

# Technical Reviewers' Rating Summary

Proposal Number  Application Title  Submitted By   
 Energy & Environment Request For  Total Project Costs

## Section A. Scoring

Statement	Weighting Factor	G-024-004	G-024-005	G-024-006	Average Weighted Score
1. Objectives	9	4	4	4	36
2. Achievability	7	4	4	2	21
3. Methodology	8	4	4	2	24
4. Contribution	8	4	3	3	24
5. Awareness / Background	5	3	3	3	15
6. Project Management	3	4	3	2	9
7. Equipment / Facilities	2	3	4	4	6
8. Value / Industry - Budget	4	4	4	4	16
9. Financial Match - Budget	4	3	4	4	12
<b>Average Weighted Score</b>		<b>189</b>	<b>184</b>	<b>151</b>	<b>174</b>
Total: 50					<b>250 possible points</b>

## OVERALL RECOMMENDATION

FUND	<b>X</b>	<b>X</b>	
FUNDING TO BE CONSIDERED			<b>X</b>
DO NOT FUND			

## Section B. Ratings and Comments

- The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Oil and Gas Research Council goals are:

Good focus of project.  
 - Reviewer: G-024-004  
 - Rating: 4

The proposed project's objective is clear and understood.  
 - Reviewer: G-024-005  
 - Rating: 4

The objectives of the proposed project clearly match the Statutory Goals & Purposes of the NDIC OGRC (found here: <http://www.nd.gov/ndic/ogrp/info/ogrcgoals.pdf>). The project touches on all five of the OGRC goals, primarily focusing on the use of new technologies and the promotion of economic and environmentally friendly utilization of wellhead gas. Although the project objectives are in line with the OGRC goals, the noticeable weakness is the lack of commitment to demonstrate capturing wellhead gas, transporting to a drilling location and using as bi-fuel diesel power. The objective simply states that it will provide producers with a compelling technical evaluation of gas-fired bi-fuel using Bakken gas.

- Reviewer: G-024-006

- Rating: 4

The objectives are consistent with the NDIC/OGRC goals as stated by the reviewers. A weakness in commitment is suggested. Continental Resources and Bakken Express are committed to the scope of work as proposed. The partners understand the financial obligations moving forward.

- Applicant

2. With the approach suggested and time and budget available, the objectives are:

Project assembles team of resources to get the job done.

- Reviewer: G-024-004

- Rating: 4

The four milestone activities of this project are obtainable in the timeline provided. I do not see any concern on delivery of each milestone based on the methodology presented.

- Reviewer: G-024-005

- Rating: 4

The EERC proposal did not provide ample scheduling and engineering detail to fully comment on its ability to complete the project within the stated time and budget. Several questions arose which could easily extend the project timeframe. To start, the project aims to start the lean gas demonstration in late July. As it is already mid-July the approval, funding and initial project kick-off make one fear a later start date. Field projects will likely kick off in mid to late fall, making weather conditions an unknown variable. The proposal does not discuss logistical or contractual agreements with the lean natural gas to be used in 'Activity 1'. It also does not seem to address the potential issues with a 3-4 month lead time of the Bakken Express skid and tube trailers when Activity 1 is only slated for 5 months. Although Continental Resources agreed to use one of its locations for testing, there is no mention of any timeline or flexibility in this, which is slightly concerning. Furthermore, there are very few details on the rich-gas demonstration which make it difficult to assess the time and funds dedicated to this phase. The equipment costs are lumped together making exact equipment variables unknown. A much more detailed budget report would have been desirable.

- Reviewer: G-024-006

- Rating: 2

The following 1-year project schedule was proposed. Activity 1 - Lean Gas Demonstration (August – December) Activity 2 - Bakken Gas Research (October – January) Activity 3 -

Rich Gas Demonstration (January – May) Activity 4 - End-use Technology Study (Duration of Project) Statement from Continental Resources: “Continental Resources has extensive ongoing operations in North Dakota and is committed to be a major contributor to this project and will make every effort to accommodate the project when final agreements on logistics and contracts are finalized. With over 25 rigs operating in North Dakota drilling wells every 30 days covering multiple areas, we are confident we can identify the proper rig drilling in an area reasonably accessible to Bakken Express to deliver fuel in a timely manner.” Statements from EERC and Bakken Express: Lean and Rich gas demonstrations are expected to occur during the drilling of a single well (approx. 1-month). Preparations are expected to begin immediately upon contract approval, and include securing pipeline gas, compression, transportation, and well site equipment. It is agreed that 5 months is aggressive, and that 6-7 months is probably more realistic for activity 1. Activities are flexible given the actual contractual start date, and expected to be adjusted. Winter operations for the demonstrations are proposed and have been anticipated. The Bakken Express equipment is designed for 24x7, year round operation, including moving from well to well during winter conditions. Continental is aware of the project requirements, and has not specified gas locations or rig commitments at this time. Bakken Express is comfortable determining exact locations at a later stage since the CNG will be transported to the converted bi-fuel rig, and the compression equipment is mobile. Ideally equipment would be moved to a well relatively near the converted bi-fuel rig. No equipment costs are proposed to be expensed from NDIC funding. Federal funds include \$70,000 for data acquisition and instrumentation equipment to be used in activities 1-3. Equipment costs for Bakken Express are proprietary and integral to their compressed natural gas services. Expected expenses for Continental Resources include the purchasing of CNG, equipment from the discharge of the tube trailers to the inlet of the diesel engines, and associated installation labor. A total of \$750,000 was estimated. Costs are subject to final agreements, therefore specific itemization was untimely.

- Applicant

3. The quality of the methodology displayed in the proposal is:

It is evident they have made proposals such as this before.

- Reviewer: G-024-004

- Rating: 4

The methodology presented walks through the problem logically, and each milestone represents meaningful advancement in the project. I have no concern with the method presented not leading this team to the anticipated results.

- Reviewer: G-024-005

- Rating: 4

The detailed work plan is only four pages double spaced, leaving the reader with a lot to wonder as the project plan is very ambitious. It does not discuss where the CNG will come from for the lean-gas demonstration. It does not discuss how the Bakken Express equipment operates or how and what will be used for both lean and rich gas demonstrations. The proposal does not go in to detail on current Bakken Express operations and what challenges they have. Concerns are among the lines of sound operation, safety, equipment reliability in winter seasons and rig configuration with bi-fuel

engine. The rich-gas details do not discuss what happens with any Natural Gas Liquids (NGLs) or potential H<sub>2</sub>S. The logistics page is two pages containing equipment pictures, sample well location and gas volumes. No discussion is given on wells up for consideration, trucking operations and CNG source location.

- Reviewer: G-024-006

- Rating: 2

Continental Resources has not yet identified the specific rig to be outfitted with the bi-fuel configuration. Discussions with multiple rig contractors have been initiated and visits to bi-fuel rigs have been made to review operational concerns. The specific well(s) where this trial will be conducted will depend upon the specific rig configured for bi-fuel and the well schedule for that rig which is subject to change due to Continental's drilling program and other factors. Continental Resources is confident that a rig will be identified and the specific well will be identified as the project moves to the implementation phase. All factors such as logistics, weather, rig compatibility and fuel supply will be taken into account as the project moves forward. Bakken Express and Continental Resources have discussed project logistics and are committed to obtaining sources of gas. A Bakken Express compressor skid will be placed at a gas plant location to capture CNG for the lean gas trial. The compressor skid captures rich or lean gas at 25-50 psig inlet pressure, dehydrates the stream to less than 11b/MMscf water content and applies 3 or 4 stages of compression before loading into CNG tube containers. The skid includes an H<sub>2</sub>S sensor to prevent loading sour production. NGLs that drop out interstage at the compressor skid are returned to the remaining flare stream. The trucking operation will be performed by Bakken Express trucking and their DOT permitted Hazmat drivers. The lead time required by Bakken Express for the rich gas trial is approximately 30 days, therefore selecting the final well location can be finalized closer to startup of the rich gas trial. The project team visited a gas drilling operation in Colorado to witness a GTI-bi-fuel system in operation on two separate drilling rigs. The operation included the supply of high pressure (1000 psi) wellhead gas to a pressure let down/conditioning skid fabricated by a third party, and subsequent supply (5 psi) to the power generation. Power generation included three 3512 Cat engines with a combined capacity of approximately 3500 kW. Each engine was fitted with a GTI-bi-fuel system. The operator and drilling contractor remain a source of support. The project team witnessed a sound and safe operation.

- Applicant

4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Oil and Gas Research Council goals will likely be:

The Bakken boom has many years to run. Flaring will become an issue that will need solutions. This has the potential to identify a solution that is economically attractive.

- Reviewer: G-024-004

- Rating: 4

The proposed project represents a significant early step for validating viable end-uses for flared gas in North Dakota. The potential impact the project could have on flared gas volumes would be measureable, however the proposed end-use technology's overall impact on flared gas volumes in ND by itself would not be extremely significant. Proving the proposed end-use is significant to the NDIC OGRC's goals.

- Reviewer: G-024-005
- Rating: 3

The proposal has significant technical contributions towards the NDIC OGRC goals with the research of wellhead gas capture opportunities. The proposal offers an ongoing twelve month end-use technology study and three month Bakken gas research commitment. This work will provide oil and gas companies with valuable information when weighing viable and commercial wellhead gas possibilities. This could potentially lead to the capture of wellhead gas and minimize flaring in areas without an established gathering system.

- Reviewer: G-024-006
- Rating: 3

Concur with reviewer comments.

- Applicant

5. The background of the principal investigator and the awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is:

Locating a comparable study in Wyoming is good. It could have been improved through a few phone calls. Contacting the authors is a good way to get more information. Publications limit the level of detail that is put into print. Talking to authors will identify added information.

- Reviewer: G-024-004
- Rating: 3

The background info and literature presented and cited in the proposal instills confidence that the project's stakeholders are aware of the industry and its challenges the project aims to influence. It is evident the proposed researched is supplemented with good industry contacts and relevant published literature.

- Reviewer: G-024-005
- Rating: 3

Background and awareness of current research activity in regards to capturing and utilization on wellhead gas is adequate. Knowledge is around potential opportunities to capture and store wellhead gas versus currently flaring techniques. CNG is a compelling alternative to flares and an exciting opportunity for oil and gas companies in addition to the NDIC. Knowledge is contained in using natural gas to create electricity through turbine generators. The otherwise use as a bi-fuel was not known in extensive detail.

- Reviewer: G-024-006
- Rating: 3

See response to item #3. The project team conducted a site visit to a gas drilling operation using a bi-fuel system firing lean-sweet gas in 3 Cat 3512 engines. The operator and driller remain available for technical assistance. EERC conducted a meeting with Butler CAT, Fargo, ND, Industrial Equipment (IE), Williston, ND, ECO-AFS, Alexandria, MN, and GTI-Altronics, Girard, OH on June 8, 2011. GTI-Altronics is the leading supplier of bi-fuel systems with over 2,200 units sold worldwide. Butler, IE, and ECO-AFS are involved

as distributors and customer support to the Williston Basin. Globally 100 GTI-bi-fuel units exist in drilling operations, and a few units have found utility in pumping units for hydraulic fracturing. Locally, units have been deployed on smaller Cummins generators firing Bakken wellhead gas on the Fort Berthold reservation for pumping power. Recently Butler CAT has agreed to provide a 3512 CAT to EERC in which to conduct the rich-gas testing. As stated in the proposal, the propensity for rich-gas to knock in bi-fuel operation is the primary technical concern, and research is proposed to identify the limits of operation for Bakken gas specific to generators used to power drilling operations.

- Applicant

6. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is:

The plan to evaluate the process in steps is good. Knock evaluation at the lab could also identify other problems or benefits.

- Reviewer: G-024-004  
- Rating: 4

The proposed plan presents a thorough and well understood management plan.

- Reviewer: G-024-005  
- Rating: 3

The weakness of this proposal falls on what is believed to be an inadequate management plan. There is an obvious lack in specific project details, scheduling objectives and financial breakdown. Specific time, budget and methodology concerns are touched on in the answers to questions two and three. The only details in the proposal discussing communications outside the EERC are outlined in the budget costs. No information is given on the cost assessment for the end user, simply stating that capital costs may range from \$300,000 to \$600,000 with associated savings in the range of \$3,200 to \$9,600 per day. The proposal does not touch on mineral right allocation for captured gas and does not discuss the costs of buying CNG. The team should have provided a lot more detail in regards to the overall plan and financial analysis.

- Reviewer: G-024-006  
- Rating: 2

A significant portion of the project budget is dedicated to the execution of project engineering, scheduling, coordination, reporting, and financial management. Project management detail was provided in relation to the timing of financial agreements and concurrent partner obligations. The expected economic performance of a gas-fired bi-fuel drilling operation is enumerated as follows: Capital Expenditures, total \$600,000 Diesel cost \$4.00/gallon - Bi-fuel system \$150,000 Delivered CNG cost \$1.00/gallon - Gas conditioning \$350,000 Diesel offset = 3000 gallons/day - Site support \$100,000 Savings = \$9,000/day Simple payback = 2.2 months The delivered CNG cost above is in consideration of the extracted costs. Continental Resources has committed a substantial amount of capital which will be sufficient to outfit a rig to run on bi-fuel. A detailed budget for equipment, installation and operation will be produced once the project is approved and quotations for capital equipment to retrofit a rig to run on bi-fuel are procured.

- Applicant

7. The proposed purchase of equipment and the facilities available is:

Use of EERC technical team and equipment prevents unnecessary expenditures. Partnering with Bi-fuel equipment manufacturer adds additional resources that do not need to be purchased.

- Reviewer: G-024-004

- Rating: 3

The proposed project's equipment and facilities needs are well justified. The proposal is asking for appropriate equipment and facilities for accomplishing the stated goal. I do not see any glaring unnecessary purchases, nor am I concerned that the right equipment is missing from the plan.

- Reviewer: G-024-005

- Rating: 4

The equipment being used is well justified for this project. However, the proposal does not discuss exactly what equipment will be used. The equipment selection is the responsibility of Bakken Express and Continental Resources.

- Reviewer: G-024-006

- Rating: 4

Concur with reviewer comments.

- Applicant

8. The proposed budget "value" relative to the outlined work and the commitment from other sources is of:

Partnering with Continental is good. If this company did not see any prospect of success, they would not participate. EERC has good credibility in the selection of projects they work with.

- Reviewer: G-024-004

- Rating: 4

The proposal's outlined work is of adequate value to the NDIC and the other funding sources. The project management costs of this proposal seem high compared to the budgeted equipment and operating cost. However, notably good value stand out in the project having a stakeholder that is able and willing to provide a drilling platform for testing and proving the end-use technology. This alone escalates the potential value of the requested investment of the NDIC.

- Reviewer: G-024-005

- Rating: 4

The budget value of this project is very good for the work outlined. Nearly two million dollars for a project that can alleviate the economic and environmental impacts of flaring gas is a good investment. If the project results meet expectations, the group will provide oil and gas companies with a compelling alternative to flaring wellhead gas. The challenge

will be to demonstrate safe and reliable wellhead gas compression, storage and collection.

- Reviewer: G-024-006

- Rating: 4

The success of the project is predicated on attention to detail and execution. The budget reflects adequate funding for project management.

- Applicant

9. The “financial commitment”<sup>2</sup> from other sources in terms of “match funding” have been identified:

Good portion of the funding is from non-NDIC sources. Intangible value from partners is their technical expertise and commitment of time and resources. There is risk of downtime to Continental.

- Reviewer: G-024-004

- Rating: 3

The proposed project has significant additional funding coming from outside of the NDIC. A critical and high value component to the project is covered by the Non-Cash Share value of gaining access to a Continental drilling rig to prove the technology in the field environment. Gaining a stakeholder that is able to provide a drilling platform increases the value of this investment. Obtaining access to a drilling platform otherwise would be extremely challenging and detrimental to the projects opportunity for success.

- Reviewer: G-024-005

- Rating: 4

The NDIC is requested to support nearly forty percent of the financial obligation requested for this project. This is below the required fifty percent support amount and the remaining funding has already been agreed on by Continental Resources and the Federal Government. The NDIC will be an equal partner in this investment.

- Reviewer: G-024-006

- Rating: 4

Concur with reviewer comments.

- Applicant

1 “value” – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar. A commitment of support from industry partners equates to a higher value.

2 “financial commitment” from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Support less than 50% from Industrial Commission sources should be evaluated as favorable to the application; industry partnerships equates to increased favorability.

## General Comments

Good use of available technology to possibly reduce flaring and identify an economically valuable process. Concern: Bakken Express is important player. They do not have an experienced track record. If they fail to deliver, the project will likely falter. BX identifies 310



MCFD needed in Figure D-3. Well decline is fast and the available time to obtain those volumes is short (figure D-2)"

- Reviewer: G-024-004

The proposed project is well conceived and has been crafted into a sound methodology. The end-use technology this proposal aims to prove is realistically achievable in North Dakota and viable in North Dakota's oil and gas industry. I recommend funding this project, and I look forward to seeing this project influence other end-use technology breakthroughs for the otherwise flared gas of our North Dakota oil fields.

- Reviewer: G-024-005

As mentioned in the above answers, this project has a lot of potential. However, there are also noticeable weaknesses in the available information provided in the proposal. The project has a lot of potential and is a great idea. I would personally like to see a few more details before fully supporting a \$750,000 commitment. I would particularly like to see more details on the methodology, costs and forecasts involved with capturing wellhead gas for use as bi-fuel. This proposal mainly focuses on the demonstration that wellhead gas can be used as bi-fuel in the form of CNG.

- Reviewer: G-024-006