What is Energy Conservation?

Energy accountability is what energy conservation is all about. If we can't account for the entirety of energy, then we don't know what is happening.

Not all energy is physical when it is electrical. Resistive impedance is purely a physical phenomenon while reactive impedance is partly a physical phenomenon and partly a mathematical abstraction depending upon whether reactive impedance is self-inductance or self-capacitance versus whether it is mutual inductance or mutual capacitance, respectively.

If too much resistive impedance should dominate, let's say... the electrodynamics of a simple flashlight circuit, then everything is physically accounted for.

Yet, if reactive impedance should dominate the behavior of a spark gap (posing as a neon bulb), then not only will we be unable to avail ourselves of physicality to explain where all of the energy goes to or comes from, but we won't be able to make any logical sense whenever *energy disappears inside of a neon bulb before it appears!*

This is what I discovered when I spent nine months drawing up my provisional patent (submitted to the U.S. Patent Office last summer in 2021). I discovered that a simple flashlight circuit gives no headaches whenever we draw up a tally sheet listing all of the energy being produced versus all of the energy being consumed. They cancel each other out yielding a zero net result.

But this is not so when spark gaps become involved. Since I was restricting myself to the wattage of each component, I merely saw the positive watts and the negative watts signifying the consumption of power versus its production. I did not see everything. This is where my head started to spin around and around. Now, I know better...

Reactive impedance has no counterpart in the physical realm if it should arise from mutual capacitance or mutual inductance. This is the mysterious realm wherein energy seemingly vanishes into, or miraculously appears from, without leaving any physical trace as to its whereabouts.

Self-inductance and self-capacitance plus mere resistance can only arise from physical causality – and in a logical fashion – which is why it is so easy to account for all of it. Resistance takes care of resistive impedance while self-inductance and self-capacitance partly explains reactive impedance. The other half of reactive impedance is explained by mutual inductance and mutual capacitance. This is the non-physical realm of abstract mathematics – probably the complex number field?

So, not all of reactive impedance is physical. Self-inductance and self-capacitance are physical along with resistance. Yet, mutual inductance and mutual capacitance are non-physical mathematical abstractions.

Unless we are willing and able to do a complete analysis by writing our own set of equations to simulate the entire behavior of a circuit, then we should never, ever, bring up our concerns for energy conservation unless we're also willing to do the hard work of accounting for everything beyond mere impedance calculations of self-capacitances and self-inductances. These are self-indulgent fantasies ignoring the whole dynamics.

Every component creates a field. Fields interact. This is where mutuality of capacitance and inductance arises from which complicates an otherwise simplistic view of electrodynamics. This is the domain of parametric amplification in which the electrostatic field of one capacitor may modify the electrostatic field of another capacitor despite their physical parameter of capacitance is hard-wired into their construction. Yet, their fields are not. Their fields are dynamic and flexible exhibiting a sensitivity to time and to each other.

This is suggested by the impedance equivalencies between capacitive reactance and capacitance as well as between inductive reactance and inductance...

Electrical Reactance is a self-fulfilling proposition...

Capacitive reactance X_C

$$X_C = -\frac{1}{\omega C} = -\frac{1}{2\pi f C}$$

Inductive reactance X_L

$$X_L = \omega L = 2\pi f L$$

Reactance Equivalencies...
Capacitance = Capacitive Reactance
Inductance = Inductive Reactance

These equivalencies are derived from the following formula for reactive impedance...

$$X = X_L + X_C = \omega L - \frac{1}{\omega C}$$

It is possible to conclude from these formulas that the only difference between the inductive X_L

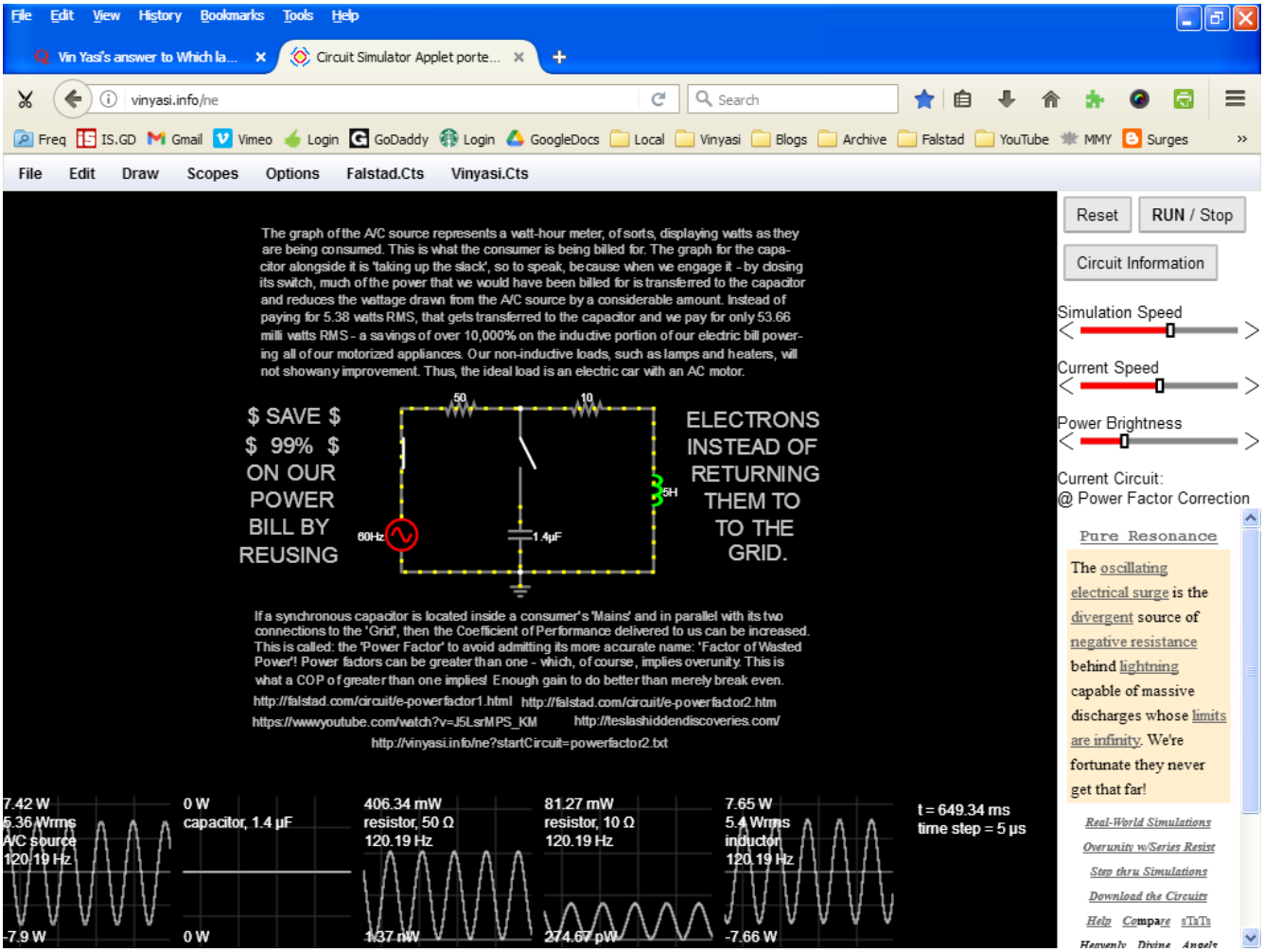
impedance of ωL and 2πfL is 2πf making frequency (measured in the 2π radians of each cycle of oscillations) plus inductance the only set of magnetic parameters worthy of our attention. Likewise, the only difference between the capacitive X_C impedance of $-\frac{1}{\omega C}$ and $-\frac{1}{2\pi fC}$ is 2πf making frequency and capacitance the only relevant set of dielectric parameters. Because, regardless of whatever voltage is fed into a complex circuit involving multiple impedances, what matters most of all has nothing to do with voltage input. What matters is frequency, capacitance and inductance. Voltage merely gets in the way by regulating the outcome. This is what makes voltage sources a regulated source of voltage letting their current vary while their voltage remains rock-steady. But if we make the input voltage small enough, it will be overridden by reactive voltage and, likewise, for current.

This renders the notion that impedance is the field which is generated by a reactive component. And this field changes over time and successfully “fakes” a constantly renewable set of values for capacitance and inductance overriding whatever is hard-wired into the original capacitors and inductors which originally spawned their fields.

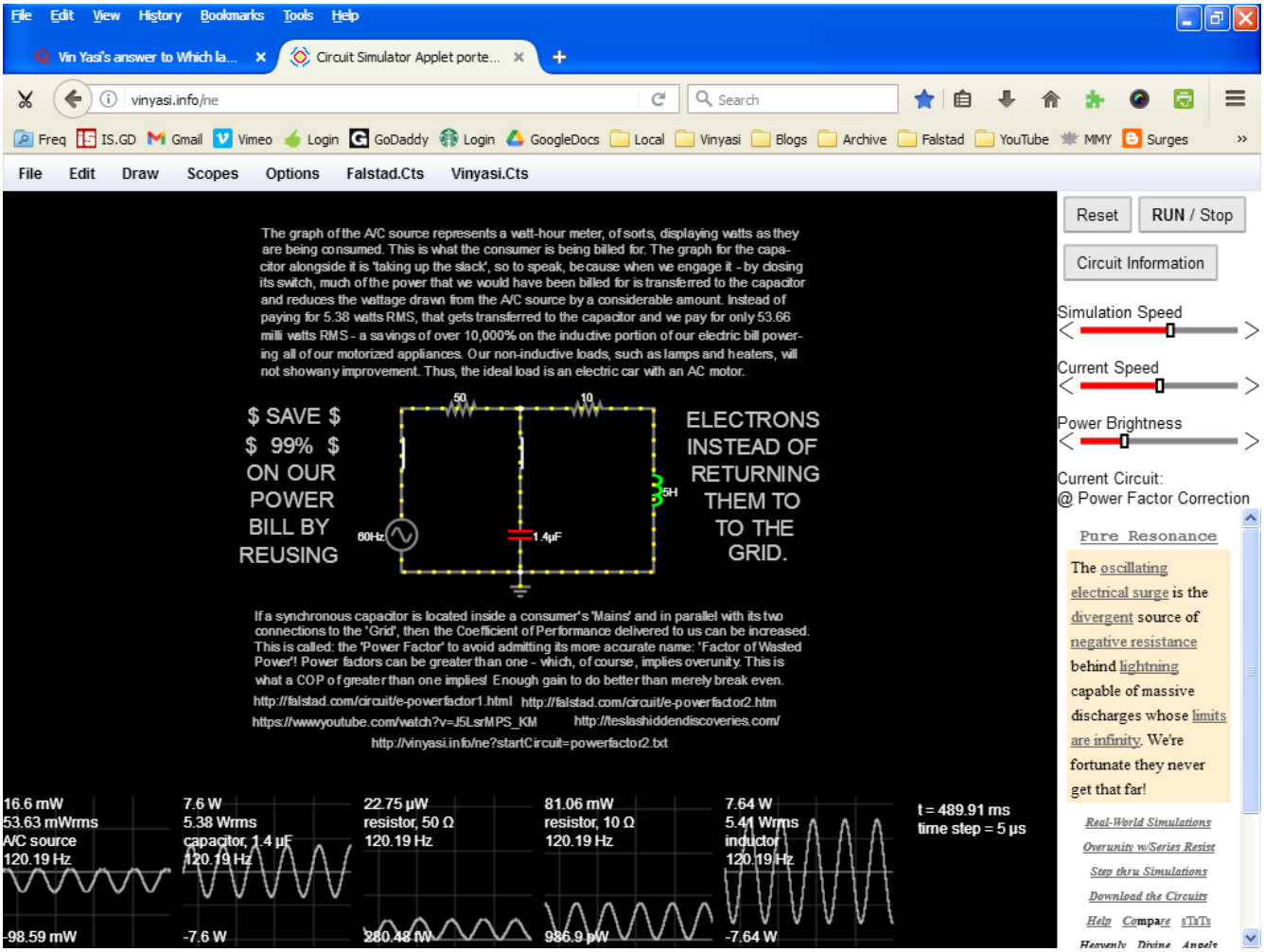
I'm not an electrical engineer. So, I'm not at all interested in doing what the simulator can do for me. If I'm curious, I might examine each and every component to see whether that component is generating negative watts or consuming positive watts and tally it all up in my head. But if it should fail to result in a grand total of zero watts, I won't be too surprised. I'll most likely use Micro-Cap (a flavor of Berkeley SPICE from Spectrum-Soft since it is far more realistic than LTSPICE. I know this, because LTSPICE is easier to explode overly-reactive circuits into a sudden infinite gain rather than deliver an impedant obstruction to over-reactance (which I'd expect is more realistic).

Micro-Cap used to cost upwards from $4.5k before they went out of business and gave it away for free.

It's pretty obvious that we can physically account for most of the energy here,,,



,,,since there is no mutuality of either capacitance or inductance which could complicate our ability to make a full and complete accounting. There is merely self-capacitance and self-inductance shifting a majority of the “source” for recycling reactive power at the capacitor and delegating the dependency for a mere signal of sine wave to emanate from the generator on the left...



This splits the responsibility for “sourcing” our energy between an in-house capacitor and a remote power plant along our utility grid. This reduces our energy expenditure and makes accountability an easy affair.

But, mutual inductance among a set of inductors or the mutual capacitance among a set of capacitors is not built into any component. Only mathematical relationships can spell out their dynamics which makes their existence an ephemeral affair.

Yet, reactive impedance depends upon this.