Increasing Energy Flux-Density: The Only Competent Energy Policy

by Benjamin Deniston

Some of the earliest archaeological distinctions between mankind and the apes come with the first appearance of ancient fire pits, used to control the power of fire for the betterment of the conditions of life for those wielding that new power.

From that time onward, mankind could no longer be characterized biologically or by biological evolution—the evolution of the creative mental powers unique to the human mind became the determining factor. Biology took a backseat to the increased power of thought wielded by the human species.

Moving to historical times, this secret—and science—of economic growth, can be measured by the control over successively higher forms of fire. This started with transitions to more energy-dense forms of chemical fire, from simple wood burning, to charcoal, then to coal and coke, and onto petroleum and natural gas – one kilogram of coal having 50% more energy than one kilogram of wood, and one kilogram of diesel fuel having 70% more energy than the single kilogram of coal. Each of these new fuels depended upon new chemical reactions, which not only provided the potential for a more energy dense form of fire, but opened up new domains of control and utilization of matter. Metallurgy, materials development, and physical chemistry all developed in dynamic interaction with the development of new forms of fire.

TABLE I

The Energy Density of Fuels

FUEL SOURCE	ENERGY DENSITY (J/g)
Combustion Of Wood	1.8×10^4
Combustion Of Coal (Bituminous)	2.7×10^4
Combustion Of Petroleum (Diesel)	4.6×10^4
Combustion Of H_2/O_2	1.3×10^4 (full mass considered)
Combustion Of H_2/O_2	1.2×10^5 (only H_2 mass considered)
Typical Nuclear Fuel	3.7×10^9
Direct Fission Energy Of U-235	8.2×10^{10}
Deuterium-Tritium Fusion	3.2×10^{11}
Annihilation Of Antimatter	9.0×10^{13}

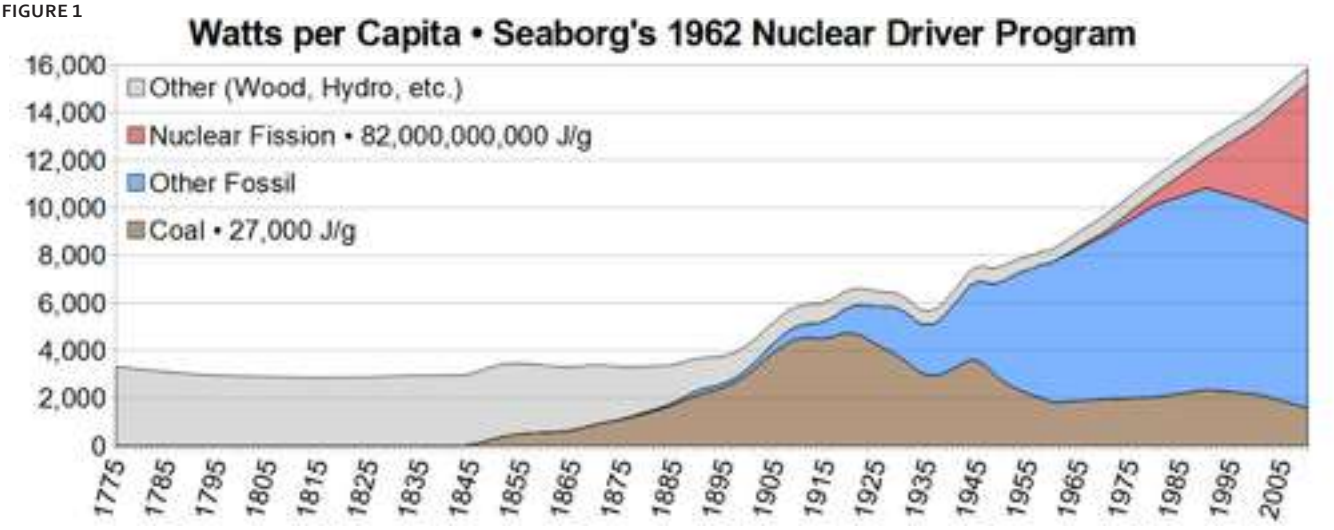
Fuel energy densities. The change from wood to matter-antimatter reactions is so great that progress must be counted in orders of magnitude, and the greatest single leap is seen in the transition from chemical to nuclear processes.

More recently the revolutionary discoveries around the turn of the 20th Century showed mankind an immense potential entirely beyond chemical reactions: Einstein's fundamental equivalence of matter and energy, as expressed in the domains of fission, fusion, and matter-antimatter reactions. Each in this series of relativistic, mass-energy reactions is characterized by successively higher energy densities—and the entire set is orders of magnitude beyond chemical reactions.[1] While this distinction is usefully expressed in the immense difference in the quantity of energy released in nuclear versus chemical reactions – with nuclear reactions having hundreds of thousands to millions of times more energy per mass than chemical reactions – the measured quantitative difference is the effect of a qualitatively distinct, higher domain of action.

Control over higher energy densities enables the increase in what Lyndon LaRouche has defined as the energy flux density of the economy, as can be measured by the rate of energy use per person or per unit area of the economy as a whole. This increasing power is as-

1. This is why individual nuclear explosives, even small ones, are measured in terms of thousands of tons, or even millions of tons of TNT. The largest thermonuclear weapon ever detonated, the Soviet Union's 1961 Tsar Bomba, was a 50-megaton explosion, meaning it would take the explosion of 50 million tons of TNT to release that much energy from chemical reactions. The Tsar Bomba was a single bomb, dropped from a single airplane (over an unpopulated region of the far north), while 50 million tons of TNT would fill 100 oil supertankers.

FIGURE 1



Historical values of watts per capita in the United States, 1775 to 1962, and Glenn Seaborg's Atomic Energy Commission 1962 nuclear power report to President Kennedy projections for 1963 to 2010. Sources, "Civilian Nuclear Power: A Report to the President – 1962," United States Energy Information Administration http://www.eia.gov/

sociated with qualitative changes throughout the entire society—fundamentally new technologies, new resource bases, new levels of living standards, and fundamentally new economies.

On the contrary, so-called green energy sources represent a step *backwards*. Much lower levels of energy provided per physical economic cost, and notoriously unreliable and sporadic generation, mean that large-scale implementation of wind and solar power *lowers* the national economic energy flux-density, as is most starkly being demonstrated in Germany presently.

Both these trends – the qualitative progress associated with increasing energy flux-density, and the negative effects of a green policy – have been expressed in the history of the United States.

National Economic Energy Flux-Density: USA Case Study

Start with the simple rate of biological energy usage for the human body, which is, very roughly, 100 watts (corresponding to consuming 2,000 food calories a day). Assuming a hypothetical pre-fire civilization in which all work is performed by human muscle, the power employed to sustain this society is 100 watts per capita .

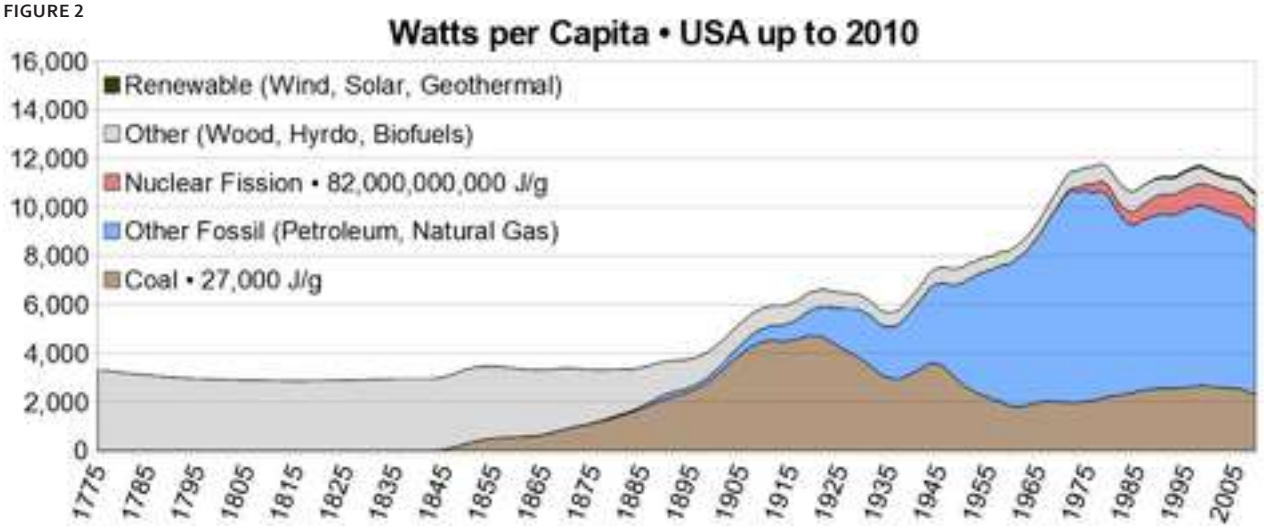
Compare this with the changing per capita power usage throughout the history of the United States.

At the time of the United States' founding, the wood-based economy provided around 3,000 watts per capita. This does not mean every individual used 3,000 watts; it includes all the power supplied to agriculture, industry, and other areas *supporting the economy as a whole*, averaged to a per capita value. In this wood-based economy, the effective power that each individual wielded and represented (expressed in terms of the individual's relation to the unity of the national economic system as a whole) was thirty times higher than the simple muscle power of a hypothetical fire-less society. This was not just "more" energy, but a quality of energy that enabled people to create states of matter and chemistry which could never be created by muscle power alone (exemplified by advances in metallurgy, for example, creating the basis for new tools, machinery, and other technologies).

The increasing use of coal throughout the economy raised the power to over 5,000 watts per capita by the 1920s. Each individual then expressed nearly twice the power of the wood-based economy (again, expressed in terms of the individual's relation to the entire national economy), supporting the motion-producing, heat-powered machinery and transportation which revolutionized the industrialized economy. The development of modern chemistry enabled the beginnings of a new revolution in mankind's understanding of and control over matter.

By the early 1960s the use of petroleum and natural gas had brought power to over 8,000 watts per capita – 80 times the per capita power of our hypothetical fire-less society – and nuclear fission power was fully capable of sustaining the U.S. historical growth rate well into the 21st Century.

FIGURE 2



Watts per capita throughout the history of the United States, 1775 to 2010. The renewable category includes wind, solar, geothermal, and biofuels (but not hydroelectric power). Source, the United States Energy Information Administration http://www.eia.gov/

In 1962 President John F. Kennedy commissioned his Atomic Energy Commission – then under the direction of Glenn Seaborg – to "take a new and hard look at the role of nuclear power in our economy." Seaborg's 70-page report, released that year, outlined a transition consistent with prior transitions from lower to higher energy sources: coal use leveling off and declining by the turn of the century, with nuclear power becoming the dominant electricity source for the nation. By Seaborg's forecast, this nuclear driver program would have brought the national economic energy flux-density to nearly 16,000 watts per capita by 2010.

By then, assuming the nation had maintained a pro-growth orientation, as fission power was becoming the dominant power source, the beginnings of applied fusion power should have begun to emerge. With isotopes of hydrogen and helium as an effectively limitless fuel source for fusion reactors, the U.S. economy would be on a path to even higher levels energy flux density – continuing this process of limitless progress. Virtually every concern over resource limitations (from food, to water, to metals, etc.) and energy limitations for all mankind, across the entire planet, can be addressed with a fusion economy—and that, for countless generations to come.

However, in the United States this natural growth process was cut off by the zero-growth policies of the green movement.

The green policy locked the economy on a path into the attritional collapse being experienced now—a collapse process accelerated by policies which lower the energy flux density of the economy. Nuclear fission power was never allowed to realize its full potential; instead, there was an increasing emphasis on solar, wind, and other forms of green energy, and the energy flux-density of the economy stagnated, and began to collapse.

This brought degenerative effects. Instead of the per capita use of coal continuing to decline (in a natural transition to nuclear power), it began to increase again by the late 1970s. Under the green, zero-growth paradigm, per capita coal use in 2010 was 33% higher than it would have been under Seaborg's nuclear driver proposal to Kennedy – with the total national energy flux-density 33% lower than it would have been under the nuclear driver program.

The 40-year gap between the expected natural growth of a progressing economy and present levels of stagnation and decline under a green policy is a measure of the current economic breakdown of the United States, and demonstrates the immediate need for a crash program to develop and implement the next stage, the fusion economy, to overcome decades of lost time and accumulated attrition by creating a new economy at a higher level than ever before.

So-called green technologies will not work (as Germany is now showing to the world). Increasing qualities of power—of "fire"—is the essential characteristic of mankind, measuring our success in satisfying the need for continual progress.

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