Electromagnetic Energy from the Vacuum:

System Efficiency (ε) and Coefficient of Performance (COP) of Symmetric and Asymmetric Maxwellian Systems

© K. Moore,[1] M. Stockton, and T. Bearden
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Abstract

Asymmetric regauging, deliberately induced in an electromagnetic (EM) system, increases the magnitude of EM energy collected, without doing work. The energy can then be used to freely do work. This paper clarifies the theoretical basis for such free energy systems, which harvest EM energy directly from the virtual-state vacuum.

We clarify thermodynamic efficiency (ε) and coefficient of performance (COP) for all Maxwellian systems — both the standard symmetric ones and the asymmetric ones not modeled by Lorentz's simplification of the Heaviside-Maxwell equations. We also clarify entropy and negative entropy, and formally correct the flawed second law of thermodynamics.

Rigorously, work is only a change in energy's form, not its magnitude. Energy collection — that is, potentialization — is always a negative entropy operation. Evans and Rondoni {11} showed that negative entropy operations are theoretically possible.

Every charge, in polarizing its surrounding vacuum, is a dipolar ensemble exhibiting the proven broken symmetry of opposite charges. Without any observable EM energy input, the charge emits a continual stream of real, observable photons spreading radially outward at light speed. Cranking a generator's shaft is **not** the source of the EM energy flowing in the circuit; cranking only creates a dipole by separating opposite charges within the generator. But it is the negative entropy operation produced by that dipole's broken symmetry that gates the emergence of observable energy from the seething virtual-state vacuum's ever-present energy repository. We focus on this subtle distinction because of its extremely useful practical implications. This is consistent with Whittaker's model {1} characterizing every EM field and potential as a continuous EM energy flow consisting of sets of longitudinal EM waves — a steady "wind" of free energy.

All observable EM energy in the universe arises in this manner: it is extracted and integrated directly from the virtual-state vacuum energy by the broken symmetry action of dipolar source charges. Lorentz arbitrarily excluded the *asymmetric* class of Maxwellian systems, modeling only the *symmetric* ones that self-enforce COP < 1.0. We give two methods of violating Lorentz symmetry, thus yielding overunity (COP > 1.0 and even COP = ∞) operation. We also falsify the naïve "perpetual motion" objections against such systems that are powered by free-energy "wind" gated and integrated from the virtual-state vacuum repository by a dipole's negative entropy operation.

We only briefly introduce our explanation for dark energy and dark matter (i.e. negative EM energy[2] and persistent Dirac sea holes) in light of Bedini's methods of evoking and using them in real EM circuits and systems — subject for a future paper.

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[1] The present paper is an update to Ken Moore's paper, "The relationship between Efficiency and Coefficient of Performance," 2002, carried on website Cheniere.org.

[2] Bedini and Bearden have filed a Provisional Patent Application on evoking and using negative energy and Dirac sea hole currents in EM circuits. Bedini has been using negative energy in his battery charging circuits for several years. Dark matter being sought by astrophysicists consists of currents of *persistent Dirac sea holes* in the Dirac sea, produced by sharp strong gradients in local vacua in processes ongoing in astrophysical objects. As a negative mass-energy electron and a source charge, a persistent Dirac sea hole continuously emits negative energy photons, producing negative energy EM fields and potentials — the so-called "dark energy" also sought by astrophysicists. Dark matter and dark energy can be induced in sharply pulsed circuits, and the resulting phenomenology can be empirically studied in the laboratory.

1.0 Introduction: System Efficiency, COP, and Work

Engineers often arbitrarily interchange the terms efficiency (ε) and coefficient of performance (COP) as if they were synonyms — which they are not. An EM system's or EM process's thermodynamic efficiency is defined with respect to **all** its energy inputs, whereas the system's COP is defined with respect to only a **subset** of the inputs (those furnished by the operator). Thus, it would be incorrect to refer to a system that outputs more energy than the operator had input as one whose efficiency exceeds 100%.

While both COP and ε are energy-output versus energy-input comparisons, they compare quite different things. For a real system with losses, the system efficiency is always $\varepsilon < 100\%$. Yet under proper conditions the system can still exhibit COP > 1.0.

Another common misconception of the definition of *work* compounds the confusion. Many people think of work as a change of *magnitude* of energy. However, rigorously, work is only a change of *form* of energy.

The basic system diagram of primary concern is given in Figure 1 below.

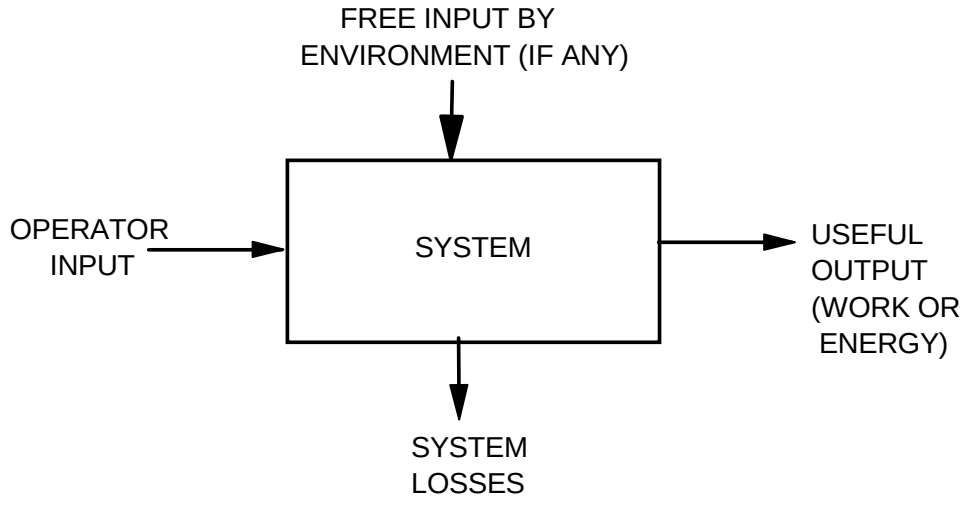

Figure 1. Basic system for efficiency and COP determinations.

1.1 **Efficiency ε** indicates how much useful work or useful energy output the system produces, in comparison to the *total energy input to the system from all sources* (e.g., from both the operator and the active environment). In Figure 1, the system efficiency is the ratio of the useful system output divided by the sum of (i) the operator's input and (ii) the input from the environment.

Conventionally, efficiency ε is this ratio expressed as a percentage.

1.2 The **Coefficient of Performance, COP,** indicates how much useful work or useful energy output the system produces in comparison to *the operator's energy input only*. In Figure 1, the system COP is given by the useful output divided by the operator's input only. The COP ratio is conventionally expressed as a decimal fraction.

1.3 **Work** is rigorously a change of *form* of some energy. A useful work process changes input energy to a different form in a way that is of use to the operator. An example is an electric motor receiving EM energy input and outputting mechanical energy that rotates a shaft. System losses produce non-useful work.

1.4 **All EM energy occurs as continuous energy flows from source charges.** All EM fields and potentials mathematically decompose into ongoing sets of EM energy flows, as shown by Whittaker {1}. All EM systems collect input energy by potentialization, but first the energy must be in the required suitable form.

1.5 **No work is done if the input energy can potentialize without changing its form**. Recall the definition of work as a change in energy's form, not its magnitude. Power is the rate of doing work. Some systems can potentialize using the input energy directly, in the exact form in which it was supplied. Because no conversion of the *form* of the energy is involved, such potentialization does not expend work. Consider the example of a receiving circuit that is potentialized from voltage in a separate circuit, in the absence of a direct dq/dt current flow between the two circuits. If current is then "pushed" simultaneously and separately (asymmetrically) through the load and losses, without being rammed back up through the back emf of the original energy source, then this free potentialization also usefully accomplishes free dissipative output work simultaneously. This class of EM system is called *asymmetric*.

1.6 **Work is done if the input energy's form must be changed in order to potentialize.** Some systems must convert their input energy to a different form before using it. In converting the energy, they expend power and work. This conversion, and the associated work, occurs *before* using the energy to potentialize. As an example, electrical engineers have been taught to build only the symmetric class of Maxwellian circuits, those which use half their collected free potentialization energy to kill the source dipole — the source of their own energy flow — faster than they power their loads. Hence, constant operation of these symmetric systems requires the operator to keep paying for input energy, to continuously keep restoring their self-destroyed source dipole. This class of Maxwellian system is called *symmetric*.

1.7 Of interest in this paper are **working EM systems**, in other words those that receive input energy and process it by changing its form to produce useful output energy or useful work in a load.

1.8 This paper is primarily concerned with systems that utilize **positive EM energy**. Negative EM energy can indeed be evoked and used in circuits and systems, producing effects and phenomenology that are startlingly different and highly useful; however, that topic is out of scope for this paper.

2.0 Four Thermodynamic Rules Always Obeyed

The clarification developed in the remainder of this paper obeys four ironclad rules:

2.1 **Energy is conserved**. Conservation of energy (the first law of thermodynamics) prohibits the efficiency of a system from exceeding 100%. Thus, the energy inputs to a working system must equal the sum of (i) the system's useful work

output and (ii) the system's non-useful losses. Useful work output is the useful change of the form of energy. Non-useful losses are those that require work that does not produce a useful result. *Obviously no system can change the form of energy that is not present and thus not available to be transduced!* That is, the best a perfect, 100% efficient, system can do is to process all of its input energy into useful work with no losses whatsoever. But most real systems inevitably have some losses — even significant losses; they do not transduce 100% of the input energy into the desired new form. Thus the efficiency of any positive energy working system with losses is always less than 100%.

2.2 **If no usable energy is input from the environment, the useful output of a system with any losses is less than the operator's input, so its COP < 1.0**. Nevertheless, the efficiency of such a system continues to be less than 100%.

2.3 **A system can exhibit COP > 1.0 if it receives sufficient excess energy from its external environment — whether or not the operator inputs anything**. Such a system's efficiency is still less than 100% — even appreciably less. An example is the common home heat pump. Its overall efficiency is about 50%, and it wastes about half of the total input energy (supplied by the operator and the environment) in losses. However, the heat pump receives so much excess heat energy from the environment that it still outputs substantially more useful work than the input that the operator furnished. Indeed, even though a heat pump has an efficiency of $\varepsilon = 50\%$, its nominal COP = 3.0 to 4.0.

2.4 **A working system can exhibit COP = ∞ if it freely receives all its energy input from the environment and none from the operator**. This is true even though the efficiency (the proportion of the total energy input that is usefully transduced) is always less than 100% and indeed may be quite low. A solar cell array power system, e.g., usually has an efficiency of only about $\varepsilon = 20\%$. However, the operator input is zero and all the energy is input freely by the environment, so the system COP = ∞.

3.0 Thermodynamics Needed to Understand the Problem

First we need to clarify the thermodynamics involved. We do this as simply as possible, considering the system primarily in stable steady-state operation.

3.1 **Systems That First Convert the Form of the Input Energy**. One type of energy system uses a process that receives input energy (from the operator or environment or both) in other than the form of energy that the system uses. So the system must first convert the input energy to a different but usable form. It can then receive and collect the resulting transduced energy in the usable form the system requires at that stage. With collected energy in a usable form, *then* the system can dissipate this usable energy to accomplish some useful work in the load, with some being lost in various system functioning called "system losses". (Refer to Figure 1 on page 2).

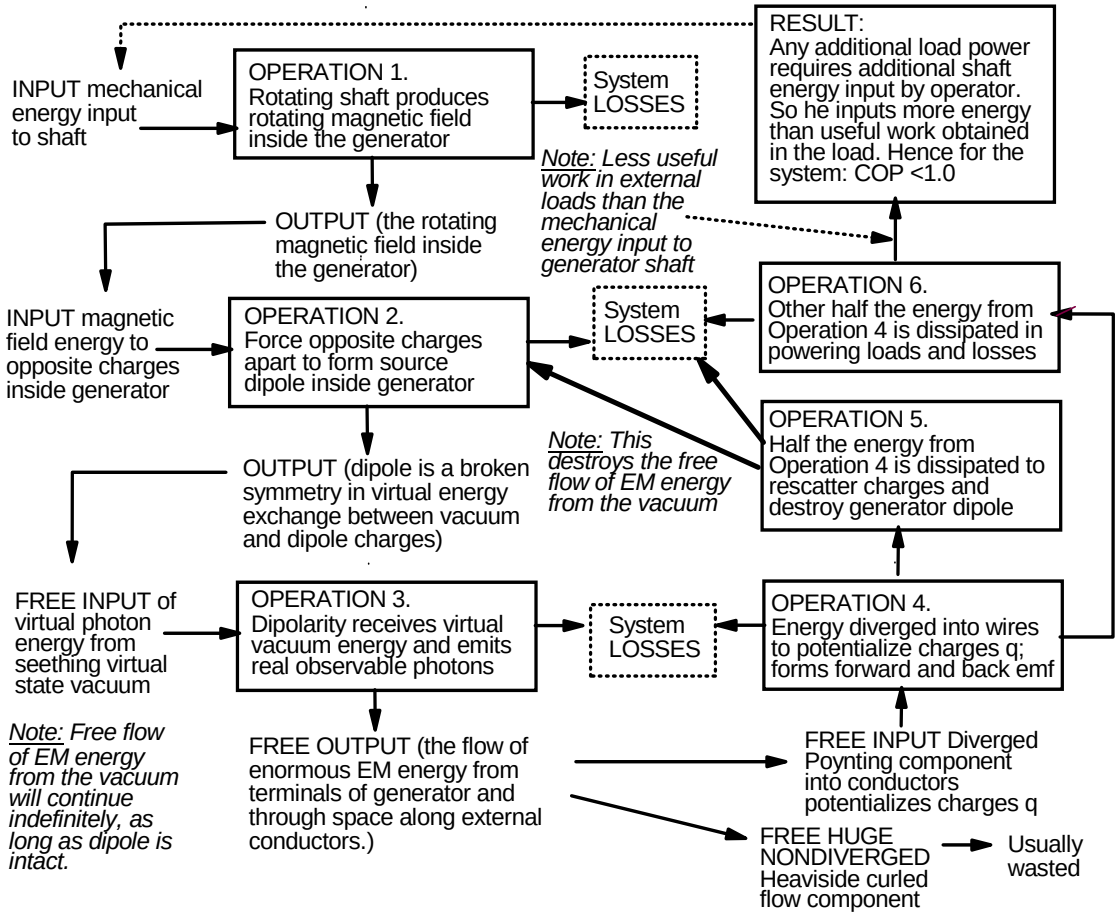

Figure 2. Six operations in generator's energy flow and powering of loads.
The mechanical energy input to the shaft of the generator does nothing but continue to remake the source dipole, that Operation 5 continually destroys due to symmetrizing the circuit design.

3.2 **Actual Source of the EM Energy Flow from a Generator**. Some of our present systems are in fact assemblies of multiple serial energy-conversion subsystems.[3] The common electrical power generator is one such system, and its operation is shown in Figure 2. The generator's input, furnished by the operator, is the energy required to mechanically rotate the generator shaft, but — contrary to electrical engineering textbooks — this shaft rotation has nothing to do with powering the generator's external loads and circuits. It only has to do with producing the internal dipolarity, by physically separating opposite charges

[3] These subsystems illustrate the fact that a single joule of input energy can do more than one joule of work, if multiple forms of change of form of the energy is done. A joule of mechanical input energy can produce up to one joule of mechanical work on the shaft, changing the mechanical input energy into up to one joule of rotating magnetic field energy. In turn, this joule of magnetic field energy can do work on the opposite charges inside the generator, forcing them apart (doing EM work) resulting in charge separation and source dipole formation. Carefully note that the conservation of energy law requires that one joule of energy can do up to a joule of work in one energy form change, but one still has all the original energy in different form. By continual change of form, a joule of original energy can result in an indefinite number of joules of work, but never more than a single joule in each change of form.

inside the generator. Once these charges are separated to form a dipole, the proven *broken symmetry of opposite charges*[4] freely extracts real observable energy from the seething virtual-state vacuum, pouring it out of the generator terminals and through space along the conductors. A giant energy flow is present (often a billion to a trillion times greater in magnitude than the mechanical energy supplied by the operator to rotate the generator shaft).

3.3 **Actual Giant Energy Flow from a Generator or Other Source**. The output energy flow from the generator's terminals has two components: (a) a giant curled energy component discovered by Heaviside {2}, which usually is not diverged and does not react with anything, and (b) the much smaller Poynting energy flow component {3} that is diverged into the conductors to potentialize the charges q (the Drude electron gas) and thus to "power the system". In the 1880s and 1890s no one could explain the energy source for the startling and immense Heaviside component. Since it usually does not diverge or interact and "does nothing", Lorentz argued that the curled Heaviside component "has no physical significance" and arbitrarily eliminated it about 1900 or shortly thereafter {4}. But the Heaviside component is still there, in every EM system, and it can be used very effectively if one knows how to do it.[5]

3.4 **Work Changes the Form of Energy**. Hence, to do some work in a working component or machine similar to the electric power generator, whatever is furnishing the original input energy — i.e., the operator or the environment — must first do some preliminary work on the conversion part of the system before the system collects *usable* energy. An example is cranking the shaft of a generator, introducing mechanical energy whose form must then be changed to rotating field energy inside the generator before it can be further used. To accomplish this change of form of the input mechanical energy, the operator must therefore perform work on that generator shaft. Figure 2 on page 5 illustrates what cranking the shaft does and does not do, and what the rotating magnetic field does, in the operation of a conventional electric power generator.

3.5 **What Cranking the Generator Shaft Does**. As shown in Figure 2, the work expended to crank the shaft of the generator has nothing to do with providing the EM energy that flows from the generator terminals and through space

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[4] Lee and Yang received the Nobel Prize in 1957 for their prediction of broken symmetry in physics, including the asymmetry of opposite charges. Wu and her colleagues experimentally proved it in Feb. 1957, and with uncommon speed the Nobel Prize was awarded to Lee and Yang in December of the same year, 1957. The impact of this great revolution in physics has unfortunately not yet penetrated electrical engineering, and particularly electrical power engineering which remains archaic and obsolete.

[5] Bearden and Moore have filed a formal Provisional Patent Application on a *negative resonance absorption* (NRAM) method of utilizing some of the enormous energy flow present in the usually-wasted Heaviside curled energy flow component that accompanies every Poynting flow. The process has been proven in physics since 1967. Applied to present power plants, the process could reduce their consumption of hydrocarbon or nuclear fuel rods by about 75%. A follow-on process would allow the operating power plant — once on line and powering its grid stably — to simply eliminate all further fuel consumption until the plant needed to be shut down again for maintenance, emergency, etc. The *optimized* NRAM process with COP = 18 has been experimentally proven many times in physics since 1967.

outside and along the conductors of the attached external circuit. Cranking the shaft rotates the rotor, which produces the rotating magnetic field inside the generator. The shaft work is done in order to change mechanical energy into rotating magnetic field energy. The rotating magnetic field, once formed, forces opposite charges inside the generator in opposite directions, thereby establishing the internal dipole. And *that is all that the energy for cranking the generator shaft does*.[6] It continually restores the internal dipolarity that the system is inanely designed to also continually destroy (Operation 5, Figure 2); the *symmetric* system destroys its internal dipolarity faster than it powers its loads!

3.6 **Source of the Energy Flow from the Generator Terminals**. Once formed inside the generator, the source dipole exhibits the broken symmetry of opposite charges {5, 6}. Broken symmetry means that the dipole continually absorbs virtual state photons in its interaction with the seething vacuum and integrates them to observable size, thereby continually radiating real observable photons (real quanta) whose energy has been extracted and integrated directly from the virtual-state vacuum. These real photons continually form and are emitted, thereby continually replenishing, at the speed of light, the "static" EM fields and potentials associated with that dipole.

Lee {7} also showed that there is no symmetry of matter alone, but only of interacting matter and vacuum. There cannot be a symmetric active matter system operating in an inactive vacuum. This fact completely falsifies the assumption, prevalent in conventional classical electromagnetics and electrical engineering, that a Lorentz-symmetric electrical power system operates in an inert vacuum and flat spacetime. It doesn't: the power system source dipole continually interacts with its active vacuum to emit a stupendous free flow of real observable EM energy extracted from that interaction.

The following traits usually characterize the type of system that self-enforces Lorentz symmetry. First, the forward emf (or mmf) is equal and opposite to the back emf (or mmf). Second, the primary "external" source remains inanely connected to the back emf (or mmf) of its own external circuit as a load whenever current is flowing.

3.7 **The Process of Transducing Virtual-State Energy into Real Observable Energy**. As Lee states {8}: *"Since nonobservables imply symmetry, any discovery of asymmetry must imply some observable. The experiment of Wu, Ambler, Hayward, Hoppes and Hudson… established the asymmetry between the positive and negative signs of electricity."* So the source dipole inside the generator breaks vacuum/system symmetry and thus must convert virtual energy — absorbed as virtual photons — to observable energy, which is then is emitted as observable photons.

[6] For the environmentalist, we also point out that inputting wind power to a windmill-powered generator has nothing at all to do with the source of the EM energy flowing from the generator terminals and powering the circuits. It only has to do with continually restoring the source dipolarity inside the generator. Similarly for the hydro-electric power plant generator and the water-wheel-driven generator.

The dipole charges receive (absorb) virtual state energy — that is, ordered individual virtual photons — from the vacuum and transduce the absorbed virtual energy to already-unitary mass-energy of the charge(s). Successive virtual increments of mass-energy are thus coherent and additive. This increases the virtual-state potentialization of the charged particle's mass energy until the next quantum level of excitation is reached. At that point, zitterbewegung "knocks out" a real observable photon, causing the excited particle to abruptly decay back to its beginning ground state by emission of an observable photon. The iterative result is the continual emission by the dipole of observable state EM energy that has been extracted from the virtual-state vacuum and coherently integrated.

Once formed, the dipole inside the generator and between its terminals freely pours out this vacuum-extracted observable EM energy flow, including both the Poynting energy flow component through space along the conductors of the external circuit, as well as the presently-unaccounted giant curled Heaviside energy flow component through that same space. The tiny Poynting energy flow component is diverged into the conductors to potentialize the electrons, in what is conventionally but inaccurately referred to as "powering the circuit". The huge Heaviside component usually is nondivergent and just wasted, flowing on off to distant space at light speed.

So the actual EM energy flow that enters the external circuit to power it and the loads comes not from the input of mechanical energy that cranked the generator shaft, but from the seething vacuum itself. The external Poynting energy flow that is diverged into and powers the circuit is also only a very small fraction of the total energy extracted from the vacuum that flows out of the generator terminals and through space around the circuit.

3.8 **Systems That Do Not Pre-Convert the Form of the Input Energy**. Another type of EM energy system receives and collects energy that is input (from the operator or environment or both) in the system's usable form. This kind of system does not have to convert the input energy to a different form in order to collect it and use it. Hence, given a free ongoing flow of its input energy from the source's dipolarity, such a system can collect energy (that is, potentialize) directly and freely, by merely diverting some of the ongoing free energy flow, *without doing any work*. It need not diminish the source in so doing, if it functions *asymmetrically* and does not use half of the energy that it collected to destroy the source dipolarity[7].

Again see Figure 2. For a COP > 1.0 energy-from-the-vacuum EM system, the energy dissipated in Operation 5 must either be zero, or less than the energy

[7] While it momentarily exists in the seething vacuum, *a single virtual photon is completely ordered*. Only a larger volume of the vacuum with many photons and other momentary particles is statistically disordered. Thus, in continually absorbing individual virtual photons, the source charge or dipole is continually absorbing *ordered virtual energy bits!* The serially absorbed ordered virtual energy bits coherently integrate (add) to the quantum level, resulting in the emission of an *observable* photon. In short, the broken symmetry of the source dipolarity functions as a true Maxwell's Demon feeding an iterative Feynman ratcheting operation.

dissipated in Operation 6. In short, Operations 5 and 6 must be mutually asymmetric, with Operation 5 the lesser in magnitude. That is, the effective back emf must be less than the effective forward emf.

With proper system design for asymmetric energy collection and use, *the dipolar source with its broken symmetry can theoretically cause the vacuum to continuously and freely furnish all the energy to potentialize the circuit*[8].

Then the system can freely dissipate the collected usable energy in the loads, outputting useful work for the operator. Collecting potential energy without changing its form is merely *asymmetric regauging, and is therefore work-free*. Asymmetric regauging provides a free new net force field to dissipate the collected regauging energy as system losses and useful system work. *The goal is to reduce or eliminate Operation 5 in Figure 2*.

Asymmetric regauging can be used to produce EM power systems that are "self-powering". Once the system is in stable COP > 1.0 operation, the operator's small energy input (for switching and control) can be replaced by a little energy siphoned from the output, and the vacuum then provides sufficient energy to power this asymmetric Maxwellian system's loads and also to power its switching and control losses.

3.9 **Conservation of Energy between Virtual and Observable States**. Overall, an energy system can output (i) useful energy flow for further use by the operator, or (ii) useful work accomplished for the operator, or (iii) a combination of both. At any rate, the conservation of energy law applies, and the total energy input to the system from all sources equals the total energy output by the system as (i) useful work or energy flow in the loads and as (ii) system losses.

Once one accounts for the enormous Heaviside curled energy flow component, a generator- or battery-powered system outputs tremendously more energy flow than the amount of mechanical work done in cranking the shaft of the source generator, or the amount of chemical energy dissipated in the source battery. *Just as there is no symmetry of matter systems alone, but only of matter and its active vacuum, there is no conservation of EM energy in matter alone, but only in the system of interacting matter and active vacuum*.

3.10 **Equilibrium.** Now consider the overall flow of energy, from input to collection and on through the system to the output (loads and losses) and back to the environment. An energy system or energy process may be in *thermodynamic equilibrium* — so that its net macroscopic energy input is zero, its net macroscopic energy output is zero, and it also has no excess collected net potential energy that it can use to output further useful work. An equilibrium system is thus one that has no *usable* additional potential energy to dissipate. Therefore *no net useful macroscopic work output* is being accomplished by a system in equilibrium, since no net energy input is entering it. This is true even though at the microscopic level small parts of the system are continuously

[8] Recall again that our present electrical engineers use only a *symmetrized* model, and design and build only *symmetrical* electrical power systems! So the world energy crisis exists and escalates as a result.

departing from and returning to equilibrium, and individually exhibiting negative entropy production followed by positive entropy production.

3.11 **Microscopic Violation of the Second Law**. Nevertheless, the individual parts of a system in equilibrium continually violate the present Second Law of Thermodynamics by fluctuations that continually depart from equilibrium and return. This was pointed out by Maxwell (also a noted thermodynamicist). Quoting Maxwell:{9}:

> *"The truth of the second law is … a statistical, not a mathematical, truth, for it depends on the fact that the bodies we deal with consist of millions of molecules… Hence the second law of thermodynamics is continually being violated, and that to a considerable extent, in any sufficiently small group of molecules belonging to a real body."*

It is very important that the reader realize that the second law of thermodynamics can be and is violated almost at will, particularly if the system is moved far from equilibrium {10}. Systems exhibiting continuous *production of negative entropy* are in fact permitted, as shown by Evans and Rondoni {11, 12}. Every charge and dipole in the universe is already just such a system, continuously producing negative entropy in the observable state.

3.12 **Departure from Equilibrium Is a Negative Entropy Operation**. When the system collects some usable potential energy from a fortuitous energy input, this "potentialization" or "excitation" of the system amounts to a collection of usable energy and order, and thereby it causes a departure from the system's equilibrium state. *That is a negative entropy operation a priori*. Hence any system that is out of equilibrium has received extra potential energy and lowered its entropy. The old second law assumes but does not account this previous excitation operation (negative entropy operation). Once excited, the system can then dissipate this excess potential energy to do some work, thereby producing some entropy, shifting itself back towards or to equilibrium. If no further negative entropy operation occurs, what results is the present old second "half-law" of thermodynamics.

3.13 **Demystifying Entropy.** Entropy is readily demystified by simply reverting to its original definition, from the system's perspective, as to what is happening to it to change the system's potential energy state. *Positive entropy production* in an EM system is primarily the dissipation of some or all of the system's collected usable potential energy, moving the out-of-equilibrium system back towards (or to) the equilibrium state. In short, dissipation of the system's excitation or potentialization decays the system back toward a state of equilibrium (or de-excitation or de-potentialization), if no other negative entropy (potentialization) occurs.

It follows that *negative entropy* is merely the addition and collection of additional usable potential energy by the system *by any means whatsoever. Potentializing or exciting an EM system by merely increasing its voltage V causes the system to collect additional potential energy E on its charges q by E = Vq. That is a negative entropy operation*, since it is merely asymmetric

regauging. It also totally falsifies the present hoary old flawed second law of thermodynamics, requiring its correction (given later herein). ***Merely increasing the voltage of an EM circuit by voltage amplification is a negative entropy operation.***

3.14 **Equilibrium Is the State of Maximum System Entropy**. A system at equilibrium is in a state of *maximum entropy*. It has already dissipated all of its available excess usable potential energy, producing the maximum positive entropy that it could produce, and thus it cannot do further work until it receives additional potentialization or excitation that moves it away from equilibrium.

3.15 **Negative Entropy Operations are Common and Ubiquitous**. Any EM energy system departs from its equilibrium state by receiving additional usable potential energy. Such excitation lowers its entropy. Lowering the system entropy is a negative entropy operation *a priori*. Therefore, any system that was originally in equilibrium, and then was subsequently potentialized and moved away from equilibrium, has undergone a negative entropy operation. This situation — neither rare nor mysterious — is in fact so commonplace and ubiquitous that it has been completely overlooked. Contrary to the view of many of the founding thermodynamicists, negative entropy operations are common in any and every useful energy system. *A system undergoes a negative entropy transition anytime it departs from equilibrium as a result of being potentialized or excited by the receipt of excess usable potential energy input*. This is true regardless of the source of the potentialization energy, and regardless of whether or not the operator "pays for" the potentialization energy input.

As an example, consider a lowly pendulum. A pendulum at rest is in its maximum entropy position, and when it is pulled back out of its equilibrium position, potential energy is added to the system and is available to be dispersed. At this point the system's entropy has been lowered, and a negative entropy operation has just occurred. The pendulum system does not care how it got pulled back or who pulled it back, as it now has additional potential energy that is available to be used, if the pendulum is released.

3.16 **Second Law of Thermodynamics Demolished**. The self-evident ubiquity of negative entropy operations makes it very apparent that a system can easily undergo either a positive *or* a negative entropy transition. This realization totally destroys the present, highly defective, old "Second Half-Law of Thermodynamics". Indeed, a system can undergo both a negative entropy interaction *and* a positive entropy interaction simultaneously, by simultaneously receiving excess potential energy while also dissipating potential energy in its loads and losses. (This paper addresses the negative entropy topic and proposes a formal correction of the present notorious second law oxymoron.)

3.17 **Near-Equilibrium Systems**. Exciting or potentializing a system usually does not move it very far from equilibrium; it is still near-equilibrium. In the absence of any further negative entropy operation, the thermodynamics describing the system's entropic decay back towards equilibrium is known as "near-equilibrium thermodynamics". Again, note the old "Second Half-Law of

Thermodynamics" just arbitrarily disregards both prior and subsequent negative entropy operations — including free ones induced by energy freely received from the environment.

3.18 **Present Inadequate Second Law of Thermodynamics**. The second law of thermodynamics, in its present uncorrected form, can be expressed as follows: *"Given some available controlled order (available controlled but usable energy; available excitation energy), this initial controlled order will either remain the same, or be progressively disordered and decontrolled over time by subsequent entropic interactions."* Or, more simply, the law states that, for an initially out-of-equilibrium system, $dS/dt \geq 0$, where S is entropy and dS is the change in entropy in time dt. In concise form, $(0 \leq dS/dt < +\infty)$.

3.19 **The Present Second Law is an Oxymoron**. The above uncorrected expression of the second law $(0 \leq dS/dt < +\infty)$ presumes the system had somehow departed from its equilibrium state by some previous negative entropy operation. *So the present defective second law describes only half of the situation* — which is why we ironically refer to it as the "Second Half-Law." *It also implicitly assumes that its own contradiction had previously occurred without being accounted for*. Specifically, it assumes that $(-\infty < dS/dt < 0)$ had occurred to the original equilibrium system at some earlier time but can be ignored.

Interestingly, note also that — contrary to empirical evidence — the uncorrected second law prohibits any excitation or potentialization whatsoever of an EM system, since it allows only zero or positive entropy production in the system.

The present "Second Half-Law of Thermodynamics" does not address at all the negative entropy operation that excited the system to depart it from equilibrium in the first place, thereby reducing its entropy and allowing it to then produce entropy and work. In short, it is a "special situation" law only and an oxymoron. It implicitly assumes that its own contradiction — a negative entropy operation — has previously occurred, but disregards and does not account for it. It also assumes that no new negative entropy operation will intervene again as the excited system decays back to equilibrium. *The so-called second law was always a highly special case and never a general law of nature at all. It has been mistakenly and dogmatically interpreted as a general "law" for more than a century.*

3.20 ***Formal Correction of the Old Second Law***. To correct the second law, we simply account for the system's assumed previous negative entropy operation and allow intervening new negative entropy operations as well. Hence we restate the corrected second law in the following form: *"First a negative entropy interaction occurs in the equilibrium system to produce some controlled order (available controlled energy), moving the system away from equilibrium and lowering its entropy. Then that initial available controlled order will either remain the same (not be dissipated) or be progressively disordered and decontrolled (dissipated) by subsequent entropic interactions over time, unless additional negative entropy interactions also occur and intervene."*

Or, simply put, ($-\infty < dS/dt < +\infty$) if negative entropy interactions also occur as well as positive entropy interactions. *The corrected second law now allows negative entropy engineering*. If additional negative entropy operations do not occur after the first one, and the system entropically decays back toward equilibrium, for this special case the law can be expressed as two serial operations which are ($-\infty < dS/dt \leq 0$) + ($0 \leq dS/dt < +\infty$). The old second "half-law" is just the rightmost term, while the ignored negative-entropy operation is the first term. The *corrected* second law now is also consistent with the numerous violations of the second law that are well-known in the literature {10, 11, 12}. As corrected, it now just states that, in general, either positive entropy-producing operations or negative entropy-producing operations can occur in a system. The special case of the *old* second law is included and its assumed previous negative entropy interaction is accounted for.

More than a century ago Maxwell himself {9} pointed out that the individual parts of macroscopic systems are continually violating the old Second Law anyway. The appearance of an ordered virtual photon in the virtual-state vacuum is a negative entropy operation (fluctuation) to space/vacuum, and its disappearance is a positive entropy operation to the vacuum.

3.21 **The Importance of Near-Equilibrium**. It is not commonly realized that entropy and entropy production involve only systems near equilibrium. Quoting Prigogine {13}:

> *"Entropy ...cannot in general be expressed in terms of observables such as temperature and density. This is only possible in the neighbourhood of equilibrium... It is only then that both entropy and entropy production acquire a macroscopic meaning."*

3.22 **Systems Far from Equilibrium**. The normal near-equilibrium thermodynamics is inadequate to describe the functioning of a system that has moved far from equilibrium. Instead, the thermodynamics of a system far from equilibrium is required. Such systems have extensive energy exchanges ongoing inside them, between their various parts and with their active environment as well. In stable operation they become *nonequilibrium steady state* (NESS) systems.

A NESS system is permitted to perform five seemingly "magical" functions. Such a system can permissibly (1) self-order; (2) self-oscillate or self-rotate; (3) output more energy or work than the energy input by the operator alone (the excess energy input comes freely from the environment); (4) power itself and its loads (all the input energy required is freely input by the active environment), and (5) exhibit (produce) negative entropy. *Non-equilibrium thermodynamics already includes the ability to accomplish negative entropy engineering, in contrast to the entropic engineering currently developed and universally taught*.

4.0 Derivation of System Efficiency

Thermodynamics texts "define" the efficiency of various kinds of energy systems in many different ways and with many different ground rules for their application. The same

can be said for the numerous "definitions" for COP and the multiplicity of rules that accompany their application. Herein, we define energy system efficiency so that it is consistent with the more widely recognized thermodynamics texts {14, 15} with respect to energy flow (see also Figure 1).

4.1 Thus, the energy system efficiency (ε) may be defined as the *total useful energy output* (E_{out}) (excluding system losses which are unusable) divided by the *total energy input* (E_{in}) from all sources:

$$\varepsilon \equiv \mathbf{E_{out\ (total\ useful)}} / \mathbf{E_{in\ (total)}} \qquad \text{[joules/joules]} \qquad (1a)$$

By convention, ε is expressed as a percentage, so we rewrite equation (1a) to express it in percentage as:

$$\varepsilon \equiv [\mathbf{E_{out\ (total\ useful)}} / \mathbf{E_{in\ (total)}}] \times 100\% \quad \text{[percentage]} \qquad (1b)$$

4.2 We may rigorously define *power* as the average time rate of doing work (changing the form of some energy). For an electromagnetic system, it is often convenient to work with the *average useful power output* (P_{out}) — i.e., dissipated by the system load — divided by the total *average input conversion rate or power input* (P_{in}) {16}. So by using average powers[9], we have:

$$\varepsilon \equiv \mathbf{P_{out\ (total\ useful)}} / \mathbf{P_{in\ (total)}} \qquad \text{[watts/watts]} \qquad (2a)$$

Again, expressing the ratio as a percentage, we have:

$$\varepsilon \equiv [\mathbf{P_{out\ (total\ useful)}} / \mathbf{P_{in\ (total)}}] \times 100\% \text{[percentage]} \qquad (2b)$$

4.3 The terms may be expressed as averages, or as steady state values, or as instantaneous values at a given time. In a perfect energy system without losses, total usable energy output would equal total energy input. The efficiency of such a theoretically perfect system would be 100%, by the conservation of energy law. For an energy system with losses, total usable energy output will be less than the total energy input. Hence for a normal working system with losses, the efficiency range will always be less than 100%. So the efficiency ε of a working energy system is bounded as follows:

$$\mathbf{0\% < \varepsilon \leq 100\%} \qquad (3)$$

5.0 Derivation of System COP

The *coefficient of performance* (COP) of a system, conventionally expressed as a decimal fraction, is often mistakenly "defined" or used in the same manner as the

[9] Actually there is no "power input" directly to a generator. There is a *mechanical energy* input rate, and since the generator is a pre-conversion system, this mechanical energy is changed in form to internal rotating magnetic field energy, providing a rate at which energy conversion (work) is done. Rigorously the "power" spoken of as "input" is that *rate of conversion* of the form of the input mechanical energy.

efficiency[10]. Then special "rules of thumb" are rather arbitrarily invoked to apply the COP to a system {17}. If the relationship between efficiency and COP is to be rigorous and truly clarified, the definition of COP must be made clearly different from the definition of efficiency — since for some systems (such as a common home heat pump) one finds that $|\varepsilon| < |\mathrm{COP}|$. Indeed, for a typical heat pump, nominally the efficiency $\varepsilon = 50\%$ and yet the system's COP = 3.0 to 4.0.

5.1 The COP provides a relative indicator to evaluate the performance of each system in terms of the energy input by the user or operator (and paid for by him) and the useful energy output generated by the system. In short, it is meant to characterize the operator's "bang for his buck." This leads to COP as the relationship between the *total useful energy or work output* and the *total input energy that the operator must supply and pay for* in order to make the system function properly {18, 19}. Thus,

$$\mathbf{COP \equiv E_{out\ (total\ useful)} / E_{in\ (operator)}} \quad \text{[joules/joules]}, \qquad (4)$$

And for average powers, the average COP is given by

$$\mathbf{COP \equiv P_{out\ (total\ useful)} / P_{in\ (operator)}} \quad \text{[watts/watts]}. \qquad (5)$$

Again, COP is usually given as a decimal fraction. As we noted, for certain systems the operator input during system operation can be zero, and the system continues to operate and produce useful energy or work output because the environment freely inputs all the required energy. For example, a windmill, waterwheel and sailboat are examples of such systems, and it is clear that the environment in which the system is operating supplies all the required input energy. It is also clear that for such systems, the COP = ∞, since the operator's input is zero. Yet, ε is less than 100%, because each of those systems has serious losses — e.g., a good windmill only has $\varepsilon \approx 40\%$.

So the *efficiency* of these COP > 1.0 energy systems is still bounded between zero and 100%, which means that $\mathbf{E_{in\ (total)}}$ from equations (1a) and (1b) must have an additional component other than $\mathbf{E_{in\ (operator)}}$. Otherwise, the system would be creating extra energy from nothing, in violation of the conservation of energy law and most of physics itself. Logically, from the empirical evidence (e.g., the windmill, waterwheel, solar array, and sailboat) *the environment is the source of additional input energy***.** Therefore,

$$\mathbf{E_{in\ (total)} = E_{in\ (operator)} + E_{in\ (environment)}} \qquad (6)$$

Thus the energy efficiency as shown in equation (1a) and conventionally expressed as a percent is more precisely defined as:

$$\boldsymbol{\varepsilon} \equiv \{\mathbf{E_{out\ (total\ useful)} / [E_{in\ (operator)} + E_{in\ (environment)}\ ]}\} \times 100\% \qquad (7)$$

[10] The authors estimate that 90% of present electrical engineers and 50% of physicists do not clearly understand the difference between ε and COP. Most are very uncomfortable with the case of COP = ∞.

6.0 Discussion

Equation (7) anticipates the possibility that the operator's input energy for a system can be zero, while the environment inputs all the required energy. However, even though system COP = ∞, the efficiency will still be less than 100% due to the inherent losses in the system, such as shaft friction, aerodynamic drag or hydraulic drag, etc., all of which serve to attenuate the useful output. The same or analogous arguments apply to electromagnetic systems, where *the environment is the active vacuum (virtual particle flux of the virtual state oscillations of the vacuum) or curved (active) space-time*. Evans et al. from the Alpha Foundation's Institute of Advanced Studies (AIAS) have published new physics based upon non-Abelian O(3) electrodynamics, which is a subset of the Sachs unified field theory derived from the Einstein theory of general relativity {20, 21, 22}. Indeed, Evans has now formally extended his theory to a unified field theory, using Einstein-Cartan-Evans geometry.

To date the AIAS has published numerous papers describing the new non-Abelian O(3) electrodynamics that accurately calculates and solves many problems that the current Abelian U(1) electrodynamics does not solve {23, 24, 25}. Several of these AIAS papers show that the vacuum is not an empty void as it is erroneously modeled in classical electromagnetics and electrical engineering (CEM/EE). To be accurate, one should model every EM system as operating in an active and energetic spacetime that can be used for additional energy exchange with a properly designed electromagnetic system {26, 27, 28}. Again, there is no symmetry of mass systems alone; instead, there is only symmetry of the *system* of interacting mass and vacuum.

Accordingly, the efficiency of an electromagnetic energy system can be more precisely defined from equation (2b) as follows:

$$\boldsymbol{\varepsilon \equiv \{P_{out\ (total\ useful)} / [P_{in\ (operator)} + P_{in\ (environment)}]\} \times 100\%} \qquad (8)$$

Then by rearranging equation (8) and solving for $\mathbf{P_{out\ (total\ useful)}}$:

$$\mathbf{P_{out\ (total\ useful)} = [\varepsilon/100\%] \times [P_{in\ (operator)} + P_{in\ (environment)}]} \qquad (9a)$$

$$\mathbf{P_{out\ (total\ useful)} = [\varepsilon/100\%] \times [P_{in\ (operator)}] + [\varepsilon/100\%] \times [P_{in\ (environment)}]} \qquad (9b)$$

Dividing each term of the equation by $\mathbf{P_{in\ (operator)}}$ and rearranging gives:

$$\mathbf{P_{out\ (total\ useful)} / P_{in\ (operator} = [\varepsilon/100\%] \times [1 + P_{in\ (environment)} / P_{in\ (operator)}]} \qquad (10)$$

Substituting the left side from equation (5) defines the COP as:

$$\mathbf{COP \equiv [\varepsilon/100\%] \times [1 + P_{in\ (environment)} / P_{in\ (operator)}]} \qquad (11)$$

Equation (11) tells us that the electromagnetic system COP is a function of (a) its *efficiency* and (b) the ratio of the *environmental input power* to the *operator input power*. If the operator input power is zero, the COP becomes infinite, as in the examples of the windmill, waterwheel or sailboat. If the net environmental input power is zero, the system

absolute value of the COP equals the absolute value of the system efficiency, as for a normal under-unity COP electromagnetic system, where the operator furnishes all the input. Equation (11) also shows that the COP of an EM system can be over-unity, and can also range from 1.0 to infinity.

So asymmetric COP > 1.0 Maxwellian systems are permitted by nature although arbitrarily excluded from present CEM/EE theory. *The only reason that the world has not had cheap, clean EM energy for half a century is because the scientific and engineering community has continued to teach, design, build, and permit only symmetric EM power systems* (such as the generator system in Figure 2).

7.0 Invalid Objections by Skeptics

For more than a century skeptics have argued that electrical power systems exhibiting COP > 1.0 by extra energy input from the vacuum are impossible because it is "prohibited by the laws of thermodynamics", and it constitutes "perpetual motion". These objections are invalid for the following reasons:

7.1 First, *all* of the EM energy in a system or circuit comes from the seething vacuum, as previously discussed. Second, every EM system already exhibits COP >> 1.0, if the long-neglected stupendous Heaviside energy flow component is accounted. Third, the thermodynamics law quoted by the skeptics (the old second half-law) applies only to a "closed system" in near-equilibrium. Even then, it implicitly assumes its own self-contradiction has previously been applied to an equilibrium system but the negative entropy operation has been ignored and unaccounted. *It does not apply to an "open system" far from thermodynamic equilibrium*. When the input from the vacuum to the source charges and dipoles is accounted, every EM system is in fact a far-from equilibrium system. See again paragraph 3.22. Theoretically, any EM system or circuit is permitted to exhibit COP > 1.0 or COP = ∞, once its self-symmetrization operation (e.g., Operation 5 in Figure 2) is nullified. Hence with Lorentz symmetry violated, the system can permissibly (i) self-order, (ii) self-oscillate or self-rotate, (iii) output more energy or usable work than the energy input by the operator alone, (iv) power itself and its loads simultaneously (exhibit COP = ∞), and (v) produce negative entropy.

Indeed, Evans and Rondoni {11} have shown theoretically that a real system can produce continuous negative entropy. *Voltage amplification (amplification of potential) to charges q in the circuit, while dq/dt = 0, freely increases the collected potentialization energy and does not in itself require work. It need not deplete the source at all.* The formula of interest is energy E_c collected on potentialized charges q from voltage V is given by $E_c = Vq$. *There is no power or work involved in that formula!*

Further, every charge and dipole in the universe already continuously and freely produces negative entropy, thus providing the experimental proof for Evans' and Rondoni's theoretical proof as well. *Simply applying voltage to a circuit with current flow momentarily pinned is a purely negative entropy operation because it constitutes free asymmetric regauging.*

The professional critics have been wrong for a century. Unknowingly, they have all enforced Lorentz's arbitrary discarding of all *asymmetric* Maxwellian systems – such as those that perform voltage amplification without allowing simultaneous current flow. Hence not one of the skeptics has knowledge of — or experience in — *asymmetric* Maxwellian circuits and systems. The entire class of professional skeptics has no knowledge of how an EM system is actually powered (see Figure 2), or where the EM energy flowing through space around a circuit actually comes from. Few if any are aware of the giant Heaviside energy flow component.

Present thermodynamics is also a bit flawed. E.g., long before general relativity and the knowledge that mass and energy are one and the same thing, thermodynamicists defined a "closed system" as one that is closed only with respect to mass exchange across the system boundary while freely allowing energy exchange across it. What they did not know was that to change the energy of the system is to relativistically change its effective mass also.

Hence, energy exchange (and consequent relativistic mass exchange) across the boundary of a "closed" energy system is permitted by the present thermodynamics theory in a thermodynamically "closed system". At best that is only an approximation and not rigorous at all, in light of more modern understanding. Since mass and energy are one and the same thing, the present old thermodynamic definitions of closed system and open system *really are not mutually exclusive*, and that is a significant non sequitur in the aged thermodynamics itself. These equilibrium and disequilibrium relationships will be clarified further in the charts and text below.

7.2 *Perpetual motion universally exists* and in fact has nothing at all to do with working EM systems, their efficiency, or their COP. Objection to perpetual motion itself is invalid because Newton's first law of motion is *the law of perpetual motion*. Once an object is placed in a state of motion in space, it will *perpetually* remain in that state of motion until acted upon by an intervening force to change its state of motion. Further, solid state physics students in a good university routinely perform legitimate *perpetual motion experiments* in their sophomore laboratory. When a superconducting current is induced in a closed superconducting loop, it will essentially flow forever, as pointed out by Feynman in his three volumes of sophomore physics in 1964. Quoting:

"First, there is no electrical resistance. There's no resistance because all the electrons are collectively in the same state. ... A current once started, just keeps on going forever."

The estimated age of the present universe is about 12 to 13 billion years. The *half-life*[11] of a circulating superconducting current in a closed loop is estimated as about 10^{23} years {29}. That's certainly "infinity" for all practical

[11] *Half-life* does not mean half the entire life of the current! Instead, it means that part of its lifetime where the current decays (exponentially) to half its initial value.

purposes — and as an approximation it's at least "good enough for government work", as the old saying goes.

7.3 Max Planck {30} gave one of the standard erroneous "forbidden perpetual motion" statements that have continued to be improperly accepted. Quoting:

"It is in no way possible, either by mechanical, thermal, chemical, or other devices, to obtain perpetual motion, i.e., it is impossible to construct an engine which will work in a cycle and produce continuous work, or kinetic energy, from nothing."

Let us analyze this statement.

Planck advances one premise (*perpetual motion is impossible*) which is false. It is contradicted by Newton's first law (the law of perpetual motion) which is experimentally confirmed. Planck's second premise (*it is impossible to construct an engine which will produce continuous work or energy from nothing*) is true since otherwise the system would contradict the conservation of energy law (first law of thermodynamics). However, Planck then equates the two premises with his *"i.e.,.."* and thereby claims that the true premise proves the false premise because they are identically the same thing. It is a simple logical non sequitur to claim that a false premise and a true premise can be the same thing. This claim amounts to $A \equiv \bar{A}$, thus violating the third law of logic. It is recognizable by any person who has had an elementary course in sophomore symbolic logic. It appears that, with more than a century of skeptics advancing Planck's statement or similar, not one has bothered to perform a simple logical analysis of statements such as Planck's, or has recognized that perpetual motion is not only possible but ubiquitous as Newton's first law.

7.4 So those who confuse perpetual motion (Newton's first law) as implying the creation of energy from nothing by a working system need to re-examine their own false thesis. Perpetual motion (Newton's first law) requires no further energy input and the system in perpetual motion does no external work. *Perpetual motion in fact has nothing at all to do with working machines and their converting input energy into another energy form, thus producing work*. A true perpetual motion "machine" (any object in perpetual motion by Newton's first law) receives no further net input energy and does no work.

7.5 In legitimate COP > 1.0 EM systems freely receiving excess energy input from the vacuum environment, the present paper has clearly specified the origin of the energy inputs. Furthermore, the thermodynamic definition for a closed system permits energy exchange for a disequilibrium state, which permits a steady-state COP > 1.0. Rigorously, the discriminator for permissible COP > 1.0 operation is sufficient excess energy input from the environment that is received by the system in its non-equilibrium state.

7.6 On the perpetual motion issue, one of the authors (Bearden), in an e-mail dated 21 June, 2002, summarized a successful defense against a perpetual motion machine charge, for a leading physics journal of a questioned paper

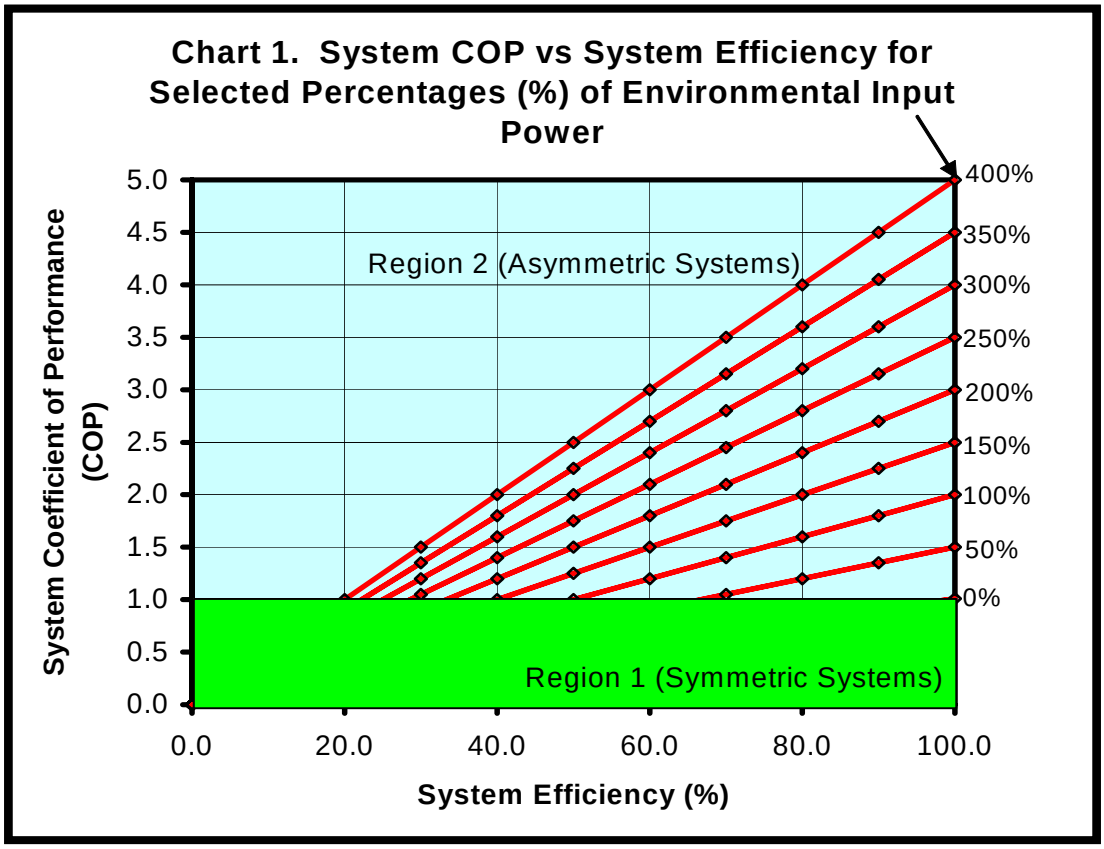
dealing with *canonical momentum*, based on the observable energy output of a source charge without any *observable* energy input, as follows:

"A strong rebuttal to the charge of 'perpetual motion nonsense' (levied by a senior Board Member of the actual corporation owning that set of journals) was what got the second MEG [Motionless Electromagnetic Generator] paper published in Foundations of Physics Letters. We confronted [them] with the proven broken symmetry of the charge and the dipole, each of which has COP = infinity. We also confronted them with the solution to the source charge problem, which does not exist in classical electrodynamics, and then challenged them to either present a solution to it in classical electrodynamics (CED) or accept the fact that CED already accepts total destruction of the conservation of energy law. The [cited] award of the Nobel Prize to Lee and Yang [in 1959] for their broken symmetry prediction cinched it. If they then objected to COP > 1.0, it meant that they had to exclude from electrodynamics all charges and dipoles. Since all fields and potentials and their energy come from their source charges, this meant they would have to exclude all EM fields and potentials — and thus all EM energy. In short, without COP = infinity of those charges, all electrodynamics models 'eat themselves by swallowing their own tail.' So the charge either falsifies conservation of energy altogether and destroys all electrodynamics, or it clearly proves that COP > 1.0 EM systems are not only possible, but ubiquitous."

To further cinch the argument, Evans and Rondoni {11} already proved that a real system can in theory produce continuous negative entropy. And the source charge proves it experimentally. That is a dramatic theoretical and experimental falsification of the "Second Half-Law of Thermodynamics", requiring its correction to function as a "full-law" of thermodynamics (See paragraph 3.20).

7.7 Chart 1 below presents the solutions to equation (11) graphically, using selected ratios of environmental input power (EIP) to operator input power (OIP). The selected ratios shown in Chart 1 have been expressed as a series of percentages that indicate the contribution of the *environmental* input power with respect to the *operator* input power. Thus, the curve labeled "400%" means the environment contributed four parts to one part from the operator, which is held constant at "100%". For each selected EIP percentage, the system COP was computed (using equation (11) for stepped values of system efficiency (every 10%) from 0% through 100%. The resulting plots show a family of linear curves, all of which originate at the origin.

7.8 Chart 1 below indicates that if the environmental input power is sufficiently large, say four times (400%) the operator input power (100%), and the system efficiency is 50%, then the COP would be 2.5, which indicates the achievement of an over-unity system. The breakpoint for a 50% efficient system would occur when the environmental and operator inputs were equal, producing a COP = 1.0.



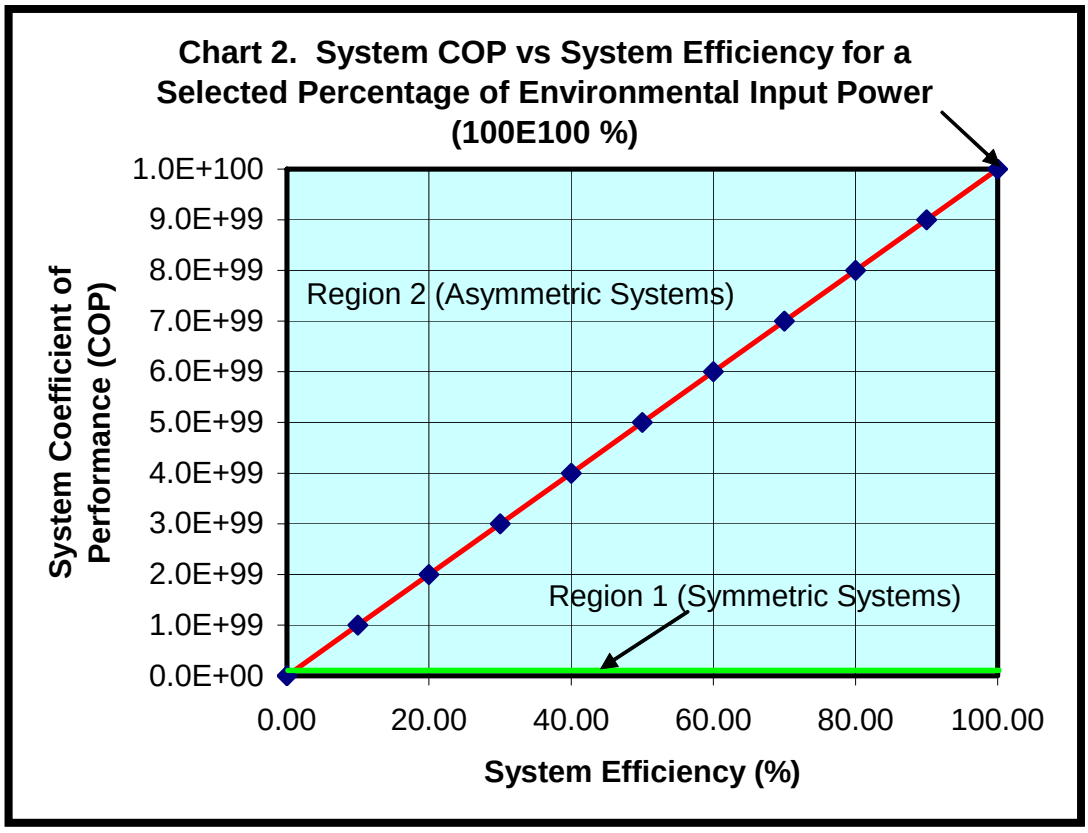
7.9 The shaded area just above the system efficiency plot axis, which is bounded by system COP value 1.0 and system efficiency values 0.0% and 100.0%, represents the region of system operation where the laws of near-equilibrium thermodynamics apply (Region 1, green). In that region, the well-known first and second laws limit the COP and the efficiency to 1.0 or less {14, 15}. Thus, Region 1 by definition is limited to *symmetric systems*, where the useful input and output energies including losses are always in balance. Again see Figure 2 for an example of how our electrical engineers build and use only *symmetric* Maxwellian electrical power systems. In Figure 2, operations (5) and (6) are due to the symmetric regauging and thus the equal and opposite forward and back emfs. As can be seen, symmetric systems arbitrarily self-enforce Lorentz symmetry, hence restricting the overall operation to COP < 1.0.

7.10 The area above Region 1 on Chart 1, where the system COP value is bounded between 1.0 and 5.0 and the system efficiency is bounded by the values 0.0% and 100.0%, defines the region where the laws of non-equilibrium (or disequilibrium) thermodynamics apply (Region 2, light blue). In other words, in Region 2 the system has been designed or modified to perform as an open system that is far from thermodynamic equilibrium with its environment {15, 31, 32, 33, 34}. Thus, Region 2 corresponds to *asymmetric systems*, where

the useful output energies are always greater than the operator's input energies.

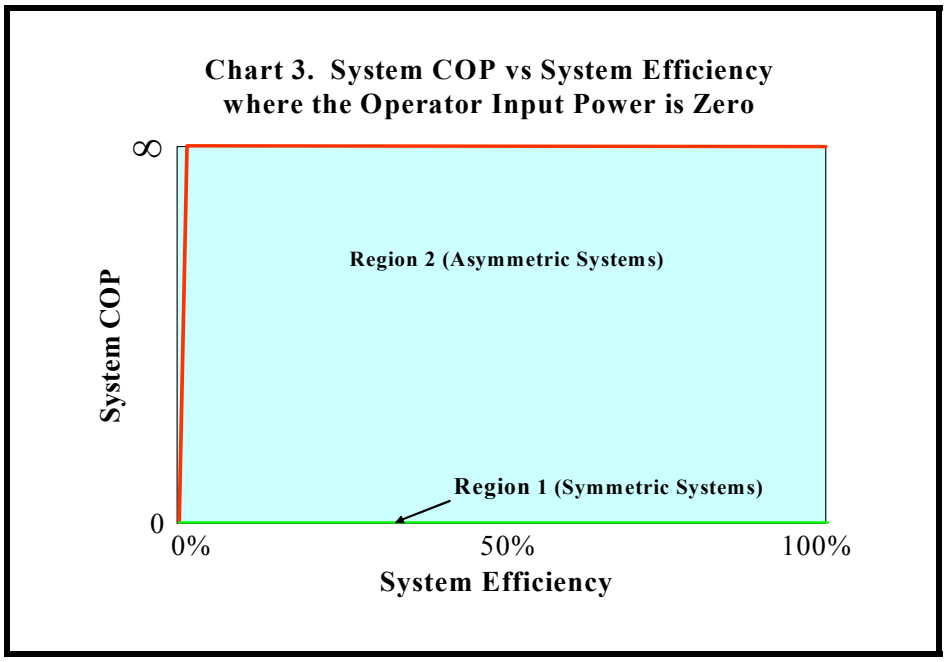
7.11 Chart 2 below shows another plot for equation (11) where the EIP has been set to a very large value, and it follows that a linear relationship remains throughout Regions 1 and 2.

At this scale for Chart 2, Region 1 is a thin rectangle along the system efficiency axis, which is drawn to an exaggerated vertical scale to be able to see it.



7.12 The implicit assumption for these curves generated by equation (11) and displayed in Charts 1 and 2 is that the system is stable and linear in the production of its output. It is well recognized that many systems (especially electromagnetic systems) may tend to be non-linear and may operate in an unstable or partially stable manner. Hence, actual results obtained may be attenuated due to the non-linear nature of the system being developed and tested. In this context, these curves may be regarded as the theoretical limits of actual results obtained.

7.13 As noted above, the maximum value for the system COP can be infinity, which is consistent with equation (11) when the operator input energy is zero. Chart 3 below shows this relationship, which is drawn conceptually and not to scale.



7.14 Chart 3 illustrates "self-powering" systems such as the windmill, waterwheel and sailboat. As another example, it indicates the impact of using solar cells to power electronic circuits, such as those that operate communications satellites. Thus, it also shows the effects on an asymmetric COP-greater-than-unity system that has been closed-looped, so that all input energy is supplied by the environment, which in this example would be photon energy from the sun. Chart 3 also indicates the system efficiency must be large enough to overcome inherent system losses, which explains why the system COP does not reach infinity at 0.0% efficiency. In a real self-powering system, the operator normally must input enough energy to "prime the pump". Once this is accomplished, the operator input is removed and the environment inputs the energy thereafter.

7.15 *Recall again that there is no symmetry of matter (that is, a purely matter system) alone; there is only the symmetry of the matter system and its interacting vacuum.* Hence a symmetric EM system limiting its COP to COP < 1.0 does so by deliberately halving and using its freely collected EM energy from the vacuum to power not only the loads and losses of the external circuit but also to kill its own source dipole equally as fast inside the generator. The arbitrary scientific and engineering Lorentz limitation to such symmetric-only EM power systems has caused the escalating world energy crisis and has been responsible for the deaths of hundreds of millions of people worldwide — in poverty, starvation, squalor, and misery.

7.16 Clearly, the goal of the system designer should be to maximize the system COP by achieving the highest possible system efficiency (as close to 100% as possible) and the highest possible free environmental energy input, while minimizing the operator's energy input needed to make the system function properly. The ultimate design goal, of course, is to use an asymmetric electric

power system and close-loop it using *only* its environmental EM energy input from the vacuum (see again Figure 1). Such close-looping (feedback of a bit of the external output energy to replace the operator's normal input) entirely eliminates the operator's energy input and thereby produces an asymmetric system with a COP of infinity. The major reason such asymmetric systems have not been designed and produced is that *Lorentz arbitrarily and erroneously discarded all asymmetrical Maxwellian systems circa 1892*, and electrical engineering departments continue to promulgate and teach only that crippled remnant of the Maxwell theory. For a century the professional arch skeptics have also thoroughly confused the issue by introducing irrelevant and misunderstood charges that such asymmetric energy-from-the-vacuum systems would be "perpetual motion machines producing work without any energy input" and other such nonsense.

With the proof of broken symmetry in 1957, we are already nearly a half century late in incorporating — into electrical power systems experimentation, design, and implementation — the broken Lorentz symmetry that modern physics has already proven (as in the asymmetry of opposite charges). Sadly, the entire scientific community has failed to update the seriously flawed and horribly archaic CEM/EE model.

With the escalating energy crisis worldwide, increasing struggles for fuel resources, increased conflict between developed nations and less developed nations {35}, and the looming catastrophic collapse of the United States economy, the leaders of the scientific community should be strongly galvanized *(preferably by a formal Presidential Directive)* into a funded national "crash project" to correct the flawed old CEM/EE model and provide a new electrodynamics that includes both the familiar symmetrical and the unfamiliar asymmetrical Maxwellian electrical power systems. They should also fund and unleash the young doctoral candidates and postdoctoral scientists in exploratory research to discover, design, and build new *decentralized*, *asymmetrical*, *self-powering* electrical power systems taking all their necessary input energy directly from the active vacuum, and thus freely powering their loads without consuming fuel.

7.17 Additional pertinent references {36, 37, 38, 39} are also given at the end of this paper.

8.0 Conclusions

8.1 The true source of EM energy flow in a circuit is the seething virtual-state vacuum environment, with individually ordered virtual photons being continually and serially absorbed by all charges and dipoles, and integrated coherently into real photons, which are continually and steadily emitted in all directions. Every charge's or dipole's associated EM fields and potentials — and all their field energy and potential energy — is steadily being produced and

replenished at light speed in this fashion, by the proven broken symmetry of opposite charges.[12]

8.2 Lorentz arbitrarily discarded all asymmetric Maxwellian systems, retaining only that small class of symmetric systems whose back and forward emfs (electrical circuit) or mmfs (magnetic circuit) are forcibly made equal and opposite, so that no net (asymmetric) free force field remains that could perform free work in a load with the freely received energy from regauging. Lorentz symmetrization self-enforces COP < 1.0 for energy-from-the-vacuum EM systems, thereby resulting in our highly vulnerable national dependence on foreign fuels, materials, and resources. It also threatens an impending catastrophic economic collapse of the U.S. and the developed Western world.

8.3 The present second law of thermodynamics (prior to the correction given in this paper) is an oxymoron, implicitly assuming that its own contradiction has first occurred and been unaccounted. The *corrected* second law embraces the many experiments that are already known to violate the old second law, and thus permits and accounts the earlier negative entropy operation that was always assumed but not accounted. The new second law thus permits negative entropy production as well as positive entropy production. It is stated in most general form as $(-\infty < dS/dt < +\infty)$. In a serial system, which does not allow simultaneous positive and negative entropy operations, the second law decomposes into the sum of two consecutive serial operations, or $(-\infty < dS/dt \leq 0) + (0 \leq dS/dt < +\infty)$. The leftmost serial term is the long-unaccounted prior negative entropy operation that the old second law (which was just the rightmost serial term) assumed but ignored. Notably, the long-ignored leftmost term now opens up a vast new area of *negative entropy engineering* in electrical power systems, using *asymmetric* Maxwellian circuits and systems previously arbitrarily discarded by Lorentz.

8.4 System COP and system efficiency have different and distinct definitions. In the ideal limit, COP is a linear function of efficiency and the energy (or power) ratio between the environmental and the operator inputs. The calculated efficiency value is bounded by 0% to 100%. It is defined for as:

$$\varepsilon \equiv E_{out\ (total\ useful)} \times 100\% \,/\, [E_{in\ (operator)} + E_{in\ (environment)}] \qquad (12)$$

where E is expressed in joules. For electromagnetic systems:

$$\varepsilon \equiv P_{out\ (total\ useful)} \times 100\% \,/\, [P_{in\ (operator)} + P_{in\ (environment)}] \qquad (13)$$

where P is expressed in watts.

[12] Note that the classical "isolated" charge has an infinite basic charge in the middle, which in modern physics is known to polarize its vacuum with an infinite opposite charge. There is a finite difference between the two charges, which is the finite "observed classical charge" value in the textbooks. So any "isolated charge" is also a dipolar ensemble and hence the charge system obeys the proven asymmetry of opposite charges. Again, there is no symmetry except of interacting vacuum and matter.

8.5 The calculated COP value is bounded by 0.0 and infinity. It is defined for the general form as:

$$\mathbf{COP \equiv [\varepsilon/100\%] \times [1 + E_{in\ (environment)} / E_{in\ (operator)}]} \quad (14a)$$

Also:

$$\mathbf{COP = E_{out\ (total\ useful)} / E_{in\ (operator)}} \quad (14b)$$

where **E** is expressed in joules.

For electromagnetic systems:

$$\mathbf{COP \equiv [\varepsilon/100\%] \times [1 + P_{in\ (environment)} / P_{in\ (operator)}]} \quad (15a)$$

Also:

$$\mathbf{COP = P_{out\ (total\ useful)} / P_{in\ (operator),}} \quad (15b)$$

where **P** is expressed in watts.

8.6 For a system with a COP in the range of zero to one, and with no net environmental input at all, the calculated value of the COP and the efficiency will be equal. This situation is supported by the equations in paragraph 8.5 above when the environmental input goes to zero (equations 14a and 15a).

8.7 For a steady state system to maintain its performance well above unity (i.e., COP > 1.0), it must be designed to function as an asymmetric open system far from equilibrium with its environment, such that the system will benefit from a continuous input of environmental energy. This environmental input must be large enough to exceed the operator input, and it must overcome the effects of a system efficiency that is less than 100%.

8.8 The ultimate design goal is to close-loop the system, so that (i) all input energy is supplied by the environment and (ii) the resulting COP is infinite.

8.9 If the system efficiency and system COP are defined as previously shown, the resulting relationship between efficiency and COP (as illustrated in Charts 1-3) is very useful in furthering a better understanding of the relationships between under-unity and over-unity COP systems. In fact, *this analysis strongly suggests that under-unity COP symmetric electromagnetic systems are only a very small subset of an infinite set of mostly over-unity asymmetric EM systems which can be developed through further research and engineering.*

Negative entropy engineering can be deliberately used in such systems to easily accept free energy from the vacuum in association with free EM force fields. These net free force fields and their net free energy from the vacuum can then be adroitly manipulated to produce free work in the loads, without destroying the dipolarity of the source.

Indeed, self-powering EM systems taking all their EM energy freely from the vacuum are expected to be developed and to become the norm.

9.0 Acknowledgment

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10.0 References

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"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire…. Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The[ir] departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire."
Note that Heaviside emphasizes the very slight amount of the flowing energy that gets diverged into the wire (by the slight departure from perpendicularity). He also corrects Poynting's erroneous assumption that the entire energy transfer is vertical — which assumption is wrong by a factor of about 90 degrees.

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