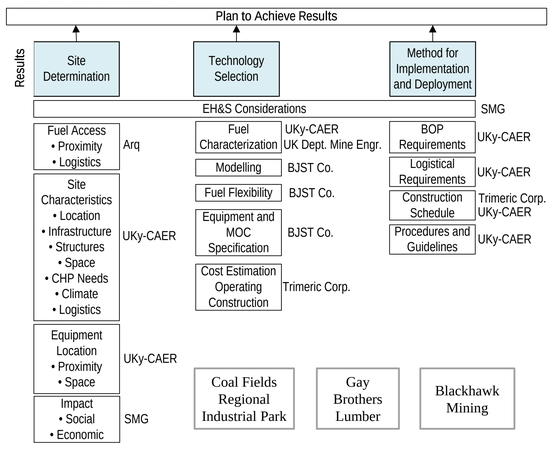




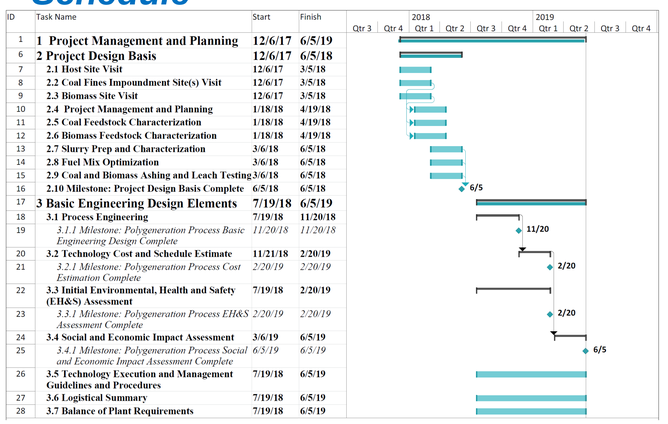
Perry County Preparation Plants.

Company	Plant	Nearest Town	Capacity (tph)	Fine Coal Recovery Circuit
Whitaker/Perry Co/ICG	#4 Plant	Hazard	750/950	HM Cyclone, Spirals
KEM/Pads Branch	Plant #25	Hazard	400	HM Cyclone, Spirals
Blue Diamond/ Blackhawk	Leatherwood	Leatherwood	800/1600	Concentrating Tables, Spirals, HM Cyclones
Lost Mountain	Harris Branch	Bulan	900	HM Cyclone
Kodak	Chester	Allock	350	Hydrocyclone
River Processing	Dunraven	Dunraven	350	Concentrating Tables, Hydrocyclone
Sunfire	#2 Plant	Combs	175	None
River Coal	Indian Head	Ned	180	None
Tesora	Wahoo	Bonneyman	420	None

Structure

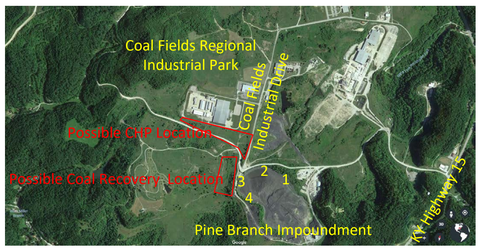


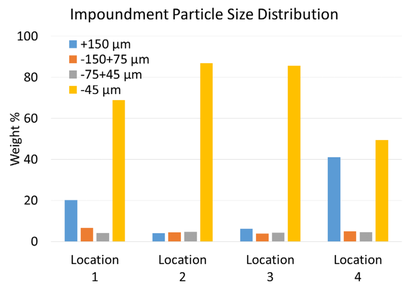
Schedule

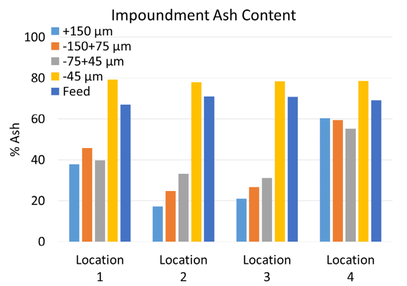


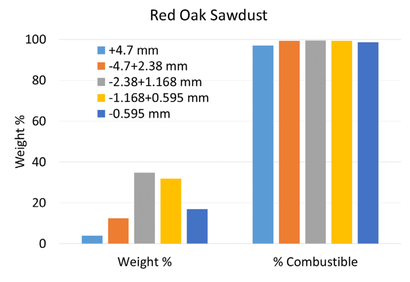
Preliminary Results

	Moisture (wt%)	VM (wt%)	FC (wt%)	Ash (wt%)	C (wt%)	H (wt%)	N (wt%)	O (wt%)	S (wt%)	GCV (Btu/lb)
Impoundment 1	2.07	14.5	14.36	69.06	22.44	2.16	0.31	5.47	0.56	1483
Impoundment 2	1.85	13.37	14.83	69.95	22.29	2.08	0.31	4.93	0.44	563
Impoundment 3	1.58	15.22	15.89	67.31	23.49	2.14	0.38	5.87	0.81	2294
Impoundment 4	1.86	16.7	16.66	64.79	25.45	2.27	0.35	6.63	0.52	1862
Sawdust	5.3	48.43	11.48	0.29	48.43	6.19	<0.01	45.06	0.03	7411









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- o DOE-NETL: David Lyons and Steve Markovich
- o UKy-CAER: Kunlei Liu, Jack Groppo, Heather Nikolic, Lisa Richburg