EERC
Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
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October 31, 2008

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
ATTN: Renewable Energy Development Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Dear Ms. Fine:

Subject: EERC Proposal No. 2009-0084

Enclosed please find an original and one copy of the proposal entitled "Renewable Oil Refinery Development for Commercialization." Also enclosed is the $100 application fee.

The Energy & Environmental Research Center (EERC) of the University of North Dakota is pleased to submit the subject proposal. The EERC is committed to completing the project as described in this proposal if the Commission makes the requested grant.

If you have any questions regarding this proposal, please contact me by phone at (701) 777-5273, by fax at (701) 777-5181, or by e-mail at cwocken@undeec.org.

Sincerely,

Chad A. Wocken
Research Manager

Approved by:

Dr. Barry I. Milavetz, Associate VP for Research
Research Development and Compliance

CAW/kal

Enclosures

c/enc: Jeff Burgess, NDIC

RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION

EERC Proposal No. 2009-0084

Submitted to:

Karlene Fine

North Dakota Industrial Commission
ATTN: Renewable Energy Development Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Proposal Amount: $500,000

Submitted by:

Chad A. Wocken

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Chad A. Wocken, Project Manager

Dr. Barry I. Milavetz, Associate VP for Research
Research Development and Compliance

October 2008

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RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION

ABSTRACT

The objective of the proposed project is to optimize renewable oil-refining technologies developed by the Energy & Environmental Research Center (EERC) and advance the technologies toward commercialization with North Dakota-grown feedstocks. The primary deliverable of the project is a complete, ready-for-bid design of a pilot-scale renewable oil refinery capable of producing diesel fuel, jet fuel, and naphtha (a light hydrocarbon mixture with applications in production of gasoline blendstocks and chemical intermediates). Following successful project completion, the EERC and Tesoro Corporation will utilize the design as the basis for construction of a pilot plant at the Tesoro petroleum refinery in Mandan, North Dakota. Tesoro is interested in operating and maintaining a renewable oil refinery, producing specification-compliant renewable fuels and chemical products, and distributing them through existing Tesoro infrastructure and marketing networks.

The project period of performance is July 1, 2009, through June 30, 2010, and project cost is estimated at $1,000,000, with $500,000 requested from the North Dakota Industrial Commission Renewable Energy Development Fund and $500,000 to be allocated from the U.S. Department of Energy-sponsored EERC Center for Biomass Utilization® Program. The EERC will conduct the proposed effort in close coordination with Tesoro and UniField Engineering, Tesoro Mandan's engineering firm of choice. Fuel samples will be produced and submitted to the U.S. Air Force Research Laboratory at Wright–Patterson Air Force Base for evaluation. The North Dakota State University Carrington Research Extension Center will assist in feedstock development and evaluation. 3M Company is interested in chemicals made from renewable oil and will work with the EERC in evaluating refinery chemical coproducts for 3M Company applications.

RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION

PROJECT DESCRIPTION

Introduction

The University of North Dakota Energy & Environmental Research Center (EERC) was awarded a contract by the Defense Advanced Research Projects Agency (DARPA) to develop a technology pathway for converting crop oil to jet fuel. Activities conducted within that project led to the development of a unique technology pathway that economically converts renewable triacylglycerides (TAGs) including crop oils, algal oils, and animal fats to a liquid hydrocarbon stream that is further refined to produce a jet fuel identical in physical and chemical characteristics to petroleum-derived military and commercial jet fuel (JP-8 and Jet A1, respectively). In addition to jet fuel, other products include diesel fuel and a naphtha stream suitable for use in the production of a variety of chemicals.

Unique from traditional transesterification-based biodiesel technologies, the EERC technology yields a hydrocarbon-only (oxygen-free) diesel fuel with cold flow, stability, and energy density characteristics similar to or more advantageous than those of petroleum diesel. Another advantage of EERC technology for renewable oil refining is the absence of trace metal and sulfur contaminants that are present in petroleum crude oils. The absence of sulfur eliminates the need for costly processing steps required to remove it from typical petroleum-derived fuels.

Although jet fuel has been the primary focus of the DARPA effort, the hydrocarbon produced from TAG feedstock comprises the basic building blocks for a variety of fuels and petrochemical intermediates and products. Through the use of integrated unit operations including separations and thermocatalytic reactions, products including naphtha, gasoline blendstocks, aromatics, olefins, and branched and cyclic paraffins can be produced. Research activities conducted by the EERC have resulted in the production of varying quantities of all of these materials; however, further optimization will be required to support the

level of detail required for completion of a biddable design for a renewable oil refinery pilot plant, the primary deliverable of this proposed project.

Feedstock is an important factor in both the technical and economic viability of a commercial renewable oil refinery. Crop oils that have been tested and processed by the EERC into renewable hydrocarbon products include soybean oil, canola oil, cuphea oil, coconut oil, and waste grease. These feedstocks represent the range of what comprises typical TAG and were all processed similarly with similar performance results. Under the proposed project, the EERC will economically optimize and specifically tailor processes for producing fuels and chemicals from North Dakota-cultivable feedstocks such as soybean and canola oil and work with the North Dakota State University Carrington Research Extension Center (CREC) to evaluate other crops including crambe, which offers chemical property advantages as a feedstock for diesel fuel.

Objective

The goal of the proposed project is to advance EERC renewable oil-refining technologies for commercialization with North Dakota feedstocks. A complete pilot-scale renewable oil refinery design, will be the final deliverable of the proposed project. As a follow-on to the proposed project, the EERC and Tesoro plan to evaluate options for building and operating a pilot plant at the Tesoro Mandan refinery. Tesoro is interested in producing and distributing specification-compliant renewable fuels and chemicals through existing Tesoro infrastructure and marketing networks.

Methodology

The proposed project will focus on three primary work areas:

1) Tailoring EERC technologies for optimum efficiency conversion of North Dakota feedstocks to fuels and chemicals, with the primary objective of generating data and information needed to support development of a renewable oil refinery design.

2) Assessing the economic viability of a renewable oil refinery based on feedstock availability and cost, energy input requirements, projected commercial-scale capital and operating costs, and product and coproduct values and markets.

3) Developing a bid-ready design for a pilot-scale renewable oil refinery.

Task 1 – Technology Tailoring for North Dakota Feedstocks. To support development of a pilot-scale renewable oil refinery design, the EERC will optimally tailor EERC-developed refining processes for use in converting North Dakota feedstocks to diesel and jet fuel, naphtha (a light [volatile] material used for production of gasoline blendstocks and polymer feedstocks), and other hydrocarbon products including chemical intermediates. Operational data generated during feedstock-specific process optimization activities will be used as the basis for development of a pilot-scale renewable oil refinery design. Product-specific activities are described below.

Jet Fuel Development. EERC jet fuel technologies will be optimally tailored for at least two selected North Dakota feedstock oils, and a 2-gallon jet fuel sample will be produced from each feedstock. The samples will be submitted to the U.S. Air Force Research Laboratory (AFRL) at Wright–Patterson Air Force Base for evaluation based on fuel property requirements delineated in U.S. military jet fuel specifications MIL-DTL83133E and/or MIL-DTL 83133F.

Diesel Fuel Sample Production. Five-gallon diesel fuel samples will be produced from at least two North Dakota feedstock oils including crambe oil, which has a unique fatty acid profile that may translate to a significant fuel yield-based economic advantage versus other oils with more traditional fatty acid profiles. Samples will be submitted to AFRL and/or another lab capable of performing full diesel fuel specification compliance testing. Additionally, the EERC will arrange the evaluation of at least one fuel sample via combustion tests on a diesel engine equipped to measure fuel performance and emission parameters. Preliminary discussions have occurred with Caterpillar, Cenco International, and the University of Minnesota, all of whom have indicated they could provide static engine tests to evaluate

diesel fuel performance. A fuel sample of approximately 25 gallons will be produced to accommodate these tests.

In developing a process for diesel fuel production from crambe oil, the EERC will utilize oil supplied by CREC. If, as expected, process development tests indicate that the unique fatty acid chemistry of crambe oil translates into a significant economic advantage in diesel fuel production, CREC will develop a strategy to regenerate and expand the once-thriving North Dakota crambe industry. Execution of this strategy will commence prior to the 2009 growing season, which will enable initiation of seed supply generation for future crops and ensure availability of sufficient quantities of crambe oil for larger-scale fuel process development and optimization activities.

Naphtha Sample Production. Naphtha is a coproduct of diesel and jet fuel production and comprises molecules with a carbon chain length ranging from about C4 to C8. Naphtha has applications as a feedstock for the production of gasoline, fertilizer, and olefins used in production of polymers and other chemical products. 3M Company is interested in chemical products made from renewable naphtha. The EERC will work with 3M Company to evaluate the suitability of renewable naphtha as feedstock for generating products that meet 3M Company requirements.

Task 2 – Renewable Oil Refinery Economic Assessment. The EERC will conduct a preliminary economic assessment of a full-scale refinery. Key outputs of the economic assessment will be estimated end-to-end costs of commercial-scale production of fuels and chemicals from North Dakota renewable feedstocks. The assessment will address feedstock cost and availability, capital equipment costs, operating and maintenance costs, and financing scenarios. This economic assessment, coupled with a pilot plant design, will form the basis for subsequent commercialization efforts leading to a full-scale commercial North Dakota renewable oil refinery.

Task 3 – Renewable Oil Refinery Pilot Plant Design. The EERC has developed a preliminary pilot plant design as part of the previous DARPA effort. The purpose of Task 3 is to—in cooperation with UniField Engineering (Tesoro Mandan's engineering firm of choice)—leverage that preliminary design in

development of a comprehensive design package that can be released for bid solicitation. UniField has an ongoing relationship with Tesoro Mandan and has provided engineering services to Tesoro for more than 20 years. UniField is ideally positioned to support the EERC effort directed toward constructing a pilot plant for integration into the Tesoro Mandan operation and would be a subcontractor to the EERC focused on completing the pilot plant design.

Anticipated Results/Impact

Building upon EERC experience and success in renewable jet and diesel fuel production, the proposed effort will optimize refinery process conditions with a focus on providing the necessary inputs, both technical and economic, for development of a ready-for-bid pilot plant design. It is anticipated that by completing the proposed activities, commercial investment will occur to construct a pilot scale renewable oil refinery in North Dakota. The construction and operation of this first-of-a-kind pilot-scale refinery will prove the technical and economic viability of the technology and enable further investment in full-scale renewable oil refineries in North Dakota and around the world.

Facilities, Resources, and Techniques

The EERC is equipped with the facilities required for effective and efficient performance of the proposed project. Experimental work will be conducted at the EERC in continuous reactor systems ranging in size from 5–500 mL/min and batch reactor systems with volumes between 250 mL – 8 liters. Liquid and gas samples will be analyzed with Agilent gas chromatography–mass spectrometry and high-performance liquid chromatography systems and an online Fourier-transform infrared gas analysis system.

Environmental and Economic Impacts of Under-Way Project

The renewable fuels and chemicals process development efforts will comprise laboratory-scale experimental activities with minimal environmental impacts. All emissions from experimental activities are vented to a thermal oxidizer, permitted for use by the State of North Dakota Department of Health under the EERC's Air Pollution Control Minor Source Permit to Operate. Aqueous solutions containing

off-specification hydrocarbon is collected in the lab and managed by the University of North Dakota Hazardous Waste Management System.

Ultimate Project Technologic and Economic Impacts

The commercial application of the proposed renewable oil refinery has the potential to compete economically with petroleum-derived fuels and chemicals and simultaneously develop a new renewable hydrocarbon industry that supports domestic and local agriculture, reduces carbon emissions, and improves energy security. It is estimated that a 50-million-gallon/year renewable oil refinery would create a demand for 500,000 to 1,000,000 acres of crambe and other oil seed crops based on typical North Dakota yields. Additionally, if successfully demonstrated, there is enormous market potential to build subsequent full-scale (greater than 50-million-gallon/year) plants in North Dakota and worldwide with estimated local economic impacts of greater than $50 million annually, 40 direct jobs, and up to 600 indirect jobs.

Project Need

The proposed project directly addresses these critical needs:

- A truly “drop-in-compatible” renewable alternative to petroleum-derived jet fuel.
- A renewable diesel fuel with energy content, cold-flow performance, and stability similar, or superior, to petroleum diesel.
- Increased market for North Dakota agricultural products.
- A sustainable market for crops suited for areas of North Dakota with shorter growing seasons, arid conditions, and suboptimal soil conditions.
- Rural economic development opportunities.
- Increased refined product (fuel) capacity.

STANDARDS OF SUCCESS

The proposed effort provides the next step necessary to commercialize EERC renewable oil-refining technology and support renewable fuel production in North Dakota. Success in the proposed project will

be achieved with the completion of a design for the pilot-scale renewable oil refinery. The EERC will utilize project results and the process design to develop commercial opportunities, specifically, the construction of both pilot-scale and full-scale renewable oil refinery operations in North Dakota using feedstock grown by North Dakota farmers.

BACKGROUND AND QUALIFICATIONS

In partnership with regional oil seed grower associations and the U.S. Department of Energy, the EERC initiated the development of a thermocatalytic process for conversion of soybean and canola oils to jet fuel. This research effort was motivated by results of prior EERC work done in collaboration with the U.S. AFRL–Fuels Branch, Wright–Patterson Air Force Base in which soy methyl ester biodiesel was mixed with JP-8 and evaluated for performance and emission impacts using the AFRL T63-A-700 turboshaft engine test stand. Results of this work were published in the July 2005 issue of the *Journal of the Air & Waste* ***Management Association.***

Key findings include that while biodiesel addition to jet fuel can yield a significant particulate emission benefit at high-power settings, it can also result in significant negative impacts on fuel freeze point and other key properties. Based on these findings, the EERC developed a catalytic process for converting vegetable oils to fuels with improved cold-flow performance. This work led to the DARPA-funded project that developed and optimized technologies for converting renewable oils into fuels and chemicals.

The key personnel for the proposed effort have extensive experience in the area of renewable fuel production. Chad A. Wocken, EERC Research Manager, has 14 years of experience in process engineering and project management and specific expertise in fuel chemistry and renewable fuel production. Mr. Wocken holds a B.S. in chemical engineering from the University of North Dakota (UND). Ted R. Aulich, EERC Senior Research Manager, has expertise in fuel chemistry, fuels analysis, analytical program management, data reduction, and reporting. In addition, he has authored numerous publications on fuel chemistry and environmental effects, waste plastics decomposition for recycling, and

coal conversion. He received his B.S. in Chemistry from UND and his B.A. in Biology from St. Thomas College in St. Paul. Dr. Paul D. Pansegrau, EERC Research Scientist, focuses on process chemistry and chemical synthesis related to developing advanced catalytic technology and thermochemical conversion technologies for coal and other hydrocarbons such as biomass to fuels and chemicals. He holds a B.S. in Chemistry from UND and a Ph.D. from Colorado State University and was a postdoctoral fellow at Ohio State University.

UniField Engineering is a wholly owned subsidiary of WorleyParson, Ltd., an international engineering and professional services firm with expertise in hydrocarbons, power generation, and infrastructure possessing staff of 25,000 worldwide. Regionally, UniField has offices in Bismarck, North Dakota, and Billings, Montana, and specific expertise and knowledge of Tesoro's Mandan refinery. UniField will work under subcontract to the EERC to complete a pilot plant design scaled for operation at Tesoro's Mandan refinery and capable of continuous operation. UniField's expertise in scale-up, cost estimating, and scheduling will be a benefit to the program in projecting capital and operating costs for full-scale units and integrated facilities.

MANAGEMENT

The EERC with its management team has a proven track record in managing projects for federal agencies, state entities, and commercial partners. To support successful execution of the proposed project, a budget-tracking system was developed that allows for task-level management of the project. Project costs are tracked and reported on a monthly basis reflecting labor, subcontract, and other project costs relative to project budget.

TIMETABLE

The period of performance for the proposed effort is July 1, 2009 – June 30, 2010. Tables 1 and 2 provide a comprehensive project schedule and outline tasks, milestones, and deliverables. All timetable assumptions are based on the proposed period of performance. Project deliverables will include interim

Table 1. Timetable by Task

Task	Task Description	Work Schedule by Quarters 1	2	3	4
Task 1	R&D of renewable fuels and chemicals				
Task 1.1	Jet fuel process development				
Task 1.2	Diesel fuel process development				
Task 1.3	Naphtha process development				
Task 2	Renewable oil refinery economic assessment				
Task 3	Biorefinery pilot plant design				

Table 2. Timetable by Deliverables

Deliverable	Work Schedule by Quarters 1	2	3	4
Interim Quarterly Report	*	*	*	
Special Report: Renewable Oil Refinery Economic Assessment			*	
Biorefinery Pilot Plant Design				*
Final Report				*

quarterly reports, a renewable oil refinery economic assessment special report, a pilot plant design biddable package, and a final report.

BUDGET

The total project cost is $1,000,000, with $500,000 requested from the North Dakota Industrial Commission Renewable Energy Development Fund and $500,000 to be allocated from the U.S. Department of Energy-sponsored EERC Center for Biomass Utilization® program. A detailed budget is included with budget notes for reference.

TAX LIABILITY

The EERC is part of UND, a tax-exempt entity.

CONFIDENTIAL INFORMATION

There is no confidential information contained in this proposal.

PATENTS AND RIGHTS TO TECHNICAL DATA

Intellectual Property Rights, Technical Data, or Patents to Be Used with Restrictions
IP 07-004 – Optimal Energy Pathway to Renewable Domestic and Other Fuels, U.S. Patent Application 11/840,191 and all corresponding foreign patent applications
IP 07-012 – Methods and Processes for Producing Aviation-Grade Kerosene from Base Blendstocks
IP 07-032 – Chain-Selective Synthesis of Fuel Components and Chemical Intermediates
IP 07-034 – Aviation-Grade Kerosene from Independently Produced Blendstocks, U.S. Patent Application 12/147,783 and all corresponding foreign patent applications
IP 08-019 – Process for the Conversion of Renewable Oils to Liquid Transportation Fuels
IP 09-001 – Hydrotreatment of Pyrolysis Products to Hydrocarbons
All intellectual property created under and related to U.S. Army CERL Contract number (W9132T-05-2-0024)
All intellectual property created under and related to U.S. Army CERL Contract number (W9132T-08-2-0014)
All intellectual property created under and related to U.S. Army Contract number (W911NF-07-c-0046)

APPENDIX A

BUDGET AND BUDGET NOTES

RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION
NDIC RENEWABLE ENERGY DEVELOPMENT
PROPOSED PROJECT START DATE: 7/1/09
EERC PROPOSAL #2009-0084

BUDGET

CATEGORY		TOTAL			NDIC SHARE		CBU SHARE	
LABOR		Rate	Hrs	Cost	Hrs	Cost	Hrs	Cost
Wocken, C.	Project Manager	$ 44.92	675	$ 30,321	300	$ 13,476	375	$ 16,845
Aulich, T.	Principal Investigator	$ 51.23	670	$ 34,324	300	$ 15,369	370	$ 18,955
Pansegrau, P.	Principal Investigator	$ 52.49	670	$ 35,168	300	$ 15,747	370	$ 19,421
----------	Senior Management	$ 65.65	211	$ 13,852	-	$ -	211	$ 13,852
----------	Research Scientist/Engineer	$ 36.27	2,258	$ 81,898	-	$ -	2,258	$ 81,898
----------	Research Technician	$ 23.45	650	$ 15,243	77	$ 1,806	573	$ 13,437
----------	Technology Dev. Mech.	$ 28.55	250	$ 7,138	-	$ -	250	$ 7,138
----------	Technical Support Services	$ 19.31	100	$ 1,931	30	$ 579	70	$ 1,352
				$ 219,875		$ 46,977		$ 172,898
Escalation Above Base		5%		$ 10,994		$ 2,349		$ 8,645
TOTAL DIRECT HRS/SALARIES			5,484	$ 230,869	1,007	$ 49,326	4,477	$ 181,543
Fringe Benefits - % of Direct Labor - Staff		53.3%		$ 123,053		$ 26,291		$ 96,762
TOTAL FRINGE BENEFITS				$ 123,053		$ 26,291		$ 96,762
TOTAL LABOR				$ 353,922		$ 75,617		$ 278,305
OTHER DIRECT COSTS								
TRAVEL				$ 2,971		$ -		$ 2,971
SUPPLIES				$ 60,643		$ 38,808		$ 21,835
SUBCONTRACT – Unifield Engineering				$ 300,000		$ 300,000		$ -
COMMUNICATION - PHONES & POSTAGE				$ 2,000		$ 150		$ 1,850
PRINTING & DUPLICATING				$ 1,516		$ 150		$ 1,366
FOOD				$ 900		$ 900		$ -
OPERATING FEES & SVCS								
Process Chem. & Dev. Lab.				$ 16,884		$ -		$ 16,884
Graphics Support				$ 5,786		$ -		$ 5,786
Shop & Operations Support				$ 336		$ -		$ 336
Outside Lab.				$ 2,500		$ -		$ 2,500
Freight				$ 1,500		$ -		$ 1,500
TOTAL DIRECT COST				$ 748,958		$ 415,625		$ 333,333
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	$ 251,042	60%	$ 84,375	50%	$ 166,667
TOTAL PROJECT COST				$ 1,000,000		$ 500,000		$ 500,000

Due to limitations within the University's accounting system, bolded budget line items represent how the University proposes, reports and accounts for expenses. Supplementary budget information, if provided, is for proposal evaluation.

RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION
EERC PROPOSAL #2009-0084

BUDGET - TRAVEL

RATES USED TO CALCULATE ESTIMATED TRAVEL EXPENSES			
DESTINATION	PER MILE	LODGING	PER DIEM
Bismarck, ND	$ 0.33	$ 60	$ 25

PURPOSE/DESTINATION	NUMBER OF TRIPS	PEOPLE	MILES	DAYS	MILEAGE	LODGING	PER DIEM	MISC.	TOTAL
Site Visit/Bismarck, ND	4	4	675	2	$ 891	$ 960	$ 800	$ 320	$ 2,971
TOTAL ESTIMATED TRAVEL									$ 2,971

RENEWABLE OIL REFINERY DEVELOPMENT FOR COMMERCIALIZATION
EERC PROPOSAL #2009-0084

DETAILED BUDGET - EERC RECHARGE CENTERS

			TOTAL
Process Chemistry. & Dev. Lab.	Rate	#	$Cost
CHN (Sample)	$89	100	$ 8,900
Miscellaneous	$61	100	$ 6,100
Lab Use Rate (per day)	$9	120	$ 1,080
Subtotal			$ 16,080
Escalation		5%	$ 804
Total Process Chemistry & Dev. Lab.			$ 16,884
Graphics Support	Rate	#	$Cost
Graphics (hourly)	$58	95	$ 5,510
Subtotal			$ 5,510
Escalation		5%	$ 276
Total Graphics Support			$ 5,786
Shop & Operations Support	Rate	#	$Cost
Technical Development Hours	$1.28	250	$ 320
Subtotal			$ 320
Escalation		5%	$ 16
Total Shop & Operations Support			$ 336

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

BACKGROUND

The EERC is an independently organized multidisciplinary research center within the University of North Dakota (UND). The EERC receives no appropriated funding from the state of North Dakota and is funded through federal and nonfederal grants, contracts, and other agreements. Although the EERC is not affiliated with any one academic department, university faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

INTELLECTUAL PROPERTY

If federal funding is proposed as part of this project, the applicable federal intellectual property (IP) regulations may govern any resulting research agreement. In addition, in the event that IP with the potential to generate revenue to which the EERC is entitled is developed under this agreement, such IP, including rights, title, interest, and obligations, may be transferred to the EERC Foundation, a separate legal entity.

BUDGET INFORMATION

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, etc.) is for planning purposes only. The project manager may, as dictated by the needs of the work, incur costs in accordance with Office of Management and Budget (OMB) Circular A-21 found at www.whitehouse.gov/omb/circulars. If the Scope of Work (by task, if applicable) encompasses research activities which may be funded by one or more sponsors, then allowable project costs may be allocated at the Scope of Work or task level, as appropriate, to any or all of the funding sources. Financial reporting will be at the total-agreement level.

Escalation of labor and EERC recharge center rates is incorporated into the budget when a project's duration extends beyond the current fiscal year. Escalation is calculated by prorating an average annual increase over the anticipated life of the project.

The cost of this project is based on a specific start date indicated at the top of the EERC budget. Any delay in the start of this project may result in a budget increase. Budget category descriptions presented below are for informational purposes; some categories may not appear in the budget.

Salaries: The EERC employs administrative staff to provide required services for various direct and indirect support functions. Salary estimates are based on the scope of work and prior experience on projects of similar scope. The labor rate used for specifically identified personnel is the current hourly rate for that individual. The labor category rate is the current average rate of a personnel group with a similar job description. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project will be paid an amount over their normal base salary, creating an overload which is subject to limitation in accordance with university policy. Costs for general support services such as contracts and intellectual property, accounting, human resources, purchasing, shipping/receiving, and clerical support of these functions are included in the EERC facilities and administrative cost rate.

Fringe Benefits: Fringe benefits consist of two components which are budgeted as a percentage of direct labor. The first component is a fixed percentage approved annually by the UND cognizant audit agency, the Department of Health and Human Services, and covers vacation, holiday, and sick leave (VSL). This percentage is applied to direct labor for permanent staff eligible for VSL benefits. The second component is estimated on the basis of historical data and is charged as actual expenses for items such as health, life, and unemployment insurance; social security; worker's compensation; and UND retirement contributions.

Travel: Travel is estimated on the basis of UND travel policies which can be found at www.und.edu/dept/accounts/policiesandprocedures.html. Estimates include General Services Administration (GSA) daily meal rates. Travel may include site visits, field work, meetings, and conference participation as indicated by the scope of work and/or budget.

Equipment: If equipment is budgeted, it is discussed in the text of the proposal and/or identified more specifically in the accompanying budget detail.

Supplies – Professional, Information Technology, and Miscellaneous: Supply and material estimates are based on prior experience and may include chemicals, gases, glassware, nuts, bolts, and piping. Computer supplies may include data storage, paper, memory, software, and toner cartridges. Maps, sample containers, minor equipment, signage, and safety supplies may be necessary as well as other organizational materials such as subscriptions, books, and reference materials. General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the facilities and administrative cost.

Subcontracts/Subrecipients: Not applicable.

Professional Fees/Services (consultants): Not applicable.

Other Direct Costs

Communications and Postage: Telephone, cell phone, and fax line charges are generally included in the facilities and administrative cost. Direct project costs may include line charges at remote locations, long-distance telephone, postage, and other data or document transportation costs.

Printing and Duplicating: Photocopy estimates are based on prior experience with similar projects. Page rates for various photocopiers are established annually by the university's duplicating center.

Food: Food expenditures for project meetings, workshops, and conferences where the primary purpose is dissemination of technical information may include costs of food, some of which may exceed the institutional limit.

Professional Development: Fees are for memberships in technical areas directly related to work on this project. Technical journals and newsletters received as a result of a membership are used throughout development and execution of the project by the research team.

Fees and Services – EERC Recharge Centers, Outside Labs, Freight: EERC recharge center rates for laboratory, analytical, graphics, and shop/operation fees are anticipated to be approved for use beginning July 1, 2008. Only the actual approved rates will be charged to the project.

Laboratory and analytical fees are charged on a per sample, hourly, or daily rate, depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the university when necessary.

Graphics fees are based on an established per hour rate for production of such items as report figures, posters, and/or PowerPoint images for presentations, maps, schematics, Web site design, professional brochures, and photographs.

Shop and operation fees are for expenses directly associated with the operation of the pilot plant facility. These fees cover such items as training, personal safety (protective eyeglasses, boots, gloves), and physicals for pilot plant and shop personnel.

Freight expenditures generally occur for outgoing items and field sample shipments.

Facilities and Administrative Cost: Facilities and administrative cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of $5000 and subawards in excess of the first $25,000 for each award. The EERC Facilities and Administrative rate for commercial entities as proposed in this budget is 60%. The components are as follows: the approved federal rate is 50%; added to the federal rate is an increment of 10%. This increment represents calculated costs that exceed the allowable 26% federal cap on Administrative costs as well as depreciation/use allowance on buildings and equipment purchased with federal dollars.

APPENDIX B

LETTER OF COMMITMENT

EERC
Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
15 North 23rd Street — Stop 9018 / Grand Forks, ND 58202-9018 / Phone: (701) 777-5000 Fax: 777-5181
Web Site: www.undeerc.org

October 31, 2008

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Dear Ms. Fine:

Subject: North Dakota Renewable Energy Council Application

This letter is in regard to the cost share provided by the Energy & Environmental Research Center (EERC) for "Renewable Oil Refinery Development for Commercialization", as proposed to the North Dakota Renewable Energy Council. The EERC will provide a 50% match of $500,000, contingent on award from the 2009 U.S. Department of Energy (DOE)-sponsored Center for Biomass Utilization® (CBU®). Availability of CBU funding is expected in early 2009 with awards sent Fall 2009; likelihood of funding is very strong, as the EERC has been receiving CBU program awards from DOE for 9 consecutive years.

If you have any further questions, please contact me by phone at (701) 777-5123 or by e-mail at czygarlicke@undeerc.org.

Sincerely,

Chris J. Zygarlicke
Deputy Associate Director for Research

CJZ/kal

APPENDIX C

LETTERS OF SUPPORT

John M. Horn **3M Industrial and Transportation Business**
Executive Director
Research and Development

3M Center, Building 220-7E-06
St. Paul, MN 55144-1000
651 733 3070 Office
651 733 8827 Fax
jmhorn@mmm.com

3M

October 30, 2008

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
ATTN: Renewable Energy Development Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Dear Ms. Fine

Subject EERC Proposal No. 2009-0084

3M Company wishes to voice support of the proposal provided to you by the Energy and Environmental Research Center at the University of North Dakota. While the bulk of the proposal focuses in the production of diesel fuel from renewable (crop) resources, the generation of renewable byproducts valuable for the production of renewable plastics and consumer goods is important to 3M Company.

3M Company, as you may realize, is a world leader in the production of technology-based products that enhance the day-to-day lives of people. We also have an industry-leading track record of commitment to the environment and sustainable development. Many of the products 3M Company produces are based in polymer technology, which relies upon petroleum as a feedstock source. 3M Company wishes to examine the potential polymer feedstocks that will be produced in order to determine their suitability for ultimately producing carbon-neutral, bio-based plastics and consumer goods. We believe that alternate, bio-based feedstocks for materials are important to ensure supply security and sustainable business in the future.

In addition, 3M Company believes in the future of renewable energy as evicenced by the formation of a Renewable Energy Division within 3M Company. Efforts such as those proposed by the Energy and Environmental Research Center at the University of North Dakota will help to accelerate the development of renewable fuels and energy, creating a vibrant new market with opportunities for the private sector.

For the reasons stated above we voice strong support of this proposal. *

Sincerely,

John M. Horn
Executive Director
Research and Development
Industrial and Transportation Business
3M Center, 220-7E-06
St. Paul, MN 55144-1000

* This letter is provided solely for the purpose of supporting NDREDP proposal # 2009-0084.

NDSU **North Dakota State University**

Carrington Research Extension Center

North Dakota Agricultural Experiment Station
663 Hwy. 281 North, P.O. Box 219
Carrington, ND 58421-0219

701.652.2951
Fax 701.652.2055
NDSU.Carrington.rec@ndsu.edu
www.ag.ndsu.nodak.edu/carringt/

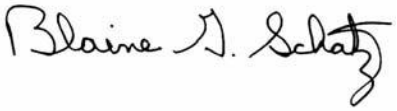
October 28, 2008

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
ATTN: Renewable Energy Development Program
600 East Boulevard Avenue
State Capitol – Fourteenth Floor
Bismarck, ND 58505

Dear Ms. Fine:

Our mission at North Dakota State University Carrington Research Extension Center (CREC) is to enhance the productivity, competitiveness, and diversity of North Dakota agriculture. The objectives of our research and extension mission are very much aligned with the objectives delineated in the proposal "Renewable Oil Refinery Development for Commercialization." Based on these common goals I wish to indicate support for this proposal. I'm especially encouraged by the emphasis on utilization of crambe oil as a key refinery feedstock. The CREC played a major role in establishing crambe as a viable North Dakota crop alternative in the 1990's. We identified crambe as a biologically diverse crop with many agronomic benefits and a high level of farmer acceptance. Success in the proposed project would rebuild, expand and sustain the once-thriving North Dakota crambe market and strengthen markets for other North Dakota oilseeds. It is noteworthy to indicate that the previous crambe market in North Dakota in the 1990's was eliminated due to a restructuring of European Union crop subsidy programs. We are committed to helping assure the long-term availability of renewable oil at the price and capacity needed to support the feedstock requirements of a new North Dakota renewable oil refining industry, and request your support to make it happen.

Sincerely,



Blaine G. Schatz
Director/Agronomist