January 28, 2013

The Honorable Ron Wyden
221 Dirksen Senate Office Bldg.
Washington, D.C. 20510

Dear Senator Wyden:

Congratulations on your ascendency to chair of energy and natural resources. In that role there is one issue I would like to call to your attention. The scientific consensus, as you well know, is that mankind is discharging too much carbon into the atmosphere. What is needed is a clean, cheap baseload energy source that does not emit carbon. While solar and wind are non-polluting, they supply only intermittent expensive power. Arguably the only promising alternative is fusion energy which holds the promise of clean, cheap, baseload power with no nuclear waste. Unfortunately while the U.S. government realizes this, it has chosen to pour millions into one possible fusion technology that has so far failed, and ignored less expensive promising alternatives.

Our foundation has and is financing research into technologies that address the issue of carbon free or carbon neutral energy technologies. This has resulted in the hybrid drive system leased to Toyota, cellulose to jet fuel and ocean thermal technologies.

The task of achieving sustainable, clean, safe and economical energy is among the most urgent we face. Fusion power, the power of the sun and stars, offers the best possibility for such an ideal energy source. Yet, in the past year, a number of events have highlighted the need for a re-evaluation of the direction of the US fusion energy research effort:

- **March, 2012**: hundreds of young fusion researchers signed a petition asking that the US fusion research not be cut in order to feed more money to the ITER International Tokamak project.
- **In October, 2012**: the National Ignition Faculty (NIF) missed its deadline to achieve ignition conditions (a self-sustaining fusion reaction); Robert L. Hirsch, director of fusion research at the U.S. Atomic Energy Commission and ERDA, the former director of the US fusion energy program and an architect of the present Dept. Of Energy strategy that focuses on the tokamak device, said in a speech to a scientific workshop that this strategy was deeply mistaken and that the fusion research program should reorient toward devices that could produce economical energy.

At present I am told no informed scientist believes that either the tokamak approach or any approach derived from NIF will lead to a new energy source that is cheaper than existing ones, and that therefore could compete with them without subsidies. As Dr. Hirsch, and many others, have pointed out, any fusion device based on deuterium-tritium fuel, which is the one that the US fusion energy program has so far emphasized, will inherently be large and expensive. Such fuels produce large

numbers of neutrons, which mean structures must be large in order to spread out the damage caused by the neutrons. While deuterium-tritium-based fusion produces much less radioactive waste and fewer safety concerns than those produced by fission reactors, managing the safety risks, together with the large size of the generators, make it impossible for any deuterium-tritium-based fusion to be economical. **On the other hand, there are paths to economical fusion power that are not, at present, being funded by the US fusion energy effort.** There exist aneutronic fusion fuels, such as hydrogen-boron fuel, which produce no radioactive waste. There are a number of devices, including the plasma focus device, inertial electrostatic confinement, field –reversed configuration and some approaches to laser-initiated fusion that can, in theory, burn such aneutronic fuels, despite the very high temperatures required. Because the main reaction produces no neutrons, and secondary reactions produce very few, such devices can be made to be very compact and therefore very economical. In addition, since the energy is released in the form of moving charged particles, electricity by definition, a direct conversion to current in a circuit is possible, with costs cuts far below any existing sources.

Promising results have been obtained in developing such devices for aneutronic fusion, using funding from private sources, or from non-DOE government sources. But these efforts are radically underfunded and collectively receive less than 10% of the funds going towards tokamak and deuterium-tritium fusion development.

This situation raises two interrelated policy questions that deserve to be investigated by the US Senate:

1. **Is the current 30-year-old concentration of the US fusion energy program on the tokamak device and on deuterium-tritium fuels too narrow to lead to economical fusion energy?**
2. **Should the US fusion energy program be redirected, if necessary by legislation, to fund a broader range of fusion devices, in particular those capable of using aneutronic fuels, which if successful could lead to fusion energy that is cheaper than any existing energy sources?**

Hopefully your committee will hold hearings to address and answer these questions.

Sincerely,

Robert C. Embry, Jr.
President