



Energy &
Environmental
Research
Center

Fuels & Process Chemistry Research Institute
Mining & Mineral Resources Research Institute
Combustion & Environmental Systems Research Institute

15 North 23rd Street - Box 8213, University Station / Grand Forks, ND 58202-8213 / Phone: (701) 777-5000 FAX: 777-5181

October 23, 1992

Ms. Karlene Fine, Secretary
North Dakota Industrial Commission
600 East Boulevard Avenue
State Capitol, Ground Floor
Bismarck, North Dakota 58505-0001

Dear Ms. Fine:

RE: EERC PROPOSAL NO. 93-6118, UNSOLICITED PROPOSAL TO THE LIGNITE
ENERGY COUNCIL

Enclosed is an unsolicited proposal concerning a multiple-use marketing of lignite feasibility study for your consideration. We presently have a commitment to the project by the Knife River Coal Mining Company for part of the industrial share, if an agricultural partner can be found. The J.R. Simplot Company of Grand Forks has authorized \$5,000 for this work. We also have a meeting scheduled with American Crystal Sugar personnel. However, \$10,000 in industrial funds are available.

This feasibility study would be a basis from which to determine whether or not the multiple-use concept is valid. My expectation is that this project, if successful, can result in the formation of a unique corporation, owned by the participants, to develop and commercialize the expanded use of lignite.

If you have any questions or would like more details, please contact me at (701) 777-5185.

Sincerely,

Curtis L. Knudson, Ph.D.
Manager, Process Chemistry

CLK/drr

Enclosure

MULTIPLE-USE MARKETING OF LIGNITE
Unsolicited Proposal
October 23, 1992

PROPOSING ORGANIZATION

Energy and Environmental Research Center
University of North Dakota
Box 8213, University Station
Grand Forks, North Dakota 58202

CONTACT PERSON

Curtis L. Knudson
(701) 777-5185

TECHNICAL ABSTRACT

North Dakota lignites are losing out to other coals in our own state. The following proposal concerns a potential multiple-use market and feasibility study to enable reestablishing and creating new niche markets for lignite, such as at the University of North Dakota (UND) and in water treatment.

North Dakota lignites contain ion-exchangeable sodium and slightly too much sulfur. The city water of Grand Forks is quite hard (it contains calcium and magnesium ions). Passage of city feed water through a bed of coal would soften the water (coal sodium would go to the water and water calcium to the coal). Calcium in coal helps retain sulfur in the ash during combustion, reducing the amount of SO_x in the flue gas. Thus a compliance coal could potentially be produced while softening water. Other side benefits may be achieved in that humates (which give drinking water a rotten swamp smell and taste) may also be removed.

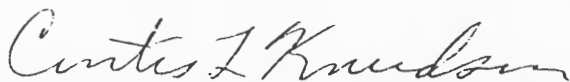
Grand Forks also contains food-processing factories which discharge wastewater containing starches. Starches are an excellent binder for coal when used in the manufacture of briquettes. Removal of starches from wastewater would decrease lagoon odor problems while providing a needed binder for a coal briquette operation. The briquettes would represent a value-added lignite product.

This would be a jointly funded project:


Industrial	\$10,000
North Dakota	10,000
Federal	20,000
<u>Total</u>	<u>\$40,000</u>

with no funds being committed until all the parties are in agreement.

Amount requested from the North Dakota Industrial Commission: \$10,000



Curtis L. Knudson, Ph.D.
Manager, Process Chemistry

 10.23.92

Dr. Kenneth J. Dawes, Director
Office of Research & Program Development

BACKGROUND

The following facts are known:

- ND lignites
 - ▶ Have higher mining costs compared to western compliance subbituminous coals.
 - ▶ Are high in sodium and natural ion-exchange material.
 - ▶ Have sulfur emissions that can exceed 1.2 lb/10⁶ Btu.
- The city of Grand Forks
 - ▶ Has water that, at times, has a humic flavor and smell.
 - ▶ Has hard water, producing scum when combined with soap, thus requiring the use of water softeners or the added use of soap.
- Potato and sugar factories (located in Grand Forks and East Grand Forks) produce potentially odiferous wastewaters.
- Starch is used as a binder in making coal briquettes.
- UND and sugar processing plants burn coal to produce power or steam.

The proposed scenario:

- Lignite is mined in western ND and shipped to Grand Forks.
- Lignite is used to soften and remove undesirable organics from Red River water. This will add calcium to the lignite which will trap sulfur during combustion, making the lignite a compliance coal.
- Calcium-rich lignite can then be burned or used to clean starches and organics from potato plant wastewater.
- Calcium-rich, starch-coated lignite is partially dried and burned locally, or briquetted and marketed.

The result:

- No one user bears the full cost of transport and use of the lignite.
- City feed water is cleaner, and a compliance coal is produced.
- Agricultural processing wastewater streams are cleaner.
- Higher-value coal briquettes are produced which could be exported.
- A cheaper, compliance, ND coal would be available for use at the UND power plant.

OBJECTIVE

The objective of this work is to provide a market feasibility study for the multiple use of lignite in the city of Grand Forks. It is expected that the information developed could be applied to other localities with minimal changes.

STATEMENT OF WORK

This work (depicted in Figure 1) will involve the investigation of a market potential for the multiple use of lignite in city water pretreatment and agricultural processing wastewater treatment to produce a compliance lignite. The work will be composed of the following elements.

Market and Economics - The market for a compliance fuel will be estimated as well as the export potential of briquettes. For instance, the University of North Dakota used 37,243 tons of coal from July 1, 1991, to June 30, 1992. American Crystal Sugar also consumes coal. Costs to purchase and transport the fuels will be determined to provide an acceptable base processing cost to upgrade the lignite. The value of the multiple use on the final compliance fuel will be determined. For instance, the processing cost to produce compliance briquettes could be \$21-\$26/ton. However, the cost of added lime could be \$6/ton and \$5-\$10 for starch binder. The multiple-use cost would then be \$10-\$15/ton for briquettes. The costs of lignite, transportation, and processing would be estimated to determine if the multiple-use concept is feasible.

Drinking Water Clean-up - Feed water to the city of Grand Forks and intermediate treatment streams will be passed over beds of coal. The effects of the lignite treatment will be evaluated as to its influence on processing costs and to the benefits of calcium addition to the lignite.

Agricultural Process Water Treatment - Process water will be contacted with lignite to determine the amount of contaminants removed. The value of lime addition will be evaluated. The benefits of the treatment will be estimated to determine a multiple-use value.

Briquette Potential - Lignite used in water treatment steps will be tested for its potential as a feedstock to a briquette plant. Briquettes (tablets) will be prepared in a hand press and evaluated as to their strength and water resistance.

Compliance Fuel Potential - To determine the ability of the final fuel product to be a compliance fuel, samples will be ashed at different temperatures, and the amount of sulfur retained in the ash will be determined.

PERIOD OF PERFORMANCE

The period of performance will be from December 1, 1992, to March 30, 1993. Monthly reports and a final report will be provided to the funding groups.

Figure 1
Multiple-Use Marketing

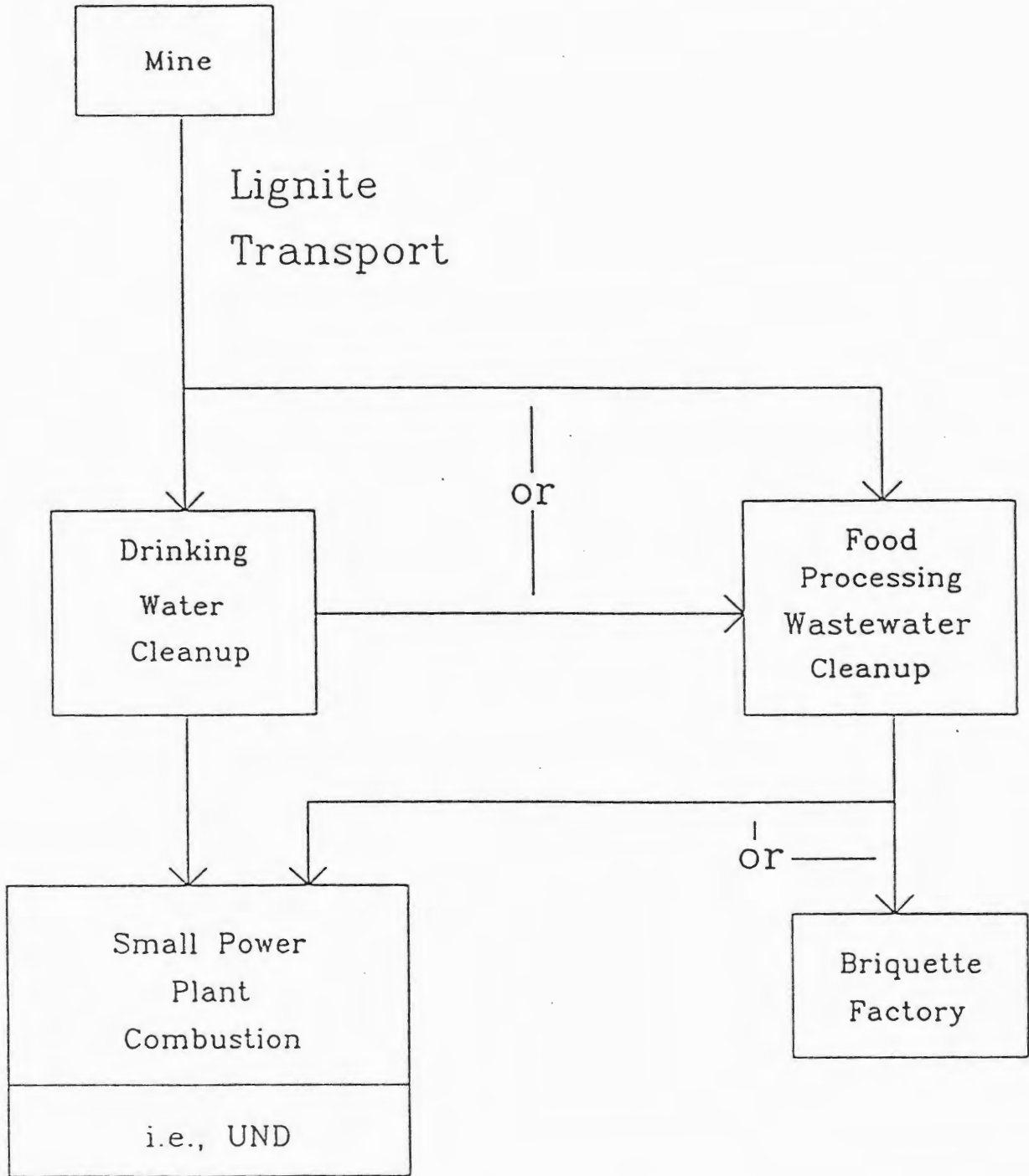


Figure 1. Multiple-use marketing.

COST

The total cost of this study is \$40,000 (see the attached detailed budget) cost shared as follows:

Nonfederal	
Industrial	\$10,000
ND Industrial Commission	10,000
Federal	
Department of Energy	<u>20,000</u>
TOTAL	\$40,000

To fund and make this a viable study, the industrial contribution will be matched by the Industrial Commission, and the nonfederal funds will be matched by the Department of Energy. Knife River Coal Mining Company has indicated that they would support this work (see Attachment 1) at a level of 50% of the industrial funds (verbally). J. R. Simplot has agreed to fund the project for \$5,000 (see Attachment 2), meaning the industrial matching funds are available. Department of Energy funds are being requested. Grand Forks City Water personnel have indicated an interest in this work and would assist in it.

KEY PERSONNEL

Dr. Curtis L. Knudson will act as the Principal Investigator for this effort. He has been involved with low-rank coal research for over 15 years at the Energy and Environmental Research Center. He holds two patents on upgrading low-rank coals and has one patent pending concerning using lignite char in stack-gas cleaning. He is also a co-owner and acts as the bookkeeper for Art & Learn (a retail store) which gives him a fundamental understanding of how a small business operates.

PROPOSER CAPABILITIES

The Energy and Environmental Research Center has established internal laboratories necessary to support this work. Coal analyses will be performed by the Coal Laboratory, and x-ray fluorescence analyses will be done by the Inorganic Laboratory using established ASTM procedures. Capabilities exist to perform BOD analyses, sodium and calcium contents, etc., as needed in the project. Coal drying and briquetting equipment is available to extend the work to the small pilot plant stage if this study is successful. Internal review will be provided by Dr. Michael L. Jones. Accounting and stenographic services are also available.

ATTACHMENT 1
MULTIPLE USES FOR LIGNITE--FEASIBILITY STUDY



KNIFE RIVER

COAL MINING COMPANY

A Subsidiary of MDU Resources Group, Inc.

1915 North Kavaney Drive
Bismarck, ND 58501-1698
(701) 223-1771

Mine Locations:
Beulah, ND
Gascoyne, ND
Savage, MT

October 15, 1992

Curtis L. Knudson, Ph. D.
Manager
Process Chemistry
Energy & Environmental Research Center
Box 8213, University Station
Grand Forks, ND 58202-8213

Dear Curt:

Re: Multiple Uses for Lignite - Feasibility Study

I apologize for not responding more quickly to your letter of September 22, 1992 related to an industry sponsor for your proposal. The matter has finally been discussed within Knife River and a decision made. We would be willing to provide part of the industry support necessary for you to conduct the feasibility study. We would like to see some form of support from the other entities involved, City of Grand Forks or the processor of potatoes or sugar beets.

Preliminary discussion with Cliff Porter, Lignite Research Council, indicates that the project would be able to be reviewed during the next round of proposals that apply for funding from the Industrial Commission. Mr. Porter indicated that there are two dates for the acceptance of applications, October 1 and October 26, 1992.

Should you be able to secure an additional sponsor we would be willing to provide some sponsorship for the project so that it would meet the criteria for matching funds from the Lignite Research Program administered by the Industrial Commission.

Please contact me as soon as you can in regard to this project proposal. Perhaps you can make the October 26, 1992 deadline for application to the Lignite Research Program for matching funding.

Sincerely,

Curtis L. Blohm
Vice President -
Engineering and Environment

ATTACHMENT 2

FOOD GROUP

October 23, 1992

Curtis L. Knudson, Ph. D.
Manager, Process Chemistry
Energy and Environmental Research Center
P.O. Box 8213, University Station
Grand Forks, ND 58202-8213

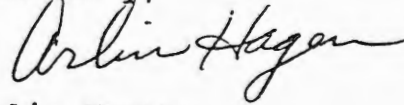
RE: RFP# 1992-7 Lignite Niche
Markets Study

Dear Dr. Knudson:

The concept of your proposal, reference above, is of considerable interest to us in view of the large volumes of wastewater generated by our plant.

I am pleased to inform you that the J.R. Simplot Company, Grand Forks, North Dakota will be an industry sponsor for RFP# 1992-7. Additionally, we agree to provide funding in the amount of five thousand dollars (\$5,000.00) to the project.

Sincerely,



Arlin Hagen,
Director of Plant Operations

NICHE MARKETS STUDY

21-Oct-92 EERC PROPOSAL #93-6118 (NONFEDERAL) & 93-6119 (DOE)

LABOR	LABOR CATEGORY	HOURLY TOTAL			NONFEDERAL SHARE		DOE SHARE	
		RATE	HOURS	\$ COST	HOURS	\$ COST	HOURS	\$ COST
M. JONES	PRINCIPAL SCIENTIST	\$39.66	12	\$476	6	\$238	6	\$238
C. KNUDSON	PRINCIPAL SCIENTIST	\$29.83	160	\$4,773	75	\$2,237	85	\$2,536
R. TIMPE	RES. SCIENTIST III	\$23.81	196	\$4,667	98	\$2,333	98	\$2,334
A. GRISANTI	RES. TECH I	\$11.08	160	\$1,773	75	\$831	85	\$942
D. MOSLEY	RES. TECH I	\$8.46	240	\$2,030	120	\$1,015	120	\$1,015
	-----OFFICE SERVICES	\$8.88	60	\$533	30	\$266	30	\$267
			828	\$14,252	404	\$6,920	424	\$7,332
ESCALATION ABOVE CURRENT BASE			0%	\$0	0%	\$0	0%	\$0
TOTAL DIRECT LABOR				\$14,252		\$6,920		\$7,332
FRINGE BENEFITS - % OF DIRECT LABOR			46%	\$6,556		\$3,183		\$3,373
TOTAL LABOR BASED CHARGES				\$20,808		\$10,103		\$10,705
OTHER DIRECT COSTS								
TRAVEL				\$600		\$300		\$300
GENERAL SUPPLIES AND EQUIPMENT < \$500				\$1,802		\$846		\$956
OTHER								
COMMUNICATION - PHONES AND POSTAGE				\$150		\$75		\$75
OFFICE SUPPLIES, DUPLICATING				\$80		\$60		\$20
DATA PROCESSING				\$94		\$60		\$34
FEES								
GRAPHIC SERVICES @\$24 /HOUR			20	\$480	10	\$240	10	\$240
PROF. STAFF CLERICAL SUPPORT FEE @ \$.62/HR			368	\$228	179	\$111	189	\$117
COAL ANALYSIS LAB				\$968		\$450		\$518
INORGANIC ANALYSIS LAB				\$520		\$250		\$270
ORGANIC ANALYSIS LAB				\$1,600		\$750		\$850
TOTAL OTHER				\$4,120		\$1,996		\$2,124
TOTAL DIRECT COST				\$27,330		\$13,245		\$14,085
INDIRECT COST - % OF MTDC*			VAR.	\$12,670	51.0%	\$6,755	42.0%	\$5,915
TOTAL ESTIMATED COST				\$40,000		\$20,000		\$20,000
				=====		=====		=====

BUDGET NOTES - ENERGY AND ENVIRONMENTAL RESEARCH CENTER

The proposed work would be done on a fixed-price basis.

FRINGE BENEFITS

Fringe benefits are estimated based on historical data. The fringe benefits which will actually be charged consist of two components. The first component covers average vacation, holiday, and sick leave for the EERC. This component will be charged as a percentage of direct labor. The second component covers actual expenses for items such as health and life insurance, social security, UNR retirement, unemployment insurance, and workman's compensation.

INDIRECT COST

The indirect cost rate included in this proposal is the rate which became effective July 1, 1989.

MULTIPLE-USE MARKETING, I

MILESTONE CHART

ACTIVITY	Month -week	1-----				2-----				3-----				4-----			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. Information Collection																	
a. Knife River		xxx	x						x								
b. Simplot			xxx	x					x								
c. Water Dept.				x													
d. Literature				xxxx		x	x	xxxx									
e. Develop Market Data				xx					xx								
2. Experimental																	
a. Coal preparation		x		xxx													
b. Agri water				xx		xxxxxxx											
c. City water				xx		xx											
d. Briquetting										xxxx							
3. Report Preparation																	
a. Coal source, et.						xx											
b. Agri water treatment								xx									
c. City water treatment								xx									
d. Cogeneration use										xx							
e. Ash-concrete potential											xx						
f. Briquetting												xx					
g. Markets				xx						xxxxxxxxx							
4. Reporting																	
a. Monthly		x				x				x				x			
b. Final																xx	

File: M-pr1.wk3, p-2

MULTIPLE-USE MARKETING WORK PLAN ACTIVITIES

12-12-92, CLK

1. INFORMATION COLLECTION

- Set up communications, reporting guidelines with all parties.

a. Consult with Knife River Coal Mining Company
coal source, transport method, quantity available, 1st pass cost

b,c. Consult with J.R. Simplot Company & City water Department
streams to test, quantities, analysis needed
potential savings evaluation
cleaner process water
water recycle value
location for water processing
support analysis they could perform

Potential of CoGeneration
MW, steam needs, value of excess
ash-to-concrete
waste heat-to-coal product drying

d. Develop Information base

Consult with

Dr. E. Sondreal

Dr. M. Jones, and combustion personnel

Dr. B. Young, etc. briquetting

Dr. W. Willson

Dr. S. Benson, ash-concrete needs

Mr. Stan Selle, Combustion consultant

Literature searches and assembly of pertinent papers

Consult with Crystal Sugar

amount, price of waste calcium carbonate

e. Develop Marketing data, size, potential value - direct consultation

on-site use

UND market

value of fuel quality (no packing, dusting), off-site storage

Crystal Sugar

Briquettes

Other

Consult with vendors

- coal prep, water treatment, briquetting, cogeneration

2. EXPERIMENTAL

(see right hand column of concerns)

3. REPORT PREPARATION

- a. Coal source and transportaion
 - b. Agri water treatment
 - c. City water treatment
 - d. Cogeneration use
 - e. Ash-concrete potential
 - f. Briquetting
 - g. Markets
- Summarize
- Transportation and Processing costs
 - Products value
 - Markets
 - What is unknown, whereto.

4. REPORTING

- a. Monthly
- b. Final

File: M-pr1.wk3

GENERAL LAYOUT OF PROJECT CONCERNS

12-12-92, CLK

PROCESSING AND MARKETING

EXPERIMENTAL

Lignite
 Source
 Ash-concrete potential
 Transport to GF
 Quantity-cost
 Handling-storage
 Preparation cost

Lignite
 Preparation
 Size fractions
 -fines
 -particles
 Analysis
 Prox-ult
 Ash Fusion

City water Use |
 Consult-where to best use
 Transport, etc.
 Value
 Water softening
 Organics Removal
 Treatment Methodology
 equipment
 costs

City water Use
 Selected fractions
 water-coal contact
 benefits analysis
 Ca removal
 organics removal
 humic acids removal
 1st-case
 coal/water ratio
 residence time

Agri-Process Water Treatment
 Consult-where to best use
 Transport, etc.
 Value
 Pumping-treatment costs
 water recycle?
 odors decrease
 Treatment Methodology
 equipment
 costs

Agri-Process Water Treatment
 Selected fractions
 water-coal contact
 calcium effect
 benefits analysis
 suspended solids
 BOD
 odors decrease
 1st-case
 coal/water ratio
 residence time

Processed Coal Product Value
 Direct Firing on-site
 CoGeneration plant
 sizing, power-steam needs
 cost estimates

Processed Coal Product Value
 Analysis
 Proximate-Ultimate
 non-coal content
 Ash Fusion
 Ash sulfur retention
 Ash concrete potential

Briquette Production
 Plant sizing
 costs
 product quality
 product value
 Market potential
 on-site
 UND
 Crystal Sugar

Briquette Potential
 Analysis
 tablet strength
 equilibrium moisture
 stability

Pelletizing Potential