Resource Assessment of Deep Coals in Eastern Montana: Potential Targets for Commercialization by In-Situ Gasification

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Statement of Problem:
Montana's vast coal reserves account for about 25% of the nation's total demonstrated reserve base - about 120 billion tons (US Energy Information Administration). At least 60% of these coal deposits, representing billions of dollars worth of mineral resources, lie more than 500 feet below the surface and cannot be accessed using conventional mining methods (figure 1). However, new technologies such as In-Situ or Underground Coal Gasification (UGG) make our "deep coal" resources economically attractive.

During the past few years, the State of Montana has received multiple inquiries from private industry regarding our overall potential for underground coal gasification and for specific UCG sites. This interest has not translated into investment in the State, in part because geologic data to clearly identify our deep coal targets are not available. This is a significant obstacle to future development of Montana's coal resources. Other states able to provide such information currently hold a significant competitive advantage over Montana.

Progress:
- A database of nearly 6,000 oil and gas wells that penetrate the coal-bearing Fort Union Formation in Eastern Montana has been constructed for use in the study. Approximately 10,000 coal drill-holes will be added to provide additional information for shallow to intermediate depths.
- The base of the Fort Union Formation has been identified in all wells. Structure and thickness maps of the Fort Union Formation have been generated and provide a "coal-potential" map for Eastern Montana. Areas with the highest likelihood of containing deep coals suitable for UCG include the Powder River Basin and the Williston Basin as shown in figure 2.

Goal:
The objective of this project is to complete a regional assessment of "deep" (500-3000 ft) coal seams in eastern Montana. It is the critical first step toward commercializing Montana's deep coal resources.

Benefits:
Immediate benefits of this study are:
- Information needed by potential investors and developers. It will put Montana on "equal-footing" with other coal-rich states.
- A set of tangible results to use as a basis for policy and management decisions for Montana's coal resources, whether they are owned by State, Federal, or private interests.
- It puts Montana in position to progress beyond the "interest" stage with private industry by providing a foundation that must precede pilot-scale testing and full-scale investment in the State.
- These same data will also be necessary and applicable as other technologies become available that could exploit the intermediate to deep coal resources of the State.

Long-term benefits include:
- Potential development of otherwise inaccessible energy resources.
- Economic growth - revenues and jobs, if development occurs.
- Overall increased knowledge of Montana's geology and energy resources that is valuable for scientific, technical, and resource-management purposes in the future.

What is In-situ Coal Gasification?
In-situ or Underground Coal Gasification is a "clean coal" process, capable of extracting the energy content of deep, unmineable coal resources while minimizing environmental impacts.

In the UCG process, injection and production wells drilled from the surface and linked in the coal seam below the water table. Air and/or oxygen are injected and the coal is ignited in a controlled manner. As the coal burns, combustible product gases - called syngas - are collected by the production well. Air at the surface, syngas is cooled and cleaned for use in power generation or manufacturing synthetic natural gas, liquid hydrocarbons, or petrochemicals.

Figure 1. Map of Eastern Montana showing the extent of the Fort Union Formation - the primary coal-bearing unit - in pink. Areas shaded brown represent near-surface, shallowable coal deposits. County boundaries and names are shown in blue.

Figure 2. This map shows the subsurface elevation of the base of the coal-bearing Fort Union Formation in Eastern Montana. The purple and dark green areas (stippled in the text) are the deepest and correspond to the Powder River Basin to the south and the Williston Basin to the west. They are more likely to contain deep coals suitable for UCG.

Figure 3. Geophysical logs acquired from oil and gas wells are shown. These logs provide information about subsurface rocks and fluids. Coal beds (highlighted) can be identified by their distinctive characteristics on geophysical logs.

- Individual coal beds are being identified using oil & gas well geophysical logs which provide information about subsurface geology (figure 3).
- Regional correlation of coal seams to determine lateral extent and continuity is on-going (figure 4).

Figure 4. Coal beds are identified from geophysical logs for individual wells, then correlated on a regional basis. The cross-section location is shown on the map in figure 2.

- Initial UCG-suitability criteria have been identified and will be applied to each coal bed (figure 5).
- Preliminary maps such as coal thickness and coal quality maps are being generated for specific areas (figure 6).

Figure 5. UCG suitability criteria as proposed by GasTech, Inc., for the Powder River Basin coals. These criteria will form the basis for "ranking" Montana's deep coals for UCG-suitability.

Figure 6. This map shows total coal thickness for a portion of Richland County. Maps like this are providing a "picture" of Montana's deep coal potential. Yellow, orange, and red areas show total coal thickness greater than 30 feet.