ABSTRACT

After four and one-half years of reporting on cold fusion and other enhanced energy devices, a bibliography of over 1500 entries has been compiled from papers gathered and reviewed from over 30 countries. This paper presents a summary progress report with an emphasis on demonstrated devices having commercial potential. An enhanced energy device that has the potential to produce 300% excess energy is defined as having commercial potential. Classes of cold fusion devices that qualify include (1) the Pons-Fleischmann palladium/lithium/heavy water system; (2) the Mills-Bush-Eagleton nickel/alkali-metal carbonate systems; (3) the Karabut-Kucherov-Savvatimova palladium/deuterium gas plasma system; (4) the Liaw-Liebert molten-salt system; and probably (5) Kaliev/Baraboshkin/Samgin bronze-crystal deuterium device; and (6) capillary fusion devices. Since March, 1989, the time of the Pons-Fleischmann first public announcement of cold fusion, there has been discovered a rich and diverse number of phenomena that produce nuclear reactions. Although these phenomena had been considered impossible but have been experimentally demonstrated and replicated by serious scientists, the result has been an increase in the study of other enhanced energy devices. Examples are DePalma-type N-machines such as (1) the Tewari Motor-generator and (2) the Inomata N-machine. There are claims, as yet not accepted in peer-reviewed literature, of substantial excess power produced by other magnetic and solid-state devices, for example (1) the J.J.Searl "Searl Effect Generator"; (2) the Methernitha TESTATIKA machine; (3) the Orlowski-Johnson Magnatron Motor; and (4) The QRM machine. Other excess energy devices include the Shoulders patented high-density charge cluster device which has been shown to produce more than 30 times excess power. There is evidence that some of these enhanced-energy phenomena have been a part of some of the experimental findings in cold fusion experiments. Some such evidence is presented and sources cited.

A. INTRODUCTION

The task of collecting, reading, reviewing, and publishing information about the new science of cold nuclear fusion has been a rewarding multi-disciplinary educational
experience. The greatest reward has been the privilege of becoming friends with a large number of dedicated scientists and engineers who have risked their reputations to continue their investigation of the new science of cold nuclear fusion. Chief among these scientists are Dr. Martin Fleischmann and Dr. Stanley Pons whose once-in-a-lifetime discovery of cold nuclear fusion has been replicated in over 30 countries and, under their scientific direction, is approaching commercialization.

This paper evaluates the commercial potential of the heavy water-palladium-lithium system of Pons and Fleischmann. In addition, several other devices are evaluated; all of which have their innovative experimental roots in the March 23, 1989, announcement by Pons and Fleischmann. The orchestrated perennial attackers of cold fusion have vented their criticism on the heavy-water cold fusion cells and have neglected the innovative products engendered by the initial Pons-Fleischmann discovery. Several researchers who accepted the validity of the announcement of cold fusion in the D₂O-Pd-Li electrochemical cells have invented or visualized additional experimental efforts. Among those who have been the most successful in not only predicting but proving that anomalous reactions can take place in or on the surface of condensed matter (especially palladium, titanium, and nickel) are Randell Mills, Robert Bush, and Robert Eagleton (light water); Bor Yann Liaw and Bruce Liebert (molten salts); Kucherov, Karabut, and Savvatimova (gas plasma); Kaliev, Baraboshkin, and Samgin (tungsten-bronze crystals); Peter and Neal Graneau, J-P Vigier, and M. Rambaut (capillary cold fusion); and Yamaguchi (gold-plated Pd sandwich). Several of these devices appear to have future commercial potential.

In addition to the new technology of heavy-water cold fusion (controversial) and light-water cold nuclear fusion (more controversial), there are other new science applications such as tapping the energy of space (much more controversial) which are described and evaluated in this paper. Some of these devices have been proposed, experimentally verified, and remain unaccepted by the standard science community. The biggest problem is that papers describing these devices have failed to pass the peer review procedures. This peer review problem engenders the following question: If new science has been discovered, who are the peers? Here is an example: Kenneth Shoulders has an impeccable reputation as one of this country's foremost inventors. He invents but he does not spend time writing technical articles. His most recent achievements have been a series of five patents totaling some 40 embodiments and over 200 claims that have laid the groundwork for an entire new high-speed electronic industry. One of his patents states that over 30 times as much energy has been produced from a high-density charge cluster than required to generate the charge cluster. The patent states, "In any event, energy is provided to the traveling wave output conductor, and the ultimate source of this energy appears to be the zero-point radiation of the vacuum continuum." Ken Shoulders has only few peers, such as Dr. Hal Puthoff, who have the direct experience to evaluate this phenomena. What journal is going to publish articles on "tapping the energy of the vacuum continuum"? If an article is written, where will the journal find peers to review the article? As amply evidenced by the actions of the Department of Energy in its treatment of cold fusion, the peer-review system fails where new science is involved!
Today's engineered products would be considered impossible by the science of even one
decade ago. Not a month passes without a peer-reviewed article in a scientific journal that
provides new facts that contradict the currently acceptable models and theories. Two of the
most cherished scientific beliefs of the past decade are (1) the concept that nuclear fusion
can only occur with sun-like temperatures and (2) the concept of the emptiness of space.
The first concept has been refuted by over 1,000 scientific papers that report on cold
nuclear reactions in a rich variety of experimental devices. The second concept is being
seriously questioned as there have been over 300 peer-reviewed scientific papers supporting
an energetic space\textsuperscript{1}. Considerable experimental evidence has been generally ignored or
denied.

The Department of Energy could use the following introductory information about space
energy: In 1930 Albert Einstein wrote, "The strange conclusion to which we have come is
this, that now it appears that space will have to be regarded as a primary thing and that
matter is derived from it, so to speak, as a secondary result\textsuperscript{2}". Some scientists, who are
convinced that Einstein forever took away the ether, discount the energetic nature of space.
Designated in the literature variously as zero-point energy, space energy, vacuum energy,
ZP fields, etc., the latest peer-reviewed scientific findings demonstrate that space indeed has
enormous energy\textsuperscript{3} and that space energy can be tapped. The reason that most of us are
unaware of the existence and magnitude of space energy is because this energy can only be
sensed or measured from an accelerating frame of reference. All of the devices that have
been demonstrated to tap the energy of space are characterized by rotating machines or by
some highly-accelerated entity (such as Ken Shoulders high-density charge clusters.) Many
anomalous discoveries have been dismissed and invention of new devices has been
subverted because of the peer-reviewed acceptance that Einstein dismissed the ether and
with it any possibility of obtaining energy from space. It is predicted that many scientists
will abruptly dismiss the concept that space has energy and that this space energy can be
commercially exploited. This paper describes some of the proven and yet-to-be-proven
devices that use space energy.

B. COLD NUCLEAR FUSION DEVICES AND COMMERCIAL POTENTIAL

A variety of anomalous phenomena have been rediscovered, remembered, or newly
discovered since the announcement by Pons and Fleischmann of apparent nuclear reactions
from the Pons-Fleischmann Effect (PFE). This section briefly describes some of those
experimental findings, cites the literature, and speculates on the commercial potential of
such devices.

1. Heavy-Water Electrochemical Cells

The original Pons-Fleischmann discovery involves electrochemical cells using heavy water,
a palladium cathode, usually a platinum anode, and lithium in the electrolyte\textsuperscript{4}. Many
research groups were unable to replicate the Pons-Fleischmann effect and some became
instant critics, even to the extent of accusing Pons and Fleischmann of fraud. However,
positive results have been obtained by research groups in more than 25 countries in
replicating the P-F effect\(^5\). Because of the geographic location of the most active critics (mainly in Eastern U.S. and in the CERN countries of Europe) there has been little cold fusion research among the Ivy-League colleges in eastern U.S. and, except for Italy, only a few cold fusion papers from Western Europe. Several groups in Eastern Europe and Russia have helped to develop a better understanding of the cold fusion technology\(^6\). However, no group has fully resolved the problems associated with the preparation of the palladium metal, the loading of the palladium cathodes, and the "turning on" of the excess heat reactions. See Fig. 1.

A heavy-water cell operated at atmospheric pressure can be expected to produce low-level excess heat, whenever the palladium cathode is loaded with deuterium such that the D/Pd atomic ratio is greater than 0.85 and provided other now well-known protocols are followed. Pressurized heavy-water cells are now being designed and tested and can be expected to produce higher levels of heat. The maximum temperature at which pressurized electrochemical cells can operate is in the range of 700°F. At higher temperatures there is no definite demarkation between liquid and gas regardless of the pressure and it is believed that standard electrochemistry would not function above this critical temperature. Dr. Pons has recently announced the expected completion ("within a year") of a commercial prototype of a cold fusion cell that is expected to produce 10,000 watts or more of thermal power\(^7\). That achievement is expected to accomplish two major tasks: first to silence the critics and second to demonstrate commercial feasibility.

2. **Light-Water Electrochemical Cells and Nuclear Transmutations**

Although the Pons-Fleischmann patent applications anticipated the use of light-water (as an addition to heavy water) in cold-fusion electrochemical cells, and Matsumoto (Japan) measured nuclear byproducts using light water\(^8\), it was Randell Mills (Lancaster, Penn.) who first showed that light-water electrochemical cells using some alkali-metal carbonates could produce excess heat\(^9\). The Mills theory of the functioning of light-water electrochemical cells has not been widely accepted. A recent paper, based on solutions to Schrodinger's and Dirac's equations for hydrogen-like atoms, provides a possible solution (energy-released transitions at deep Dirac levels)\(^10\). Drs. Bush and Eagleton (Cal-Poly, Pomona, California) have extended the light-water cold-fusion experimental work and Dr. Bush has modified his Transmission Resonance Model (TRM) to explain both the heavy-water and the light-water results as being alkali-metal-hydrogen fusion\(^11\). See Fig. 2. More recently Bush and Eagleton have demonstrated that there are definite transmutations of alkali elements by fusion with hydrogen (in the light-water electrochemical experiments)\(^12\) to produce elements with an added proton in the nucleus.

Experimental results from Bush and Eagleton and later several groups at BARC, Trombay, India\(^13\), Dr. Reiko Notoya at Hokkaido University\(^14\), and Ohmori and Enyo at Hokkaido University\(^15\) have shown that the light-water electrochemical cells are highly reproducible: usually produce 20 to 70% and occasionally up to 300% excess heat; and function with all of the alkali metals (usually as carbonates). The cathodes used are nickel, gold, silver, and tin and range from wire and plate to porous materials (such as the porous nickel used in Nickel-Cadmium batteries.)
There has been some evidence, especially in small-scale light-water electrochemical cells, that excess heat considerably higher than 300% has already been achieved. Therefore, by definition, this technology qualifies for potential commercialization. It is expected that the newer experimental discoveries in light-water electrochemical cells will certainly lead to a better understanding of the overcoming of the Coulomb barrier, of the basic structure of matter, and the control of nuclear reactions in/on a metal lattice. Although many scientists lament the end of funding for the Texas superconducting super-collider (SSC), it is increasingly apparent that there are enormous opportunities of learning about the structure and interaction of matter by further study of nuclear reactions in or near metal lattices in cold fusion reactors and at a small fraction of the cost of an SSC. This is an important reason for accelerating funding for further experimental investigations into both heavy- and light-water cold fusion reactors.

3. Molten Salts Electrochemistry

Drs. Liaw and Liebert of the University of Hawaii invented and demonstrated the use of molten salts to provide relatively high temperatures in an electrochemical cold-fusion cell. Their work showed that as much as 1500% excess heat could be achieved using palladium as the anode and using an eutectic mixture of salts in an aluminum container. See Fig. 3. It has been found that there are some serious materials problems to be resolved in working at these higher temperatures. The replication of this work has been difficult. Only a few other groups have replicated the Liaw-Liebert molten salt work. However these problems are expected to be resolved and the molten salts "cold fusion" devices become an important part of future enhanced energy systems. The high level of heat achieved does mark this technology as eligible for commercialization after the materials problems are solved. The applications for molten-salts cold-fusion devices are obviously destined for systems where higher temperatures are desired or required, such as in the manufacturing and/or processing of many glasses and metals.

4. Gas Plasma Devices

At least one U.S. inventor has filed a patent for a gas-plasma device which is expected to produce excess heat. Some excellent work using gas-plasma devices has also been performed in Russia by Drs. Kucherov, Karabut, and Savvatimova. Other gas plasma replication has been accomplished by Romadanov in Russia and by scientists in the People's Republic of China. This Kucherov et al. device uses deuterium gas at relatively low pressures and in the presence of moderately-high voltages (500 volts). See Fig. 4. It is projected that the development of this gas-plasma device will produce enhanced-energy systems that operate at high temperatures and in aerospace environments. (Neither heavy-water nor light-water electrochemical cells are deemed suitable for either high-temperature or aerospace use.) The best results that have been achieved with gas-plasma devices (over 500% excess heat) appears to make this type of cold fusion device a candidate for future commercialization.
5. Capillary Fusion

Some types of metal crystals can be made in which small diameter, long tubes or capillaries are created. Under appropriate conditions it has been experimentally shown that fusion of hydrogen can be achieved in this type of device. Dr. Vigier \(^{21}\) has described the observation of capillary cold fusion in metal wires using high amperage. After initial successes, work is being continued by Baraboshkin and Samgin in Russia to investigate this approach to the development of excess heat \(^{22}\). The Vigier article and other articles about the role of Ampère forces in nuclear fusion \(^{23}\) suggest that devices using the right combination of capillaries, hydrogen (or deuterium) gas and appropriate treatment with high-amperage electrical current may develop sufficient excess heat to be subject to commercialization. See Fig. 5. Recently, Peter Graneau \(^{24}\) presented a concept for a capillary fusion reactor. Graneau believes that it will take some expert materials engineering to produce this type of reactor because of the relatively large internal forces that are expected to be produced. However, Graneau's approach is a serious proposal for a device that would lead to commercialization of capillary fusion.

6. The Yamaguchi Pd sandwich.

Eiichi Yamaguchi and Takahashi Nishioka \(^{25}\) have shown that palladium plates that are gold-plated on one side (to prevent migration of deuterium) and plated with MnO on the opposite side (to slow down rate of deuterium diffusion) can produce nuclear reactions. The plates, see Fig. 6, are exposed first to a vacuum then to deuterium gas. Being again exposed to vacuum and triggered with an electrical pulse, both tritium and alpha particles ('He nuclei) are produced together with considerable heat. As Yamaguchi & Nishioka reported in the third annual cold fusion conference, "We have for the first time succeeded in detecting \(^{4}\)He production in situ and with high reproducibility. Our in vacuo method gives the first definite evidence for the reality of cold nuclear fusion in solids.

This work has been of great importance to demonstrate the rich phenomena involved in the production of nuclear reactions in or on the surface of a metal lattice. It is not easy to predict the degree of commercialization that can be achieved by use of the Pd sandwiches. However, the reproducibility is important for studying the parameters that are involved with the production of nuclear by products.

Note: The January issues of Fusion Facts for the years 1990 through 1993 have honored the "Fusion Scientists of the Year" who have been Pons and Fleischmann; Liaw and Liebert; Mills, Bush, and Eagleton. and most recently, Kucherov, Karabut, and Savvatimova. Except for the Pons-Fleischmann patents-pending, which are owned by the University of Utah, and Mills, the technologies developed by these other "Fusion Scientists of the Year" have been assigned to ENECO, Inc. (formerly Fusion Energy Applied Technology, Inc.), a Utah corporation, for future development and marketing. This privately-funded corporation, after thorough investigation of the commercial potential of cold fusion, has invested in the future commercialization of this new science. It is suggested that ENECO will likely become one of the world leaders in the commercialization of cold fusion.
C. OTHER ENHANCED ENERGY DEVICES AND COMMERCIAL POTENTIAL

1. The N-Machines

The author has not, as yet, mastered the three-decade history of the development of rotating machines that produce excess power (also known as over-unity machines). The basic device is the homo-polar electrical generator discovered by Michael Faraday in December, 1831. Bruce DePalma is one of the proponents and successful experimenters with machines that appear to obtain excess power by using magnets and coils rotating generator (usually driven by an electric motor.) These electrical generating machines are characterized by the following: (1) the demonstrated ability to produce more electrical power than used to rotate the machines; (2) an electrical output of low voltage but high current; (3) the dynamic characteristic that requires relatively high rotational speeds to produce over-unity power; (4) the apparent lack of increasing counter-torque on the generator shaft as high output is achieved, and (5) the requirement for relatively high magnetic field strengths

The latest articles by Bruce DePalma have been published recently in New Energy News. During the past decade (or more) P. Tewari has developed N-machines with the latest experimental work being documented in both printed and video media. His latest report and video presentations depict a machine driven by an electrical motor that is capable of rotating the generator at more than 4,000 rpm while consuming up to about one-kilowatt of input electrical power from the standard electrical mains in India. See Fig. 7. As shown in the videos and as described in his latest article, the generator has produced more than three times as much output power as being consumed by the driving motor. The output voltage is less than three volts but with high amperage. As shown in his latest paper and confirmed with video recordings, the over-unity condition is achieved at rotational speeds of about 3,000 to 4,000 rpm.

Shiuji Inomata of the Electrotechnical Laboratory in Ibaraki, Japan has developed and tested a smaller motor/generator which has been shown to produce over-unity power output. Recently, Inomata provided New Energy News with his latest design which will use superconducting magnets to increase the magnetic field strength. Inomata has derived an equation for the voltage output of the machine showing that the output voltage is directly proportional to rpm and to magnetic strength and proportional to the square of the radius of the rotating copper disks used in his machine. His calculations, based on experimental evidence with the current model (see drawing, Fig. 8) indicates by using superconducting coils to increase the magnetic force, that the output can be increased to provide 10 kW and more from a machine with 25 cm diameter copper disk.

The biggest disadvantage of the N-machines is their low-voltage output (in the range of 1 to 40 volts). The output current can be in thousands of amperes. This combination, together with the requirement that the d.c. output must be taken off a rotating disk, places substantial demands on the development of the electrically-conducting brushes. The second problem is to transform the low-voltage, high-current output into more acceptable electrical
power. Both problems have been potentially resolved by modern engineering developments. The use of hundreds of hair-like conducting-metal fibers for the brushes and the use of modern solid-state devices for transforming low-voltage d.c. into high-voltage a.c. are the proposed solutions.

Tewari's goal is to produce a motor-generator plus transforming circuitry so that the generated power can be used to drive the electrical motor and still have excess power delivered to the output load. This demonstration will be, of course, the final proof that such a machine is transferring power from a heretofore unused energy source. That source is "space energy" or ZPE (zero-point energy). We await such demonstration with keen interest.

2. The Searl-Effect Generator

There have been several reports of excess power devices by experimenters who are now deceased. However, J.J. Searl is still alive and pursuing funds to get back into production with his Searl-Effect Generator. Searl is not an academically-qualified scientist, he is, however, a successful experimenter. Although Searl has built about 40 of his power-generating devices and used them in his experimental work with levitating disks (See Fig. 9), there is, at present, no known working model of his generator. His writings are not easy to understand because they are more descriptive than explanatory. The lengthy video tape of his lectures and the pictures of the earlier construction of levitating disks is of poor quality but with some interesting historical pictures that cause the viewer to seriously consider that Searl's work may be real and promotes a desire for further engineering and scientific data on his power generator and levitating disks. One of the interesting video clips shows Searl demonstrating that his early magnets utilizing a spinning magnetic field (the video shows how a paper clip string combination would indicate magnetic spots that cause the paper clip to spin.) It is interesting to learn that Searl revealed (or demonstrated?) his work to the U.S. Air Force at Edwards Air Force base in California in about 1970. A current Air Force project is reportedly test-flying craft that appear to have similarities to Searl's work. Is this development just an historic coincidence?

3. The Swiss Methernitha Machine

According to Stefan Marinov, Paul Baumann built the first working prototype of the Methernitha machine while in jail. In his book Divine Electro-Magnetism, Marinov has the following comments: "Paul Baumann is the spiritual head of the Christian religious community METHERNITHA in Switzerland... God has given him an amazing intellect, or something more, as according to me, the machine TESTATIKA is constructed rather by inspiration than by brain." Marinov, who has seen and tested various models of the Testatika machines reports that the small single-disk machines produce some 200 Watts of free energy. See Fig. 10. The machines with two counter-rotating disks of about 50 cm in diameter produce about 3 kW and the latest, uncompleted [as of summer 1993], larger machine (disk diameter of 2 meters) is expected to produce 30 kW. All models can be started by hand and, thereafter, produce useable power, according to the many visitors who have been allowed to observe the machines in operation. Photographs of the machine are
shown in Marinov's book. A video of the machine in operation is in existence and was shown at the recent International Conference on New Energy (April 1993, Denver). Under Marinov's urging, the members of the Christian community Methernitha, voted on a proposal to reveal the secret of this machine to the world. The vote was 23-to-1 against doing so at this time. Obviously, no peer-reviewed technical papers about this machine are available. However, it is possible that Marinov's continuing research and development work will produce a similar "free energy" machine. Marinov's latest experimental work is described in "Important Information Added in Proof", pp 287-289 of reference. The Siberian Coliu machine or S-machine, is designed to tap space energy. See Fig. 11. Marinov, who has been exploring the many experimental contradictions to currently taught electricity and magnetism, is one of the world's few scientists who are intellectually prepared to produce machines that tap space energy. This "intellectual preparation" includes acceptance of an energetic space. New Energy News will continue to report on Marinov's latest developments and intellectual reports.

4. The Orlowski-Johnson Magnatron Motor

Prior to his death, Rory Johnson invented, built, and operated various "Magnatron motors", one of which was installed in his 1974 Buick Electra. Reportedly, Johnson operated his automobile for over a year without buying any gasoline. Gerald Orlowski, as an expert in electro-magnetic motors and generators, and as an employee of Greyhound Corporation was sent to investigate the Magnatron motor. As Orlowski relates in his historical review Johnson died after moving to California and finding that promised development funds were not available. One of the more interesting features of this machine was a "fuel cell" which reportedly used a mixture of deuterium and gallium and produced the increased magnetic power that was instrumental in making the engine a success. The use of deuterium and gallium is an interesting selection of chemicals in this cold fusion age, however, this combination was being used by Johnson before 1978. To my knowledge, no one has replicated Johnson's work although hundreds of people witnessed a working demonstration of his motor.

5. Can Magnetic Machines Tap Space Energy?

The Adams magnetic motor (See Fig. 12) and the magnetic motor development by Troy Reed have had considerable publicity but no peer-reviewed articles have been published. Both Adams and Reed are inventors without the standard Ph.D. qualifications to be called "scientists". Both have made claims for significant over-unity power production. Replication and/or further reports with suitable engineering data so that others can build and test these machines are required before serious comments on commercial potential can be projected. However, the DePalma, Tewari, and Inomata machines have been demonstrated. technical papers have been written and presented. and these machines appear to have significant commercial potential.
D. THE SHOULDERS INVENTION AND COMMERCIAL POTENTIAL

Dr. Harold Puthoff is one of the scientists who have written extensively about space energy. He and Kenneth Shoulders have been working in this new field of science for several years. The discovery by Kenneth Shoulders that high-density electron clusters can be produced, maintained, and controlled has laid the groundwork for a new revolution in electronic devices. Of most importance for this paper is Shoulders' demonstration (as reported in the patent discussion, prior to the claims) that under certain conditions an EV (Shoulders' name for high-density electron clusters) can produce more than 30 times the amount of energy required to produce the EV. The drawing in Fig. 13 is taken from the patent abstract and illustrates how the EVs are created and how power is obtained. Basically, the EV is produced and launched through a tube or channel which is surrounded by a wire coil. The EV is a traveling bundle of electrons, moves at about 0.1 the speed of light, and induces a surge of electrical power in the coil. The EV is captured by the anode and provides about the same amount of energy that was required to produce the EV. The power from the coil has been measured to be more than 30 times the power required to produce the EV. (In discussions with Shoulders, he reported great difficulties in producing continuous excess power due to induced electrostatic charges caused by the energetic EVs.) Shoulders' latest innovation is expected to overcome the problems and provide for a commercial product.

In the discussion given in the patent, the statement is made (and accepted by the patent examiner) that the source of power "appears to be the zero-point radiation of the vacuum continuum." It is believed that this is the first U.S. patent that has been granted which claims to tap the energy of space. The important aspect of the production and use of EVs is that the charge density (in terms of charge per cubic centimeter) is extraordinarily high, perhaps similar to ball lightning or within lightning strokes. It appears that the highly-dynamic nature of the EV actually does tap the energy of space and that a traveling EV is continually giving off energy and having its internal energy restored. There will obviously be an increasing interest in creating, launching, and studying the ways by which the energy of the EV can be coupled to provide useful work in a variety of ways.

D. PHENOMENA RELATED TO COLD FUSION

Matsumoto reported experimental results in cold fusion that Fox suggested were the results of the production of high-density charge clusters. Fox's letter and Matsumoto's kindly rejection of Fox's suggestions have been published.

EVs or high-density charge clusters can be produced within a variety of dielectrics including low-pressure gases and liquids if the bulk resistance is moderately high. The production of EVs within a palladium deuteride has not been confirmed. However, there have been several photographs shown at various cold fusion meetings (Los Alamos in May 1989 by Sandia, and at Como, Italy in July 1991 by Oak Ridge) where holes about the size of EVs (about 20 microns in diameter) have been photographed and displayed.
Any environment that produces sparks may also produce EVs. The dissolution of an EV (usually when it impacts a metal surface) produces a burst of electromagnetic energy that can be picked up on a transistor radio. Of course one should tune the radio off of any station so that the automatic volume control feature provides maximum amplification. By placing the radio near a reactor, one can easily learn something about the nature of the cell. Please note that most cells are not operated at voltage levels at which sparks may be produced. However, the fracturing of a Pd solid may produce sufficient voltage to cause EVs to be generated.

The production of heat in a cold fusion cell can be influenced by a change in the magnetic field strength in the vicinity of the cell as shown by Cravens. Others have shown that the nuclear reactions (or excess heat) in cold fusion reactors can be influenced by certain electromagnetic frequencies, and even by sonoluminescence.

The discovery of a variety of phenomena associated with the discovery and enhancement of cold fusion is now well publicized. It is to be expected that such diverse phenomena will be found to be influenced by a wide-range of environmental conditions. As these various phenomena are studied and measured, it is suggested that they be included in brief reports (such as could be published in Fusion Facts so that theorists can have more data on which to evaluate their work.)

E. PREDICTED TIME AND COST TO COMMERCIAL USE

The following table lists selected devices that, in my opinion, can be expected to provide commercial devices. My previous forecasts for the commercialization of cold fusion have been overly optimistic. The following table is based on tempered optimism, and to the extent possible, includes inputs from some of the leading researchers for the device listed. Note that an attempt has been made to list the devices in order of their expected appearance on the commercial market. Some new technologies have been identified (but not necessarily from peer-reviewed literature) and some estimates of commercial timing have been included. This list includes some speculations on the development of both room-temperature superconductivity and super batteries. Both of these developments have been demonstrated, one in Russia and the other in Ukraine. In all cases, the forecasts for commercialization are based on the concept that funding will be made available in the near future in the amounts indicated.
### TABLE I. ENHANCED ENERGY DEVICES HAVING COMMERCIAL POTENTIAL

<table>
<thead>
<tr>
<th>System or Device</th>
<th>Energy Output</th>
<th>Percent-Exc. Power</th>
<th>Year to be Commercial</th>
<th>Fund Needs in Millions of $</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFE Cell</td>
<td>10 - 20 kW</td>
<td>500</td>
<td>1994</td>
<td>$5</td>
</tr>
<tr>
<td>Charge Clusters</td>
<td>1 kW</td>
<td>1,000</td>
<td>1994</td>
<td>$1</td>
</tr>
<tr>
<td>Lt. Water CF</td>
<td>1 - 10 kW</td>
<td>300</td>
<td>1995</td>
<td>$2</td>
</tr>
<tr>
<td>N-Machine</td>
<td>10 - 80 kW</td>
<td>300</td>
<td>1994</td>
<td>$1</td>
</tr>
<tr>
<td>Glow-Discharge</td>
<td>1 - 10 kW</td>
<td>500</td>
<td>1997</td>
<td>$5</td>
</tr>
<tr>
<td>Molten Salts</td>
<td>1 - 50 kW</td>
<td>1,000</td>
<td>1997</td>
<td>$7</td>
</tr>
<tr>
<td>Capillary</td>
<td>1 - 10 kW</td>
<td>300</td>
<td>1998</td>
<td>$3</td>
</tr>
</tbody>
</table>

**Associated New Technologies**

- Hi-Efficiency Motors/Generators: 1994 $1
- Room Temp. Superconductivity: 1995 $2
- Hi-Efficiency Thermal/Electric Conversion: 1995 $2
- Super Battery Technology: 1996 $3 to $5
- Commercial Elemental Transmutation and Reduction of Radioactivity: 1997 $5 to $10

**Note:** All estimates based on discussions with R&D personnel working on various devices shown. All devices listed are based on laboratory experiments. No inventions are scheduled. Costs and times are estimated by Hal Fox from data available up to November 1993.

**Suggestions to Cold Fusion Skeptics**

The cold fusion skeptics have persistently attacked the reality of excess heat in the Pd/D$_2$O/Li reactors. This author strongly suggests that the skeptics expand their attacks to include a much wider range of so-called cold fusion phenomena. The experimental evidence now is so pervasive (both geographically and among various research disciplines) that it is now up to the skeptic to explain the nature of the phenomena being reported. There is not now (and probably never was) any substantial evidence for "pathological science", "spiking the experiments", or other attempts to discredit researchers in cold fusion. A confirmed skeptic needs to marshall sufficient scientific evidence that explains the observed, oft repeated, phenomena in the literature of over 1500 articles and papers. **Derision, personal opinions, or appeal to old science is no longer sufficient to convince the cold fusion scientific community that no new science has been discovered.**
The intransigence and fierce denial of new discoveries by many so-called scientists is neither new nor honorable nor is the hasty and unqualified denial of new experimental evidence. New science should create skepticism, and should be followed by intelligent questioning and scholarly replication among interested peers. Emotion-laden arguments in defense of truth are expected, however, scientists should welcome new discoveries and new anomalies and should not attack the personal integrity of the discoverer. Pons and Fleischmann are not the first scientists to be driven from seats of learning to continue their research in other lands. If such as they could be induced to abandon their factual discoveries, regardless of the difficulties with replication, they would not merit the title of scientists. Those who deny new discoveries, such as cold fusion, for reasons of professional territory, fear of loss of grants, or loss of prestige, retard the progress of science and inhibit the spread of new knowledge. The surest way to lose scientific prestige is to deny new science and then be proven wrong. Puthoff\textsuperscript{33} quotes Podny as saying: "It would be just as presumptuous to deny the feasibility of useful application [of space energy] as it would be irresponsible to guarantee such application."

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Fig. 1. FLEISCHMANN AND PONS
Heavy Water - Palladium - Lithium Cell

Fig. 2 CAL POLY LIGHT WATER CELL

Fig. 3. MOLTEN SALT ELECTROCHEMICAL CELL
Fig 4. GAS PLASMA DEVICE

Fig 5. CAPILLARY FUSION IN BRONZE CRYSTAL

Fig 6. YAMAGUCHI PALLADIUM SANDWICH
Fig. 7. TEWARI’S SPACE-POWER GENERATOR

NOTE: Terminal 'A' is more positive than terminal 'B'.
Terminals 'A' and 'B' are electrical output terminals.

Fig. 8. CONCEPTUAL FIGURE OF JPI-II TEST MACHINE

Fig. 9. THE SEARL-EFFECT GENERATOR

SECTION SHOWING PLATES AND ROLLERS
Fig. 10. METHERNITHA MACHINE "TESTATIKA"

Fig. 11. The S-MACHINE SIBERIAN COLIU with liquid rotating ring.

Fig. 12. ADAMS' PERMANENT MAGNET ELECTRIC D.C. MOTOR GENERATOR
Fig. 13. Energy Conversion Using High Charge Density