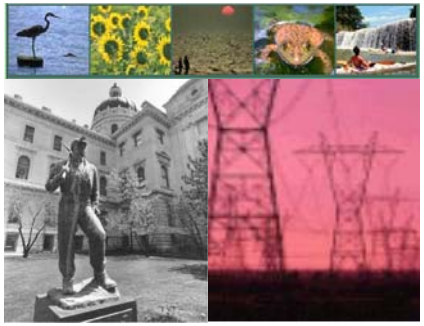
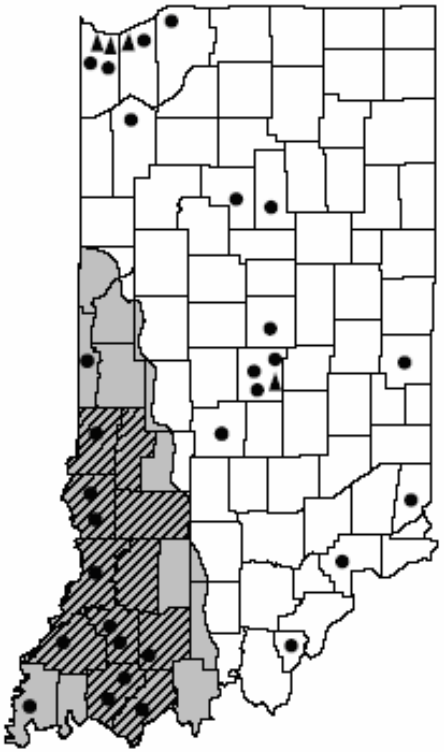
THE INDIANA CENTER FOR COAL TECHNOLOGY RESEARCH, CCTR, ~ 2005 RESEARCH PROPOSALS





Presentation to the CCTR Advisory Panel
Indianapolis

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PURDUE UNIVERSITY
https://engineering.purdue.edu/IE/Research/PEMRG/CCTR/

2005 Coal Research Proposals
Review Process

Seven criteria are described in the RFP review process:-

- Significance
- Involvement & capacity enhancement
- Scientific merit & prior experience
- Planning adequacy & cost sharing

CCTR received three submissions:-

Topic J1- Indiana University
Topic J2 - Purdue University
Topic K6 - Purdue University Calumet

Topic J1 - Indiana University

"Assessment of the Quality of Indiana Coals for IGCC Performance"

MOTIVATION:

Evaluating Indiana coals for IGCC is necessary & urgent. 73% of Indiana coal is used to generate electricity and more than 90% of electricity generated in Indiana comes from coal.

Indiana has significant coal reserves (17.5 Billion Tons). The Coal has high sulfur content & therefore emissions problems.

IGCC technology could help Indiana coal. IGCC can achieve 99% SO_2 removal. IGCC removes mercury & CO_2 upstream of the combustion process. IGCC systems are 45% efficient.

IGCC technology has good prospects in Indiana – Cinergy/PSI is considering construction of an IGCC plant.

Topic J1 - Indiana University

"Assessment of the Quality of Indiana Coals for IGCC Performance"

OBJECTIVES:

Assess data availability & identify areas of poor data coverage. Document Indiana coal properties for IGCC technology, with a special emphasis on moisture, heating value, volatile matter content, mineral properties, and char reactivity.

Outline essential future research for assessing coal performance during gasification; propose new analyses to assess the performance of Indiana coal for IGCC and identify collaborators.

Suggest strategy for modeling coal performance in IGCC units.

Identify sources for matching funds.

Topic J1 - Indiana University

"Assessment of the Quality of Indiana Coals for IGCC Performance"

CAPABILITIES:

Indiana Geological Survey, IGS, has a demonstrated unique experience with Indiana coals.

Institutional capacity building & data enhancement for IU.

Indiana users and other institutions/companies outside IU will need this coal data.

Awaiting letters of commitment from potential users of the research & confirmation of non university partners. An Australian leading team in coal research has expressed interest in collaboration.

Topic J1 - Indiana University

"Assessment of the Quality of Indiana Coals for IGCC Performance"

WORKPLAN:

Months 1-2, Identifying properties.
Months 3-4, Properties & IGCC performance.
Months 5-6, Identify areas of inadequate data coverage.
Months 7-9, Formulate new analyses.

CCTR Funding $25,360.0, Cost sharing $0.0
Drobniak 25%, Mastalerz 7%, Rupp 2%, Shaffer 2%

ACTION:

CCTR recommends funding.

J2 - Purdue University

"Factors that Affect the Design & Implementation of Clean Coal Technologies in Indiana"

MOTIVATION:

Coal is major fuel for power generation in Indiana & significantly contributes to pollution. Clean Coal Technologies - CCTs - with near zero emissions may be the best solution. Integration of CCT into Indiana power plants - how to minimize costs & investment risk with emerging stricter environmental standards?

What are plausible CCT scenarios/roles for Indiana in next 10 to 20 years? Develop public/private action plan and priorities for vital coal technology research issues.

Two major CCT types:-
(1) IGCC (2) Ultra super critical Pulverized Coal, PC.
Indiana applications:- Power, Fertilizer, Coke, By-products.

J2 - Purdue University

"Factors that Affect the Design & Implementation of Clean Coal Technologies in Indiana"

OBJECTIVES:

How is CCT to be suitably implemented for Indiana electricity Production? Which design options have greatest impact on costs? How effective is CCT in removing current/future environmental Pollutants?

Innovative research needed for assembling all relevant materials in CCT context for Indiana. Assess critical interactions & generate broad CCT scenarios for Indiana. Initiate concise CCT public-private action plan & future critical coal research agenda for Indiana.

Assess options of running multiple gas turbines in parallel each driven by a single gasifier or multiple gasifiers to drive one gas turbine etc. Compile performance comparisons of various gasifiers especially in regard to impact on levels of reliability.

J2 - Purdue University

"Factors that Affect the Design & Implementation of Clean Coal Technologies in Indiana"

Bright future for fertilizer production in Indiana using Indiana coal and gasifiers. 55% of United States nitrogen is imported. What is the most economically efficient use of Indiana coals/resources?

CAPABILITIES:

All participants have substantial & demonstrated experience to undertake this study.

Advisors & consultants - letters of commitment received from:-

- Wabash Power Association
- Illinois Clean Coal Institute
- Indiana Geological Survey
- Coal Teck LLC

J2 - Purdue University

"Factors that Affect the Design & Implementation of Clean Coal Technologies in Indiana"

Purdue's State Utility Forecasting Group work with the IURC brings a 20 year base of experience and knowledge of data sources.

WORKPLAN:

Months 1-3, Indiana characteristics & CCT options.
Months 4-6, Critical interactions & broad scenarios.
Months 7-9, Public-Private Action Plans, Coal Research Priorities.

CCTR Funding $30,000.0, Cost sharing $21,262.0,
Total Cost $51,262.0
Rardin 5%, Yu 17%, Gotham 10%, Holland 10%, Graduate 50%,
Consultants $7,500.0

ACTION: CCTR recommends funding.

K6 - Purdue University Calumet

"Development of Coking/Coal Gasification Concept to Use Indiana Coal for the Production of Metallurgical Coke & Bulk Electric Power"

MOTIVATION:

Concept – to use Indiana coal in a mine mouth environmentally friendly, high efficiency coking/coal gasification facility – to increase supply, reduce costs, & enhance electricity reliability.

At present all of the coal used in the coking process is imported from outside Indiana. The United States has a short-fall of 5.5 MTons/year of coke with high dependence on imports. Prices are high & volatile. This places an enormous strain on Indiana's steel & foundary industries.

This concept will use Indiana coal as main feed stock, provide transportation savings, cogeneration, blending, & storage on site.

K6 - Purdue University Calumet

"Development of Coking/Coal Gasification Concept to Use Indiana Coal for the Production of Metallurgical Coke & Bulk Electric Power"

OBJECTIVES:

Indiana is home to 22% of domestic base steel production for the United States. An international investment of $140 Million for rebuilding aging coke ovens is taking place at Wheeling-Pittsburg Steel Corporation. Indiana coal can become an active participant in this expanding market.

Calumet's use of Computational Fluid Dynamics (CFD) analysis maximizes the value of coke generated from Indiana coals. Comprehensive modeling will determine engineering & chemical parameter values. A proposed detailed follow-on study is to validate the Round 1 results with experimental data.

K6 - Purdue University Calumet

"Development of Coking/Coal Gasification Concept to Use Indiana Coal for the Production of Metallurgical Coke & Bulk Electric Power"

CAPABILITIES:

All participants named in this proposal have substantial & demonstrated experience to undertake this study.

Advisors & consultants (letters of commitment received) are:-

- Mittal Steel
- Solar Sources
- Argonne National Laboratory
- Coal Science Inc
- Indiana Business Modernization & Technology Corp
- Purdue University Calumet faculty & students

K6 - Purdue University Calumet

"Development of Coking/Coal Gasification Concept to Use Indiana Coal for the Production of Metallurgical Coke & Bulk Electric Power"

WORKPLAN:

Months 1-3, Consultations with industrial partners & identify further funds for expanded project.

Months 4-6, Prepare environmental, economic, & policy evaluation reports.

Months 7-10, Evaluate aspects of preliminary modeling results.

CCTR Funding: $29,995.0 Calumet Cost share: $15,463.0

Industrial cost share: $4,000.0 Total cost: $49,458.0

Kramer $17k, Zhou $4k, Abramowitz $4k, Students $4k

Consultants: $5k

ACTION: CCTR recommends funding.

Midwest Coal Research Funding & Fall 2004 Regional Visits

In November & December of 2004 the CCTR staff made regional visits to Illinois, Kentucky and Ohio to meet with coal researchers and senior state administrators.

Discussion took place and continues with organizations including:-

- ◊ Illinois Clean Coal Institute
- ◊ Coal Research Center, Southern Illinois University
- ◊ Office of Coal Development, Illinois
- ◊ Center for Applied Energy Research, University of Kentucky
- ◊ Ohio Coal Development Office

Illinois Coal Funding

Coal Technology Development Assistance Fund

Approximately $25.0 Million from the Coal Technology Development Assistance Fund is appropriated annually for Coal Programs. The fund receives 1/64th of the revenues collected by the Public Utility Sales Tax (plus ½ of the revenues from the Renewable Energy Resources and Coal Technology Assistance Charge).

- Coal Research and Development (Illinois Clean Coal Institute, ICCI) - $3.5 Million annual budget.
- Coal Competitiveness Program - $17.0 Million annual budget.

Coal and Energy Development Bond Fund

Fund provides spending authorization of $683.0 Million for development and construction of coal and energy facilities in Illinois. General Obligation Bonds are sold to finance projects. Repayment of bonds is from the state's general revenues.

- Coal Demonstration Program - $183.0 Million program authorization.
- Coal Revival Program - $500.0 Million program authorization.

Coal Bond Fund

Started in 1982. Spending authorization has grown to $183 Million. Supplied as grants and not required to be paid back. Most of this funding is now used up.

Source of Information: Office of Coal Development - OCD
Illinois Department of Commerce and Economic Opportunity

Kentucky Coal Funding

Coal Tax

Severance tax raises about $200.0 Million per year ~ 4.5% of the sales value of coal. Half of this goes to the coal companies and the other half goes to the State General Fund.

Center for Applied Energy Research, CAER, receives:-

- Direct funds from the University of Kentucky ~ $4.0 Million per year.
- External funds from straight contract awards (not necessarily matching funds), external grants/project awards from companies, federal agencies and the state small business development funds ~ $4.0 Million/year.

Source of Information: Center for Applied Energy and Research – CAER
University of Kentucky

Ohio Coal Funding

Bonding Authority

All OCDO projects funded through constitutionally-authorized Ohio Coal R&D bond fund. Authorized up to $100.0 Million in debt outstanding at any point in time. Bonds paid back from the General Revenue Fund over a 10-year period.

From these funds, each year OCDO supports:-

- The Ohio Coal Research Consortium, receives ~ $1.2 Million/year for ~13+/- projects, at 6 Ohio universities.

- Several multi-year pilot and large-scale demonstration projects, provided ~$10.0 Million/year. Use Ohio funds to leverage contributions from multiple federal and private sources.

Source of Information: Ohio Coal Development Office – OCDO
Ohio Air Quality Development Authority

CCTR Funding Options

(A) Direct appropriation (burden on taxpayer)

(B) Public Utility Tax (burden on all ratepayers)

(C) Electricity Consumption Tax (burden on electricity ratepayers)

(D) Electricity generated from Coal Consumption Tax (burden on electricity ratepayers, adjusted for coal use)

(E) Indiana Coal Production Tax (burden on Indiana coal producers)

(F) Indiana Coal Consumption Tax (burden on Indiana Coal Consumers)

Pros and Cons

- Direct Appropriation:-

  Pro – Since all benefit from economic development, all should pay for it.

  Con - Major beneficiaries should pay, let ripple effects spread out from them.

- Public Utility Tax:-

  Pro - 95% of electricity generated by coal;

  Con - Non-electric utilities pay tax, misses non-utility coal consumption (25% of total).

- Tax on Electricity Consumption:-

  Pro - Better than Public Utility Tax;

  Con - Misses non-utility coal use, taxes electricity generated by other fuels.

Pros and Cons (Cont)

- Tax on Electricity generated from coal (Stilwell Bill):-

  Pro - Better than Tax on Electricity Consumption;

  Con - Misses non electric use of coal.

- Tax on Indiana Coal Production:-

  Pro - Major beneficiary pays;

  Con – Misses tax on imports, making Indiana coals more expensive than imports.

- Tax on Coal consumed in Indiana:-

  Pro - Better than tax on Indiana coal production;

  Con - Commerce clause?