This piece was originally written to address Terrence Manning's op-ed in the August 20th Laramie Boomerang, and it addresses the same issues.

Re: Terrence Manning's proposal, 'Want to bring emissions back to pre-industrial levels? Start by refitting coal burning Power plants for Carbon capture and using the captured carbon dioxide in enhanced oil recovery."

Carbon capture and sequestration (CCS) plus using this sequestered CO_2 in enhanced oil recovery, have been Studied in depth and well modeled for certain Wyoming sites. As an example of CCS, "one evaluated scenario was the sequestration of 15 million tons (Mt)of CO_2 per year for 50 years into the Weber sandstone on the Rock Springs uplift . . . because the Jim Bridger Power plant (2200MW) Is located on the uplift and emits 15 Mt/yr of CO_2 . . . In this example, 750 Mt of CO_2 is sequestered . . . And one cubic kilometer of displaced Brine is produced and treated over a 75 year period"1

This makes sense short term: The coal mine would ship coal, no CO_2 would enter the atmosphere from the power plant, CO_2 would be available for enhanced oil recovery, and recovered brine would be treated to yield fresh water and dissolved minerals (lithium from the Weber).

But long term there are major problems with such a power-plant/CCS system on the Rock Springs uplift that would worsen over time. CCS and the production and treatment of displaced brine require considerable amounts of electric power. Over time, greatly increased electric power demand from ground transportation and industry would follow the nation's growing awareness of the need to replace internal combustion engines with electric motors to deal *effectively* with climate change. The Jim Bridger would have to meet this increased power demand, burning more and more coal and increasing more and more CO_2 and so at some point exceeding the CCS rate limit and spilling more and more CO_2 into the atmosphere. Thu, we would need to move beyond CCS to deal with increasing CO_2emissions from the power plant long term. While CCS appears to be reasonable short term, its inclusion in a protocol with other processes would be required to optimize the benefits of CCS with increasing electric power demand and "bring emissions back to preindustrial levels" on the Rock Springs uplift.

Here, for example, is such a protocol, a set of processes designed to compose an integrated local system on the Rock Springs uplift to achieve definite economic and environmental goals – greatly reduced CO_2 emissions, a sustainable Wyoming coal industry, and a clearly enhanced Wyoming economy – in the face of greatly increased demand for electric power.

(1) For starters: Develop and deploy a CCS facility near the power plant, Manning's proposal), to capture and sequester CO_2 emitted in coal-fired electric power generation, up to the CCS rate limit.

(2) Concurrently, deploy a Liquid Fluoride Thorium Reactor (LFTR) at the Jim Bridger plant, to fire such electric power generation that would cause the CCS rate limit to be exceeded and to provide process heat for coal-to-chemicals processes,

(3) all with zero CO_2 emissions.

[The very idea of a nuke may be off-putting, ever frightening (we've been so conditioned), but please consider the following: We aren't talking about our familiar reactors, fueled with solid uranium in fuel rods, water-cooled and moderated, and subject to frightful accidents. In comparison with our familiar reactors, the LFTR ("lifter"), fueled with liquid thorium, is a compact, inherently safe (vs. fixed to be safer), far more efficient reactor that produces scant waste to be stored a far shorter time, and uses no water. In light of such advantages, we find in the LFTR a downright attractive source of green energy.]

(3) Concurrently, build a coal-to-chemicals plant near the Jim Bridger and the LFTR to convert coal as feed stock to a chemical product (ethanol, or ammonia, or diesel, or car bodies, or . . .) using LFTR process heat.

Taken together, these three processes and the power plant would form an interactive system – the Jim Bridger generating electric power and emitting CO_2, the CCS facility capturing and sequestering that CO2 up to the CCS rate limit, the LFTR providing back-up heat to fire the power plant as the CCS rate limit is exceeded plus process heat to fire the coal-to-chemicals plant, and the coal-to-chemicals plant functioning as a new Wyoming industry, diversifying our economy, consuming Wyoming coal and significantly increasing state tax revenues from the value added to its product.

The balance among these four processes would change over time in response to changing economic conditions, increasing electric power use, and growing national will to deal with climate change. Coal would fire the Jim Bridger at a rate governed by the CCS rate limit and changing CO_2 demands, while more and more LFTR heat would be required to meet increased electric power demand. Additional coal-to -chemical plants coming on line would require yet more LFTR heat and more coal as feedstock. In time, coal as feedstock would mostly replace coal as fuel. Future plans might well include a second LFTR, trucked from a Wyoming LFTR factory and lowered into its underground home. As suggested above, a transition from internal combustion engines to electric motors in transportation and industry

– even in heavy duty mining equipment – would be increasing apace, in order to move us toward "bringing emissions back to pre-industrial levels."

This protocol is focused on dealing responsibly and *effectively* with climate change at a certain location: We're looking at a near 100-percent reduction in CO_2 emissions on the Rock Spring uplift and near 95-percent reductions in Rock Springs and or the adjacent interstate and railroad – and at abetting our state economy while keeping our coal mines open. We strongly urge those planning Wyoming's future to consider the environmental, social, and economic costs, benefits, and opportunities projected in this protocol.

1. Surdam R C, ed. (2013) Geological CO_2 Storage Characterization: The key to deploying clean fossil energy technology (New York, Springer) p. 234-5

David Copeland and David Earnshaw, two retired scientists (geology and physics), founded the Wyoming LFTR Energy Alliance (WLEA) in Laramie several years ago to study and communicate the vital opportunities that LFTRs present in responsible energy planning.