ALTERNATIVE ENERGY SOURCES:

Good News/Bad News
and
"The 1-Watt Challenge"

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ABSTRACT

In researching innovative energy sources, we are faced with a good news/bad news situation. On the good news side, new arenas of research activity are being opened up and pursued vigorously. These range from relatively mainstream approaches to develop solar energy, to highly innovative approaches to extract energy from vacuum fluctuations. On the bad news side, despite varying degrees of claimed success, there are as yet no standalone devices in this class (with the exception of solar devices) that unambiguously demonstrate the generation of net excess energy to the satisfaction of the consensual research community. It is suggested here that the credibility of these efforts requires meeting what we call "The I-Watt Challenge," the demonstration of a device that can continuously generate, on a stand-alone, self-powered basis, a minimum of at least I watt excess average output power.

Background

In the field of alternative energy research, researchers are attempting to develop energy sources based on the application of innovative concepts that, for the most part, lie outside the mainstream of energy research and development. These range from the relatively straightforward techniques of capillary fusion, through the controversial phenomena of "cold fusion," to the speculative proposals to extract energy from vacuum fluctuations via Casimir processes, or the claims of energy generation from the very fabric of space itself via rotating magnetic devices (e.g., by Faraday-disk homopolar generator action). Given the overused but nonetheless useful phrase "extraordinary claims require extraordinary proof," we comment here on the difficulties encountered in these efforts, both in gaining scientific credibility and in obtaining appropriate high-risk investment capital, and suggest a strategy to meet these challenges.

The Good News

The good news is that there is theory and evidence, even demonstration, acceptable to the mainstream scientific community, that new, alternative potential energy resources exist that have yet to be brought to fruition. In addition to the mainstream examples of solar energy and thermonuclear fusion, capillary fusion and Casimir energy extraction come to mind. Thus the innovative energy field as a field is not pseudoscience, or the pursuit of a chimera. What remains to be proven, however, is whether the fundamental processes involved can be brought from proof-of -principle to engineering maturity so as to constitute market-viable energy resources.

As an example, consider the case of so-called vacuum zero-point energy (ZPE), a research area being pursued, both theoretically and experimentally, by our research team at the Institute for Advanced Studies at Austin. This research is based on the fact that, in accordance with the discoveries of quantum theory, empty space is not truly empty, but rather contains an enormous amount of untapped electromagnetic energy known as the zero-point energy, or ZPE [1]. (The adjective "zero-point" signifies that such energy exists even at a temperature of absolute zero where no thermal effects remain.) Such energy can be traced to radiation from the fluctuating quantum motion of charged particles distributed throughout the universe [2]. Well-known physical consequences of the ubiquitous background ZPE include the perturbation of atomic spectral lines known as the Lamb Shift, the van der Waals forces of chemical attraction at absolute zero, and the Casimir Effect, a unique attractive quantum force between closely-spaced metal or dielectric plates, or other geometries.

Since the energy associated with the ZPE is known to be essentially ubiquitous and inexhaustible, the question that arises is whether such energy can be "mined" for practical use, that is, extracted to perform useful work. Although it would be natural to assume that any attempt to extract energy from the background ZPE might somehow violate energy conservation laws, or at least thermodynamic constraints, a careful analysis shows that this is not the case, and that energy and heat can in principle be extracted without violation of fundamental precepts [3]. As discussed in the literature, just such processes might already occur in Nature in certain large-scale, energetic astrophysical phenomena [4].

With regard to laboratory experimentation, the candidate mechanism for energy extraction is the above-mentioned Casimir Effect, the ZPE-driven attractive force between closely-spaced plates. This attractive force can be shown to be due to partial shielding of the region between the plates from the background ZPE, with the consequence that the plates are driven together due to the resulting imbalance in ZPE radiation pressures [5]. As emphasized by Forward at Hughes Research Laboratories in his paper "Extracting Electrical Energy from the Vacuum...," proof-of -principle of Casimir energy extraction is seen during the process of the plates moving together, which results first in the conversion of the attractive Casimir (vacuum) potential energy into kinetic energy, then heat as the plates collide [6]. In an alternative embodiment envisioned by Forward, the plates are electrically charged with the same-sign charge, resulting in the buildup of electrical (Coulomb) energy as the stronger attractive (1/d4) Casimir force overcomes the weaker Coulomb repulsion at small spacings and draws the plates together. While these mechanical examples are admittedly impractical for significant, continuous energy generation, they nonetheless demonstrate the basic principle involved.

Experimentation in our laboratory is directed toward a plasma version of the above process. In short, we are investigating the possibility of a Casimir-type pinch effect that may be a contributing mechanism to the generation of high-density charge clusters in micro-arc discharges (which itself has led to the development in our laboratory of a new, patented microelectronics technology known as condensed-charge technology, CCT). With regard to the potential energy extraction process of interest here, we envision a "Casimir fusion" process, which in its cycle of operation would mimic the nuclear fusion process, but without the radioactive byproducts. it would begin, like its nuclear counterpart, with an initial energy input to a plasma to overcome a Coulomb barrier, followed by a condensation of charged particles drawn together by a strong, short-range attractive potential (in this case a Casimir rather than a nuclear potential), and with an accompanying energy release in some form (heat, electrical). Should the energy requirements for plasma formation, and electrical circuit and other heat losses be kept at a level below that required for break-even operation, then, as in the nuclear case, net useful energy would be generated. Calorimetry measurement of possible excess heat (energy) generation in this process is ongoing in our laboratory. Although encouraging results, both by calorimetry and electrical measurement, have been obtained under certain conditions at various times, stand-alone operation, the sine qua non of proof-of-utility (as will be argued below) has not yet been achieved.

In addition to the scientific soundness of new energy generation principles, as a separate "good-news" item we have had the opportunity to sample the pulse of the oil industry, and of the government, as to their potential response to the development of alternative energy sources as discussed here. Contrary to the prevailing "folk-myth" of some, we have found little evidence of potential suppression.

With regard to the oil industry, for example, we briefed the presidents, vice-presidents or research directors of Pennzoil, Texaco, Tenneco, Marathon Oil and Coastal Oil. Without exception, it appeared that the development of alternative energy sources would be welcomed for the simple reason that if the burden of major energy use were to be removed from the oil industry, then their rapidly dwindling resource could be conserved for a longer period of time, and they could concentrate on the development of pharmaceuticals, plastics, synthetic fibers, etc., for which the profit margins are significantly greater. One executive likened the present use of oil for gross transportation and utility requirements to "heating one's house by burning Picassos and Van Goghs," and opined that the oil industry would itself become a major user of new energy technologies to increase efficiency and reduce cost in refinery operations.

Similarly, in briefing various government agencies, including the DOD, NIST (National Institute of Standards and Technology, formerly the National Bureau of Standards), and the Patent Office, we did not encounter any evidence of suppression or hindrance of our efforts, only encouragement.

The Bad News

Despite the fact that a number of experimenters, including ourselves, feel that steady (sometimes not so steady!) progress is being made toward the goal of new, viable alternative energy sources, we must face the fact that an unambiguous demonstration of a working model remains elusive. Facetiously, I would say that by unambiguous I mean sufficiently riveting that one must turn away any further potential investors. Seriously, by unambiguous I think we require a broad consensus that the device under consideration (a) exhibits a non-borderline excess useful energy output not traceable to ordinary, mundane sources, based on close scrutiny by independent observers (nondisclosure agreements acceptable); (b) said excess energy is measurable by standard measurement apparatus operating within standard operating characteristics; (c) some plausible concept of the energy gain mechanism is proffered; (d) a reasonable requirement for independent reproducibility and replicability is met; and (e) I suspect that stand-alone, self-powered operation (as opposed to energy-out/energy-in gain measurement) is required – a potentially contentious point I will defend below. Many would say that the Swiss ML converter satisfies (a) and (b) somewhat, (e), but not (c) and (d); "cold fusion" satisfies (a), (b) - (d) somewhat, but not (e); and so forth.

Although each of the above points could stand detailed discussion, I will "cut to the chase" and argue that, in my opinion, in alternative energy research (e) is the most critical. If proof of a viable process requires separate measurement of input and output energies, and a comparison of same, then arguments can always be raised concerning the measurement procedures, and not just by intractable skeptics. For one, as research in the "cold fusion" arena has shown, calorimetry is as much of an art as it is a science. In our own laboratory calorimetry efforts, for example, which have involved sophisticated, computer-automated apparatus, we are many years and tens of thousands of dollars into nth-generation modifications. This even includes detailed evaluation and eventual rejection of commercial calorimeters as inadequate to the task. Again, as George Hathaway discusses elsewhere in this conference, electrical measurement can be problematical for circuits involving, for example, high-intensity spark-discharge phenomena where stray capacitance and inductance effects can predominate over expected resistance characteristics of a load for pulse signals in the nanoseconds range if, on the other hand, one has a modicum of excess energy, one can in principle tailor whatever portion of the output energy is required to provide input driving, head-to-tail, so to speak, to achieve stand-alone operation; then arguments concerning measurement become moot. There are, of course, justifiable reasons along the way as to why this stringent requirement cannot be met. In our own efforts, for example, outputs in the form of heat, even with gain, cannot survive the inefficiencies of thermoelectric conversion to provide a required high-voltage DC input. Thus we too cannot yet meet this requirement, but it is a stated goal of our research effort. In those cases where multiples of input energy are claimed, however, nothing will show up an error in measurement, if there is one, as fast as an attempt to run head-to-tail; and, conversely, nothing will validate a true energy gain as quickly, either.

Other arguments that could be raised against requirement (e), however, we find not so compelling. For example, it has been offered that self-excitation smacks of "perpetual motion," and that the consequences of this appellation (e.g., difficulties with the patent procedure) argue against its use. In fact, "perpetual motion of the second kind," in which conversion of energy from some source offsets losses in a system (which presumably is a condition that must be met in a "free energy" machine unless we were to discover new evidence to the contrary), is perfectly acceptable in physics and engineering. (The "perpetual motion" of Niagara Falls is a good example, where the sun provides the energy we do not have to pay a price for, through the evaporation/rain cycle.) In the case of our own research, for example, we have been successful in obtaining patents that speak of the conversion of ambient vacuum energy, as opposed to the generation of "free" energy.

Another argument we have heard is that one must provide clearly usable amounts of power (e.g., kilowatts) to have a viable energy technology. It is claimed that the diversion of a significant amount of output power to self-excite (as opposed to the use of, say, a separate low-power input) would be self-defeating in this regard, demonstration of practical utility would suffer, investment would not be as forthcoming, etc. We would offer that the elimination of measurement ambiguity would more than offset the downsizing of a prototype demonstration device in the eyes of any potential realistic investor.

Finally, adherence to requirement (e) eliminates potential confusion attendant to the discussion of "incremental" as opposed to "net" gain, a difficulty often faced in attempting to evaluate, for example, homopolar-generator devices. Again, we have ourselves dealt with this problem in our own laboratory in which a homopolar generator is seen to "waste" a certain number of watts just to overcome windage and friction, but when loaded does not appear to require as much incremental input as is being generated at the output. It is tempting to extrapolate that engineering improvements to reduce the waste "tare" will result in over-unity efficiency, but one must demonstrate that indeed this is the case, since motor efficiencies typically change radically with changes in operating parameters.

"The 1-Watt Challenge" Strategy

Based on the above discussion, we would recommend that the surest route to credibility for alternative energy research lies in meeting what we call "The 1-watt Challenge." This is the demonstration of a device that, on a stand-alone, self-powered basis, can continuously generate a minimum of at least I watt excess average output power. Specifically, consider that one had a device that required ten watts of input power from an external source, say, a battery, but with this input was capable of generating, say, twenty-one watts of output power in the form of heat (a little over 2:1 power gain). We would argue that if one could operate alternatively by diverting twenty of those output watts through a 50%-efficient heat-to-electric converter to provide the ten-watt input power, the reduction of the output from twenty-one watts to one watt would be worth the sacrifice in output power to remove the ambiguity of the measurement argument, and the reliance on a separate energy source. Clearly, since to our knowledge such operation has not yet been demonstrated to consensual satisfaction, this is a tough requirement to meet, despite the perhaps disappointingly-small-sounding, 1-watt requirement. Nonetheless, in the absence of our research community collectively "holding its feet to the fire" to meet such a challenge (and this includes our own research effort as well), we would submit that the credibility of the alternative energy research field is subject to erosion by false hopes and unsubstantiated claims. Alternatively, the satisfaction of such a requirement would provide a solid foundation for discussion and presentation of the reality of the energy developments we wish to bring to fruition. And this is a challenge I think can be met.

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