The New Physics and Global Sustainability

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***Abstract* – Models of global sustainability suggest a near term crash of global economies caused by depletion of world energy resources, rapidly declining industrial output, and food shortages. In scenarios which do *not* end in catastrophic crash, technology is the key factor which allows the world to avoid a significant decline in global economies: technology which reduces the use of energy resources per unit of industrial or food output, decreases pollution, and increases land yield. To avoid collapse and ensure global sustainability, the ratio of *energy input* to *product output* ("EI/PO") must be lowered. Based on scientific consensus regarding energy and thermodynamics, such a technology solution is unlikely, if not impossible. It should be remembered however that these same sciences were introduced and developed by Albert Einstein, who warned many times that the foundations of twentieth century physics were incomplete. He theorized hidden quantum variables that would one day complete the foundations of quantum physics and reshape scientific understanding of systems, energy and thermodynamics.**

The hidden variables postulated by Einstein have been discovered. Recent work with these variables has radically changed scientific understandings of energy, thermodynamics, and quantum relationships. The new physics which is emerging provides scientific mechanisms by which the ratio of energy input to product output can be lowered, and has opened the door to previously unexplored concepts in energy dynamics and resonance science. This on-going scientific revolution may provide the technologies required to sustain global economic development, energy production, resource use, pollution remediation, and industrial and food output.

***Index Terms* – Energy, Hidden variables, Resonance, Quantum mechanics, Sustainability.**

I. Introduction

The sustainable use of world resources has come into sharp focus in scientific, business and government circles. Assessments of an impending crisis due to the decline of fossil fuel reserves rely in large part on the scientific and technological understandings discovered more than 100 years ago, at the turn of the twentieth century. It was then, in the early 1900's, when Max Planck and Albert Einstein began the quantum revolution that propelled science, technology and global societies forward in a rapidly expansive growth phase. With the ready and inexpensive availability of fossil fuel-based energy now in jeopardy, many see this growth phase drawing to a close. Worse yet, some warn of a potentially abrupt and significant decline, cautioning that not only is *growth* not sustainable – but that *current levels* of technology and energy use are not sustainable either.

Hopes for technological advances in alternative or new energy sources have not been fulfilled. Using twentieth century thermodynamics and quantum concepts, incremental improvements have taken place but the new technology paradigms required to address the looming energy sustainability issues have not materialized. Neither Planck nor Einstein were satisfied however with the underpinnings of that same twentieth century physics, and the quantum revolution which they fathered. Both were uncomfortable with the uncertainties which crept into later development of the quantum sciences and longed for a version of their quantum concepts which could be applied more universally and with greater certainty and definiteness. Einstein in particular was quite vocal on this point in his later years and came to be regarded as somewhat of a dinosaur by later generations of physicists. Einstein insisted that something had been missed – "hidden variables" – and that the discovery of those variables could bring the dawn of a new era for humankind. He held true to his beliefs throughout his last days, however the physics and scientific communities moved past him on their own path, in nearly unanimous agreement that they were right and Einstein was old, befuddled, and simply wrong. The laws of thermodynamics immutably governed the uses and transformations of energy - or so said the scientific majority. Nothing in quantum mechanics was "hidden" scientists claimed, and scientists and policy makers alike could do nothing more than resign themselves to the fixed and unrelenting laws of energy and nature contained in the twentieth century concepts of thermodynamics.

The 1972 book *"The Limits to Growth"* warned of the potentially disastrous results at the confluence of population growth, peak oil, climate change, and decreased availability of potable water and adequate food supplies. Three decades later, the follow-up book *"Limits to Growth: The 30-Year Update"* found that in large part the world had adhered to a scenario of continued population growth accompanied by increased consumption of resources at a level that exceeded the carrying capacity of the planet.[1] The effects of technological advances in staving off a decline or collapse were considered, however a true scientific revolution and paradigm change was deemed unlikely, and the authors concluded that in the long run *"society develops technologies and markets that hasten a collapse instead of preventing it."*

The processes resulting in scientific revolutions or technology paradigm shifts were themselves the subjects of intense study and discussion during that same intervening 30 years. In *"The Structure of Scientific Revolutions"* the transition from one scientific paradigm to another was described as taking place *"via revolution"*.[2] These same concepts were later applied in economics resulting in analyses of the impact of scientific revolution and entrepreneurship on techno-economic paradigms and large-scales economies.[3] While gradual improvements and incremental changes can take place on technological trajectories, *"revolutions"* in science and technology can lead to dramatic changes. Revolutionary technology paradigms resulting in decreased *energy input* to *product output* ratios (EI/PO) on a global basis, could result in beneficial modifications to global techno-economic systems, thereby avoiding economic collapse.

II. A Scientific Revolution

History has demonstrated that there is no greater indication that science is on the verge of a significant revolution, than loud proclamations to the contrary. As Lord Kelvin famously declared more than 100 years ago (just a few years before the quantum revolution), *"There is nothing new to be discovered"*. Likewise, at the turn of the twenty-first century scientists declared *"the end of science"*, asserting that humanity is approaching "*the limits of knowledge in the twilight of the scientific age"*.[4] Fortunately, paradigm shifting discoveries soon followed, however, and a powerful scientific revolution is now under way.

A. Einstein's Hidden Variables

Einstein's hidden variables have been found.[5,6] The science revealed by the newly found variables completes quantum mechanics in a manner impossible to conceive of under the old paradigm. New universal constants have been revealed, and the many paradoxes and uncertainties of the old paradigm have melted away. The energy concepts and thermodynamics of the last 100 years, rather than being a complete scientific theory, are now being increasingly recognized as a subset of a much larger discipline of *energy dynamics*, which incorporates the new quantum mechanics, energy fields and waves, and the most efficient energy transfer mechanism of all – resonance.[7,8]

The story of the hidden variables and how they eluded discovery for more than 100 years is an important lesson. In the late 1800's Germany was a leading power in physics research, led by renowned interdisciplinary scientist Prof. Hermann von Helmholtz, M.D., Chair of the Dept of Physics at the University of Berlin. There Helmholtz taught an entire generation of physicists about energy, work, thermodynamics, resonance, and his fundamental energy equation:

$$E = A + TS \tag{1}$$

where "E" is energy, "A" is work energy, "T" is temperature, "S" is entropy, and their product "TS" is thermal energy.

By 1900 one of his former students - Max Planck - was working in two major areas – 1) the theoretical basis for *"resonant Hertzian waves"*, i.e., the resonant electromagnetic waves demonstrated experimentally by another of Helmholtz's former students, Heinrich Hertz (radio, microwave, visible light, etc.); and 2) the thermodynamic equation for "black body" radiation, i.e., the electromagnetic ("EM") energy emitted by an object based solely on its temperature. The experimental devices used to study black body radiation were purposely designed to exclude all resonant EM energy, so that *only* the thermal energy could be measured.

Planck's famous paper describing the black body radiation equation was published in 1901.[9] In it, Planck first described the relationship between energy, work, resonance, and thermal entropy. He hypothesized that resonant electromagnetic waves can be converted completely into work energy (the "A" in Helmholtz's energy equation). Because the black body devices were designed to exclude resonant work energy and measure *only* the thermal energy, he assumed:

$$A = 0, \qquad \text{therefore} \qquad E = TS. \tag{2}$$

Planck next hypothesized that energy is quantized and assumed his famous quantum formula as a mathematical given:

$$E = h\nu \tag{3}$$

where "h" is Planck's action constant, and "ν" is frequency. Using both his resonance and quantum hypotheses he derived the equation for black-body thermal energy. Importantly, the experimental data which Planck used (and on which quantum physics was later founded), assumed that the internal energy of the experimental device was composed *only* of thermal energy and necessarily omitted all *resonant* work energy ("A"). Twentieth century science was thus founded almost exclusively on thermodynamics, with boundary conditions that virtually excluded consideration of EM work energy and resonance dynamics.

After Planck's paper was published, Einstein seized on Planck's idea of quantized energy, and a few years later wrote his own papers on the photoelectric effect and special relativity, including his famous equation, "$E = mc^2$".[10] With that, the quantum revolution was off and running. Although Werner Heisenberg and Erwin Schrödinger both attempted to include resonance dynamics in their quantum work, they encountered mathematical roadblocks and gave up.[7] Planck's initial resonance hypothesis on the work energy of resonant light waves was all but forgotten.

The fertile ground of resonance dynamics lay fallow for nearly a century, until a small quantum puzzle was noticed. Research led back through the historical record to Planck's original 1901 paper, where Planck's initial resonance hypothesis was discovered. The solution to the quantum puzzle was found in that paper as well: it seems a time variable and an energy constant had both been hidden in the incomplete quantum formula Planck had assumed as a mathematical given. Planck's *complete* quantum formula is:

$$E = \tilde{h}\, t_m\, \nu \qquad (4)$$

where "$\tilde{h}$" is the energy constant and "t_m" is the measurement time variable. Additional quantum variables and universal constants were soon identified, and a simpler and more classical interpretation of quantum mechanics has emerged.[11] This new interpretation possesses greater certainty in ways impossible under the old paradigm, and does not rely on the "quantum spookiness" to which Einstein had objected.

Further analysis of Planck's 1901 paper also revealed that due to a small mathematical issue the value of the hidden time variable had been unknowingly fixed at "one second". This limitation in degrees of freedom had led to many paradoxical concepts regarding photons and wave/particle duality, and had obscured concepts regarding the true nature of light. The "photon" of the 20th century was actually a *time-based collection* of elementary particles, and was not the elementary particle of light itself. The actual elementary particle of light is the single wave of light (i.e., one electromagnetic oscillation).

Overall, the new quantum interpretation has opened doors to many new technology areas, and has provided mechanisms for previously anomalous phenomena.[12] The new physics that has emerged is thus beginning to provide new scientific tools for energy, industry and agricultural production which were considered impossible under the 20th century paradigm.

B. Resonance and Energy Dynamics

Resonance mathematics and dynamics trace their origins to Galileo Galilei, and his pendulum research in which he described *"natural"* resonant frequencies and the use of minute resonant energy inputs "*under the Time properly belonging to [the system's] Vibrations"* to cause *"a Motion considerably great"* and thereby increase total system energy levels. Galileo's resonance work was portrayed graphically by Pierre de Fermat in a resonance curve (Fig. 1).

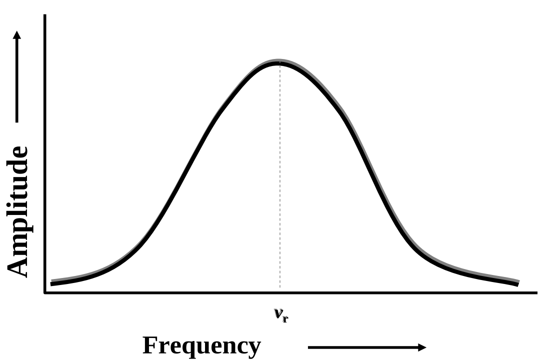

Figure 1. Resonance curve demonstrating that the amplitude of oscillation (and thus energy) in a system peaks when input oscillatory energies are at a resonant frequency ("ν_r") for the system. At the resonant frequency, the input oscillations are converted into work on the system, which increases the amplitude of oscillation of the system. Non-resonant inputs do not produce higher oscillation amplitudes in the system.

Planck's brilliant resonance hypothesis combined this earlier resonance work of Galileo and Fermat with Helmholtz's energy equation and Hertz's EM waves (Fig. 2). Planck hypothesized that at resonant frequencies, the energy of electromagnetic light waves would be free to be completely converted into organized work energy on the system, rather than into chaotic, non-work thermal energy.

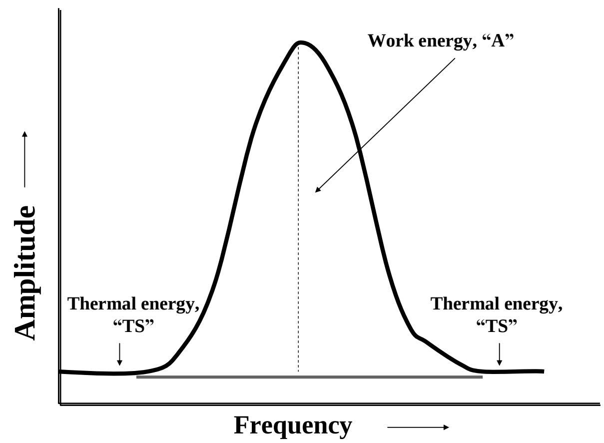

Figure 2. The addition of resonant EM energies to a system produces work energy in addition to the inherent thermal energy "TS" already present. Non-resonant energies whether at higher or lower frequencies, are not available to perform work on the system in the same way, and thus provide only baseline thermal energy.

III. The Experimental Evidence

Although previous generations of scientists (including Planck himself) abandoned Planck's resonance hypothesis, advances of recent decades have fostered a rebirth of this neglected area of science. Research in the last 15 years has established that resonant wave energies and fields can be converted into useful work energy in a wide variety of physical, chemical and biological systems. Experimental studies have demonstrated significant differences between resonance dynamics and thermodynamics in terms of overall energy dynamics and product output, including for example:[13-16]

- Doubling of fish growth rates by the use of resonant sound waves at controlled amplitudes;
- Plant germination, growth rates, and crop yields increased 10 - 30% by resonant sound waves or resonant EM fields;
- Crystal growth rates in ionic, covalent, metal alloy, or protein crystals increased up to 2,000 times using resonant EM waves;
- Crystal shapes and faceting controlled by resonant UV/visible light or by resonant microwaves;
- Reduction of activation energy by 70% in nitridation of titanium-dioxide reaction using non-thermal (non-equilibrium) microwaves; and

- Biomass conversion into ethanol precursors in 1/50th the time, using a less expensive catalyst and producing up to 50 times greater yields, using frequency specific microwaves.

Both theoretical and experimental work is ongoing in development of resonance and energy dynamics in private industry, at the Japanese National Institute of Fusion Science, and in academia (e.g., Penn. State, Osaka, Nagoya, and Chubu Universities). Additional "hidden variables" have been identified specifically in association with resonance dynamics, including the resonance factor and resonance work variables.[7]

Reductions in the EI/PO ratio are becoming apparent. For example, water was exposed to either resonant light (which energized the water vibrational levels) or maintained under thermodynamic conditions. After three (3) hours the temperatures of both the resonant and thermodynamic water were the same. Identical solutes were added to the resonant and thermodynamic water, and rates of solute dissolution were compared. The resonant water performed 1.4 kJ of work on the solute and dissolved it approximately 9% faster than the thermodynamic water, even though both waters had *identical temperatures*. This amounted to a "virtual" thermal effect in the resonant water of 25°C, i.e., one would have to heat water by 25°C, in order to dissolve the solutes as quickly as the resonant water. Heating the water (500 ml) by 25°C would have required 52 kJ of energy. Only 2.1 kJ of energy were used by the light source to energize the resonant water, however. The EI/PO (*energy input* to *product output*) ratio was **reduced 96%** using resonance dynamics.

IV. Implications for Global Sustainability

The implications of resonance science and technologies for global sustainability and energy savings are profound. A thermodynamic system is not able to perform any "work" in a classical sense, and instead must rely on random collisions of molecules and atoms to produce desired products. Under the old paradigm energy intensive processes were required, wasting most of the input energy in heat and random motions. The technologies of the 19th and 20th centuries were focused on finding empirical methods to channel the heat and random motions into useful production processes and the energy requirements were necessarily large.

When energy is used at resonant frequencies, however, the system can achieve far greater amplitude and hence internal energy. Unlike thermal energy, the resonant energy *is* available for work. That work can be used to make useful products, in processes that do not waste large amounts of the input energy in heat and random motions. In other words, the application of resonant energies can be very *targeted*.

In addition, the transfer and utilization of energy under resonance dynamics can be several orders of magnitude more *efficient* than purely thermodynamic mechanisms. In the water solvent example above, the 2.1 kJ used to deliver resonant energy performed 1.4 kJ of work on the water, for an efficiency of 67%, compared to 3% efficiency for thermal heating of the water.

Lastly, use of resonance dynamics can be orders of magnitude more *cost-effective*, as evidenced by the 96% reduction in EI/PO ratio above. In another example, NASA had experimented with growing protein crystals at accelerated rates in the low gravity environment of the space station. Using resonance dynamics, the same protein crystals were grown as large and as quickly here on earth, under ordinary gravitational conditions.[14]

Conclusion

The current science revolution regarding energy and resonance dynamics may hold the key to global sustainability. This scientific revolution is being fueled by the discovery and application of previously hidden variables and constants. The fact that the New Physics alters the EI/PO equation changes everything in the context of global sustainability – not only does it have the potential to change the slope of global forecast curves, it has the potential to fundamentally shift the curves. The potential energy savings likely from development of resonance dynamics in preference to the less efficient and more costly thermodynamic technologies may lower the global EI/PO ratio to levels low enough to ensure global sustainability without economic collapse, and could even allow for continued economic growth and development.

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