# Wyoming's Energy Future: The Case for Thorium Energy and the Other Reactor

David Copeland and David Earnshaw

## Introduction

During the nation's mid-20th-century experiment in the then-new field of atomic energy, both solid-uranium-fuel and molten-thorium-salt-fuel reactors were under development, and working models of both were up-and-running within our system of national laboratories. Solid-uranium-fuel reactors were chosen to power our nuclear submarines and provide weapons-grade reaction products – for reasons cogent at the time – and subsequent commercial development of nuclear electric power plants followed suit. The molten-thorium-salt reactor program was curtailed short of commercial development because, with a few prescient exceptions, there was no perceived need for it. Now, in a new century, we see *great* need for it.

We are discussing two kinds of nuclear reactor for firing electric power generation, the kind we have and the kind we should have. The conventional, solid-uranium-fuel reactor, the kind we have, we see as costly, inefficient, disaster-prone, and productive of copious radioactive waste to be "stored" eternally – and therefore as unacceptable. The other reactor, the kind we should have, the Liquid-Fluoride Thorium Reactor (LFTR, "lifter"), we see as safe, efficient, productive of scant, relatively benign waste, and economical to build and operate*. All the shortcomings of the conventional reactor are eliminated in the LFTR.*

Today, growing interest in thorium energy and the LFTR hinges on their promise as the ideal source of reliable, continuous clean energy (1) to back up clean energy from intermittent sources – solar and wind – and (2) standing alone, to supply electric power for large-scale loads.

❖ ❖ ❖

Consider a program to provide electric power while meeting the challenge of climate change. If a goal is to go green by increasingly incorporating renewables into our electric power mix (to reduce GHG emissions), reliance on these *intermittent* sources of electric power absolutely requires provision of *continuous* back-up electric power for large-scale loads. Today, heat sources for such large-scale continuous electric power generation comprise coal/gas/oil-fired boilers and nuclear reactors. If another goal is to quit burning hydrocarbons for electric power generation (to eliminate GHG emissions from that source), then nuclear reactors must fire our power plants for the program to work. If a third goal is to rid the planet of nuclear reactors (to eliminate their many problems and dangers), then the program fails: its goals cannot be met concurrently; it cannot work.

The fallacy in this troubling logic is the misconception that "nuclear reactor" means simply the familiar reactor we have now, failure to recognize the other reactor, the LFTR, with its many beneficial properties, waiting in the wings. For, thorium energy released as heat in the LFTR would make the program work: the program would guide the evolution of an area's energy platform from fossil-fuel-based (or, increasingly, renewables/fossil-fuel-based) to renewables/LFTR-based. The program succeeds in incorporating renewables in our electric power mix, eliminating the burning of hydrocarbons from electric power generation, and incorporating acceptable and beneficial nuclear reactors. The elements of the evolved energy platform – stand-alone renewables, LFTR-backed renewables, and stand-alone LFTRs – would be balanced in their most economical applications.

In Wyoming an obstruction is the perceived impact of the program on the coal industry. In fact, the program presents impressive opportunities: with LFTRs providing GHG-emissions-free process heat, coal-as-fuel would evolve to coal-as-feedstock for production of carbon-fiber products, plastics, aircraft fuels . . . many chemical products, with many benefits. That is, the LFTR could absolutely save the coal industry while greatly increasing state tax revenue from value-added production.

❖ ❖ ❖

**Part I** envisions an energy environment a century from now that will have witnessed the replacement of coal-fuel, gas-fuel, and uranium-fuel with thorium-fuel LFTR electric power generation; a global increase in electric power use, especially in vehicles; coal used as feedstock for value-added chemical production with LFTR-generated process heat; and a 95% reduction in global greenhouse-gas emissions. We propose Wyoming as an optimum environment and proving ground for LFTR development and deployment in a renewables/LFTR energy platform, as well as for creating a leading model of energy selfsufficiency. Wyoming has the opportunity to lead the world in the definitive commercial development of the 21st century's most important energy resource.

**Part II** elaborates the many differences between the LFTR and the solid-uranium-fuel reactor, the type employed around the world today, showing the superiority of the LFTR by every measure. We discuss differences in design, fuel requirements and costs, fuel-cycle, safety, water requirements, time and cost of construction, ease and cost of operation, and production, properties, and disposition of radioactive waste. We point out the advantages of the LFTR's much higher operating temperature both for efficient electric power generation and for high-temperature industrial processes.

**Part III** (forthcoming) will present issues surrounding and embedded in the transition from a hydrocarbon-based to a renewables/LFTR-based energy platform in Wyoming and globally: technical, social/political, economic, and moral issues.