Mysteries Reconciled

Previously Unexplained Electromagnetic Phenomena Resolved Through the Burton-Poynting Framework

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Reference Document: The Burton-Poynting Unified Field Theory — Master Document V1.0 (CC BY-NC-SA 4.0)

Reference Framework: The Burton-Poynting Codex — Constitutional Laws 0–IX

Preface

The conventional electrical framework, built upon the drift-velocity model of electron flow, has served engineering for over a century. Its computational predictions are reliable. Its practical applications are proven. Yet beneath this functional surface lie persistent phenomena that the conventional framework cannot explain mechanistically — only describe mathematically. Engineers and physicists have been taught to accept these phenomena as "just how it works," to trust the equations without demanding a physical picture of why.

The Burton-Poynting Framework, grounded in the Poynting Vector lifecycle ($S = E \times H$) and the ten Constitutional Laws (Laws 0–IX), provides that physical picture. This document catalogues electromagnetic phenomena that have historically resisted intuitive explanation and demonstrates how each is resolved — not through new mathematics, but through a corrected physical interpretation of what the existing mathematics has always been describing.

Each section presents the mystery, the conventional explanation (or lack thereof), and the Burton-Poynting resolution with reference to the specific Constitutional Law that governs the phenomenon.

I. What Happens When the Switch Closes — The PID Feedback Loop

The Mystery

When a switch is closed on a load, the source "knows" to supply the correct amount of energy. An alternator supplying a 100-watt load does not send 1,000 watts. A generator connected to a heavier load works harder — its prime mover (engine, turbine) must consume more fuel. But how does the mechanical prime mover, separated from the load by kilometres of conductor, "know" what the load requires? The conventional framework describes this through Kirchhoff's laws and load impedance calculations, but provides no physical mechanism for the real-time feedback between a distant load and a mechanical prime mover.

The Conventional Explanation

"The load impedance determines the current drawn, which is set by the voltage and resistance per Ohm's Law (I = V/R). The generator responds to the electrical load through electromagnetic coupling in the stator." This is mathematically correct but physically incomplete. It treats the circuit as an instantaneous entity — as though the generator simultaneously "knows" what the load impedance is. It does not describe the physical messenger that carries load information from the load back to the source.

The Burton-Poynting Resolution

Governing Laws: Law 0 (The Mandate of Return), Law I (Transverse Initiation)

The moment the switch closes, the following causal chain occurs in strict temporal sequence:

1. Conception (Law I): The alternator's rotating magnetic field sweeps past the stator windings, conceiving a Poynting Vector — a discrete energy packet with both E (electric) and H (magnetic) components coupled in Unity. This packet exists as a pulse, born at the moment of pole sweep, with magnitude determined by the field strength and rotational velocity.

2. Transport ("The Tsunami"): The conceived Poynting Vector propagates along the conductor path at near-luminal velocity in the dielectric surrounding the conductor. It is a coherent electromagnetic pulse — not electrons drifting through wire.

3. Arrival and Harvest (Law III, Law IX): The Poynting Vector arrives at the load. The load's resistance converts the E component to work (heat, light, motion). E is consumed at the load — fully and irrevocably (Law IX: E never returns to the source). In a purely resistive load, E is harvested efficiently and converted entirely to work. In a reactive load (containing a Saboteur), E is still consumed at the winding resistance, but the Saboteur's geometry displaces H by 90°, creating Dis-Unity. The displaced H cannot facilitate full harvest — not because E returns, but because the angular misalignment between E and H reduces the effective Poynting flux available for conversion. The Harvest Ratio (cos θ) measures this geometric efficiency. E is always spent forward. It is H that returns bloated and misaligned.

4. The Widowed Return (Law 0): After E has been harvested, H persists. It must return to its source — this is the Mandate of Return (Law 0). The magnetic field component, now widowed (bereft of its E partner), propagates back along the return conductor to the source.

5. Mechanical Feedback (Lenz's Law as PID Response): The returning Widowed Field arrives at the alternator stator. Its magnetic polarity is opposite to the conceiving field (a consequence of the energy extracted at the load). This opposing field creates mechanical resistance against the rotor — the phenomenon conventionally termed "back-EMF" but more accurately described as **Widowed Opposition by Counter-Pole**.

6. The Governor Responds: The prime mover's governor detects the increased mechanical resistance (the rotor is harder to turn). It opens the throttle — more fuel, more steam, more water flow — to maintain rotational speed. A heavier load

means a stronger Widowed Return, which means greater opposition, which means more fuel consumed.

This is a **closed-loop PID (Proportional-Integral-Derivative) feedback system:**

- **Sensor:** The returning Widowed Field (H) at the stator
- **Error Signal:** The difference between the desired rotational speed and the actual speed (slowed by the Widowed Opposition)
- **Controller:** The mechanical governor
- **Actuator:** The fuel/steam/water valve
- **Setpoint:** The nominal frequency (50/60 Hz)

The physical messenger is the Widowed Field itself. It carries the load information — encoded in its magnitude and phase — from the load back to the source at near-luminal velocity. The generator does not "know" the load impedance instantaneously. It learns it one Poynting Vector cycle at a time, through the returning magnetic field.

An empty circuit (switch open) returns no Widowed Field. The governor idles. A heavy load returns a strong Widowed Field. The governor opens wide. The feedback is continuous, automatic, and electromagnetic — not mystical.

II. What the Ammeter Actually Measures

The Mystery

Every electrical apprentice is taught that an ammeter measures "current" — the flow of electrons through a conductor. Yet the physical sensing element in every clamp-on ammeter is a toroidal ferrite core that responds to the magnetic field surrounding the conductor. No ammeter detects, observes, or counts individual electrons. If the ammeter is sensing a magnetic field, why is it labelled a "current" meter?

The Conventional Explanation

"By Ampère's Law ($\oint H \cdot dl = I_{enc}$), the magnetic field intensity around a conductor is directly proportional to the enclosed current. Therefore, measuring H is equivalent to measuring I." This is mathematically correct. The proportionality is real. But "equivalent" is not "identical." Measuring the shadow of an object is equivalent to measuring its height under fixed lighting conditions — that does not make the shadow be the object.

The Burton-Poynting Resolution

Governing Law: Law 0 (The Mandate of Return)

The clamp-on ammeter is, and has always been, a **magnetic field intensity sensor**. Its toroidal core responds to the H component of the Poynting Vector surrounding the conductor. The instrument senses H, applies a calibration constant derived from Ampère's Law, and displays a number labelled "amperes."

On the supply conductor, the ammeter senses the full Poynting Vector's H component — E and H are both present, coupled (or partially decoupled in a reactive circuit).

On the return conductor, the ammeter senses the **Widowed Field** — H alone, returning to source after E has been harvested at the load. The reading is the same magnitude (by conservation), but the physical nature of what is being measured is fundamentally different: it is a magnetic field completing its mandated return, not "current flowing back."

The Burton-Poynting Framework does not change the ammeter's reading. It changes the operator's understanding of what the reading represents. The instrument has always been measuring H. Only the label was wrong.

III. Why "Displacement Current" Works Without Current

The Mystery

In 1861, James Clerk Maxwell added a term to Ampère's Law — the "displacement current" — to account for the continuity of the magnetic field across a capacitor's dielectric gap. The capacitor's plates are separated by an insulator. No charge carriers cross the dielectric. Yet the circuit behaves as though current flows through it. Maxwell's term ($\varepsilon_0 \partial E/\partial t$) makes the equations work, but the name "displacement current" implies charge displacement that does not physically occur.

The Conventional Explanation

"The changing electric field between the plates is mathematically equivalent to a current, so we call it displacement current. It's not real current — it's a mathematical convenience." This has been the standard pedagogical disclaimer for over 160 years. Students are told to accept the term, use it in calculations, and not worry about the physical mechanism.

The Burton-Poynting Resolution

Governing Law: Law V (Dielectric Suspension) — The Principle of Dielectric Coupling

There is no "displacement current" because there is no current. What occurs across the dielectric is **field coupling** — the same category of phenomenon as magnetic coupling through a transformer core, but in the electric domain.

A capacitor is a **dielectric-coupled mirror pair**. Its two plates are not independent conductors separated by an insulator. They are a single field system coupled through the electric field established in the dielectric medium. What one plate experiences in the E-field, the opposing plate must instantaneously mirror.

When the E-field at Plate A increases (a positive-going Poynting Vector arriving), the dielectric medium transmits this field state to Plate B, which responds with a corresponding field change. No charge crosses the gap. No "current" flows

through the dielectric. The plates communicate through the electric field itself — the dielectric is the coupling medium.

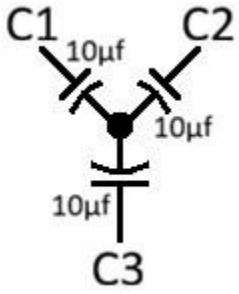
Maxwell's $\varepsilon_0 \partial E/\partial t$ term is not a current. It is the mathematical expression of the rate of change of dielectric field coupling. It produces the same magnetic effects as a conduction current (which is why it completes Ampère's Law), but its physical nature is field coupling, not charge transport.

The Burton-Poynting Framework replaces the misleading term "displacement current" with the physically accurate description: **dielectric field coupling**.

IV. Why Floating Wye Capacitor Banks Correct Power Factor

The Mystery

In three-phase power systems, power factor correction is commonly achieved using three capacitors connected in a wye (star) configuration. Each capacitor has one plate connected to a phase conductor (A, B, or C). The other three plates are tied together at a common star point. This star point is typically **not connected** to the system neutral or to any other part of the circuit. It floats.



Yet the correction works. Each capacitor provides its full rated reactive compensation. The floating star point establishes the correct potential. Electrical engineers calculate the required capacitance, install the bank, and measure improved power factor. But if one side of each capacitor is not electrically connected to the circuit, how does it "know" what to do?

The Conventional Explanation

"Displacement current flows through the dielectric of each capacitor, completing the circuit. The star point establishes a virtual neutral through the balanced impedance of the three capacitors." This explanation relies on the "displacement current" concept (see Mystery III) and on the mathematical abstraction of a "virtual neutral." It provides no physical mechanism for how the unconnected plates establish their potential.

The Burton-Poynting Resolution

Governing Law: Law V (Dielectric Suspension) — The Principle of Dielectric Coupling

Each capacitor is a dielectric-coupled mirror pair. The phase-connected plate (Plate A) sees the phase voltage — the E component of the Poynting Vector on that phase conductor. Through dielectric field coupling, the opposing plate (Plate B, at the star point) **instantaneously mirrors** the field state of Plate A.

No charge crosses the dielectric. No "displacement current" completes the circuit. The mirror response is a field phenomenon occurring through the dielectric medium.

With three capacitors:

- Plate A_1 (Phase A) → dielectric coupling → Plate B_1 (star point) mirrors Phase A
- Plate A_2 (Phase B) → dielectric coupling → Plate B_2 (star point) mirrors Phase B
- Plate A_3 (Phase C) → dielectric coupling → Plate B_3 (star point) mirrors Phase C

The three star-point plates (B_1, B_2, B_3), tied together, self-establish a balanced potential through three simultaneous mirror responses. The "virtual neutral" is not a mathematical abstraction — it is the physical consequence of three dielectric-coupled mirror pairs operating in a balanced three-phase field.

The correction works because each capacitor independently mirrors its phase's reactive component through dielectric coupling, providing the compensating

field at the junction. No circuit connection to the neutral is required because the coupling mechanism is the electric field within the dielectric, not charge transport through a conductor.

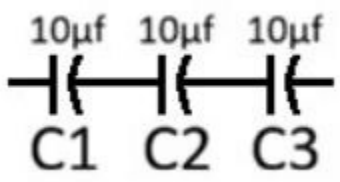
V. Why Series Capacitors Work When the Center Cap Is Not Connected

The Mystery

When three capacitors are connected in series, the total capacitance is calculated using the reciprocal formula:

> $1/C_{total} = 1/C_1 + 1/C_2 + 1/C_3$

Each capacitor's full rated value is used in this calculation, and the result accurately predicts the circuit's behaviour. Yet consider the physical topology:



Only Plate A_1 (on Line A) and Plate B_3 (on Line B) are electrically connected to the external circuit. The center capacitor (Cap 2) has **neither plate connected to the external circuit.** Plate B_1 connects to Plate A_2 via a short conductor, and Plate B_2 connects to Plate A_3 via a short conductor — but these are internal connections between capacitors, not connections to the circuit being corrected.

How does Cap 2 contribute its full capacitance value to the circuit when neither of its plates touches the external circuit? For that matter, even Cap 1's Plate B_1 and Cap 3's Plate A_3 are not connected to the external circuit — only their outward-facing plates are.

The Conventional Explanation

"Displacement current flows through the dielectric of each capacitor, so the circuit is complete through all three." This again relies on the displacement current abstraction. It provides no mechanism for how a capacitor with no external circuit connection on either plate can participate as a full-value circuit element.

The Burton-Poynting Resolution

Governing Law: Law V (Dielectric Suspension) — The Principle of Dielectric Coupling

This is **cascaded dielectric coupling** — the mirror-pair mechanism operating in series:

1. The E-field from Line A arrives at Plate A_1 of Cap 1.
2. Through dielectric coupling, Plate B_1 **instantaneously mirrors** the field state of Plate A_1.
3. Plate B_1's response propagates through the conductor to Plate A_2 of Cap 2.
4. Through dielectric coupling, Plate B_2 **instantaneously mirrors** the field state of Plate A_2.
5. Plate B_2's response propagates through the conductor to Plate A_3 of Cap 3.
6. Through dielectric coupling, Plate B_3 **instantaneously mirrors** the field state of Plate A_3.
7. Plate B_3 is connected to Line B — the coupling chain is complete.

The center capacitor works because dielectric coupling does not require external circuit connection. Each mirror pair hands off to the next. The field state cascades from Plate A_1 to Plate B_3 through three successive dielectric coupling stages.

This is the same principle as the floating wye bank (Mystery IV), but demonstrated even more starkly: in the wye bank, at least one plate of each capacitor touches the circuit. In the series string, the center capacitor has **zero plates on the external circuit** — yet contributes its full value. The only

mechanism that explains this without invoking fictional "displacement current" is dielectric field coupling.

The capacitor is not a break in the circuit that current "somehow" crosses. It is a **field coupling stage** — each plate mirrors its partner, and multiple stages cascade. The circuit is continuous not because charge flows through it, but because the electric field couples through it.

VI. Why Power Factor Correction Is Instantaneous

The Mystery

When a capacitor bank is energized across an inductive load, the power factor correction takes effect within one cycle. The source-side measurements show immediate reduction in reactive power. If the correction required energy to travel from the capacitor to the source and back (a round-trip at near-luminal velocity, but still a finite time for long transmission lines), there should be a measurable delay. In practice, no such delay is observed at the source — the correction appears instantaneous from the source's perspective.

The Conventional Explanation

"The capacitor's leading current cancels the inductor's lagging current at the point of connection, reducing the net reactive current seen by the source." This is mathematically correct but uses the language of charge transport ("current cancels current") rather than describing the physical field mechanism.

The Burton-Poynting Resolution

Governing Laws: Law V (Dielectric Suspension — Mirror-Pair Mechanism), Law VII (Field Unity and Dis-Unity)

The correction is instantaneous because it is **local**. It occurs at the parallel junction where the Repeller (capacitor) and Saboteur (inductor) share a common node — not at the source.

The Saboteur's output arrives at the junction with H displaced 90° from E. The Repeller, operating as a dielectric-coupled mirror pair, produces the exact mirror of this displacement — the inverse reactive field. These two fields meet at the junction node and cancel:

- Saboteur output: H displaced by +90° (lag)
- Repeller mirror: H displaced by −90° (the mirror, appearing as 270° recoil)
- Sum at junction: +90° + 270° = 360° = 0° = Unity

The source never sees the individual reactive components. It sees only the net result at the junction: a unified, corrected Poynting Vector with E and H in phase. The bloated Widowed H-field that would have returned to the source — carrying the magnetic signature of incomplete harvest — is intercepted and corrected at the junction before it begins the return journey. E never returns to the source. E is either harvested at the load or reflected at a dielectric boundary. Only H returns, and after local correction, even H returns lean — carrying only the magnetic signature of the real power consumed by the winding resistance of the Saboteur.

This is why the correction appears instantaneous — it does not require a round trip. The Repeller corrects the field locally, and the source only ever receives the corrected vector.

VII. What "Back-EMF" Actually Is

The Mystery

When current through an inductor changes, a voltage appears across the inductor that opposes the change. This is termed "back-EMF" or "counter-electromotive force." Every electrical student learns the formula $v(t) = L \cdot di/dt$, but the physical mechanism behind this opposing voltage is rarely explained beyond "the magnetic field resists change" — a statement that anthropomorphises a field without providing a causal mechanism.

The Conventional Explanation

"A changing current produces a changing magnetic flux, which by Faraday's Law induces an EMF that opposes the change (Lenz's Law)." This is a correct statement of the mathematical relationship but describes a circular chain: current → flux → EMF → opposes current. It does not identify the physical entity that carries the opposition.

The Burton-Poynting Resolution

Governing Laws: Law IV (Self-Inductive Inversion), Law 0 (The Mandate of Return)

The Saboteur (inductor) is a **miniature inverse creation engine**. It employs the same physical mechanism as the alternator — a magnetic field and a conductor in relative geometric relationship — but inverted in purpose.

In the alternator, the rotor's magnetic field sweeps past stationary stator windings to conceive a Poynting Vector. In the Saboteur, the arriving Poynting Vector's changing H-field threads through the coil geometry and induces a counter-field — an opposition that is not "resistance" in the dissipative sense, but a **geometric self-opposition of the magnetic field forced into recursive confrontation with itself** by the coil's topology.

The "back-EMF" is more accurately described as **Widowed Opposition by Counter-Pole**: the Saboteur's coil geometry forces the magnetic component into a configuration where its own return path (mandated by Law 0) passes through the same coil that conceived it, creating temporal opposition. The H-field is not destroyed — it is delayed by 90°, emerging from the Saboteur displaced in time from its E partner.

This is not a mysterious "resistance to change." It is the physical consequence of Law 0 (every field must return) operating within a coiled geometry that forces the return path through the conception path. The inductor is a topological trap that delays the magnetic field's mandated return.

VIII. The 270° Recoil — Why the Capacitor Does Not "Lead"

The Mystery

In AC circuit analysis, the capacitor's current is said to "lead" the voltage by 90°. This is represented as a −90° phase angle or, equivalently, a +90° phase advance. The language implies that an effect (the current response) precedes its cause (the applied voltage) — an apparent violation of causality that is glossed over in conventional teaching.

The Conventional Explanation

"It's just a convention. The capacitor responds to the rate of change of voltage (i = C dv/dt), so maximum current occurs at maximum dv/dt, which is at the voltage zero-crossing — 90° before the voltage peak. The 'lead' is mathematical, not causal." This explanation correctly identifies the mathematical relationship but leaves students with the uneasy sense that the capacitor somehow "knows" what the voltage will do before it does it.

The Burton-Poynting Resolution

Governing Laws: Law V (Dielectric Suspension), Law VIII (Dimensional Prohibition)

The capacitor does not lead. The 90° apparent "lead" is a **270° recoil delay** — the echo of the previous cycle's stored energy being released into the current cycle.

The causal chain:

1. **Cycle N:** A Poynting Vector arrives at the Repeller. E cannot cross the dielectric — it is reflected. The dielectric stores the field energy. H is displaced by the mirror-pair mechanism.
2. **Cycle N+1:** The stored energy from Cycle N is released as the field reverses. This release coincides with the early portion of the new cycle,

creating the appearance that the capacitor's response precedes the current cycle's cause.

3. **The measurement:** An instrument observing only the current cycle sees the Repeller's output arriving 90° "early." But this output is not a response to the current cycle — it is the recoil from the previous cycle, arriving 270° after its original cause.

90° lead = 360° − 270° = the same point in the cycle. The mathematics are identical. But the physical interpretation is fundamentally different:

- **Conventional:** The capacitor leads (effect before cause — acausal)
- **Burton-Poynting:** The capacitor recoils with 270° delay (cause before effect — causal)

Law VIII (Dimensional Prohibition) provides the foundational constraint: E is temporal (time-locked by Noether's Theorem) and can only be harvested or echoed, never advanced. H is spatial and susceptible to geometric displacement. No device can advance E ahead of its temporal moment. The "lead" is an illusion created by measuring a recoil as though it were an anticipation.

IX. Why Kirchhoff's Voltage Law Works — The Field Accounting

The Mystery

Kirchhoff's Voltage Law (KVL) states that the sum of all voltage drops around any closed loop equals zero. This law is taught as fundamental and applied universally, yet its physical basis is rarely explained beyond "conservation of energy." Why does the voltage sum to zero? What physical mechanism ensures this?

The Burton-Poynting Resolution

Governing Law: Law III (Electrical Exhaustion — Revised Kirchhoff)

KVL is the accounting statement of the Poynting Vector's E-component lifecycle. A Poynting Vector is conceived at the source with a specific E magnitude. As it traverses the circuit, each load harvests a portion of E. At the end of the loop, all E has been harvested — the sum of voltage drops equals the source voltage, leaving a net of zero around the loop.

What remains after E has been fully exhausted is H — the Widowed Field — which must return to the source per Law 0. Kirchhoff's Voltage Law is not a separate principle; it is the **E-component bookkeeping** of Law III. It accounts for where E was harvested. Law 0 accounts for where H goes afterward.

KVL tells you the electrical story. Law 0 tells you the magnetic sequel. Together, they describe the complete Poynting Vector lifecycle around any closed loop.

X. Why Transformers Transfer Power Without Electrical Connection

The Mystery

A transformer transfers power between two circuits that have no electrical connection. The primary and secondary windings are insulated from each other. No charge carrier crosses from one winding to the other. Yet energy flows from primary to secondary with high efficiency. How?

The Conventional Explanation

"A changing current in the primary creates a changing magnetic flux in the core, which induces a voltage in the secondary by Faraday's Law." This correctly describes the mathematical chain but frames the energy transfer as a two-step process (current → flux → voltage) rather than identifying the direct energy transfer mechanism.

The Burton-Poynting Resolution

Governing Law: Law VI (Flux-Field Scaling — The Ratio Law)

The transformer is a **magnetic-coupled field bridge**. Energy crosses from primary to secondary via the Poynting Vector entering the core from the primary winding's surrounding field and exiting into the secondary winding's field.

The core does not "carry current." It carries the magnetic component of the Poynting Vector. The primary conceives a field; the core couples the H-component to the secondary; the secondary's geometry (turns ratio) reshapes the field envelope — trading E magnitude for H magnitude (step-down) or H magnitude for E magnitude (step-up) while conserving total Poynting flux:

|S_primary| = |S_secondary|

The transformer is the magnetic analogue of the capacitor:

- **Capacitor:** Electric field coupling through dielectric (E-domain bridge)
- **Transformer:** Magnetic field coupling through ferrite core (H-domain bridge)

Both transfer energy without charge transport across the coupling medium. Both are field-coupling devices. The capacitor couples E through a dielectric; the transformer couples H through a core. Neither requires "current flow" through its coupling medium to function.

XI. Why the Return Conductor Carries the Same "Current"

The Mystery

Ohm's Law and Kirchhoff's Current Law state that the current entering a load must equal the current leaving it. The return conductor carries the "same current" as the supply conductor. But if the load has consumed energy (converted it to heat, light, motion), how can the return conductor carry the same amount? If energy was removed, shouldn't the return be diminished?

The Conventional Explanation

"Current is conserved. The electrons that enter the load must exit the load. Energy is extracted from the electrons (they lose potential), but the number of charge carriers is unchanged." This is the drift-velocity explanation. It requires the student to accept that electrons lose energy but persist in equal numbers — a correct but incomplete picture that does not address what physical entity the return-path ammeter is actually detecting.

The Burton-Poynting Resolution

Governing Laws: Law 0 (The Mandate of Return), Law III (Electrical Exhaustion)

The return conductor does **not** carry the "same" energy as the supply conductor. It carries the **Widowed Field** — the H component of the Poynting Vector, returning to source after E has been harvested.

On the supply conductor: the full Poynting Vector is present — E and H coupled, carrying energy toward the load.

On the return conductor: only H remains. E was consumed at the load. The return-path ammeter reads the same magnitude as the supply-path ammeter because H is conserved (Law 0: the magnetic field must return in full). But the physical nature of what is measured is fundamentally different:

- **Supply path:** H accompanied by E — a married field carrying energy
- **Return path:** H alone — a Widowed Field completing its mandated return

The return conductor's "current" reading is not evidence of equal energy flowing in both directions. It is evidence that the magnetic field is conserved and must return to source — as Law 0 requires. Energy was harvested. The field was not destroyed. The widow returns home.

XII. Why E Is the Reference in Every Phasor Diagram

The Mystery

In every AC circuit analysis course, every textbook, and every phasor diagram, the Electric component (voltage) is used as the **reference**. All other quantities — "current," capacitive response, inductive response — are described as "leading" or "lagging" relative to E. The sine wave begins with E. The phasor is anchored on E. Every phase angle is measured from E.

No textbook explains why.

Why E and not "current"? Why is voltage the fixed reference from which all phase relationships are measured? The convention is universal, yet the justification is absent. Students are told "we use voltage as our reference" and the lesson moves on. No physical basis is offered. No therefore.

The Conventional Explanation

"It's a convention. We need a reference, and voltage is convenient because it's set by the source." This non-explanation has persisted for as long as phasor analysis has been taught. It treats the choice of reference as arbitrary — as though "current" could have served equally well and voltage was selected by historical accident.

It was not arbitrary.

The Burton-Poynting Resolution

Governing Law: Law VIII (Dimensional Prohibition — The Asymmetry Law)

E is the reference because **E is the temporal component of the Poynting Vector.** By Noether's Theorem, energy conservation arises from time-translation symmetry. E, as the energy-carrying component, inherits this temporal invariance. E is locked to the "now" of its propagation. It cannot be advanced. It cannot be delayed. It cannot be phase-shifted by any spatial mechanism. **E is time itself within the circuit.**

H is the spatial component. It is susceptible to geometry — the coil topology of a Saboteur can delay it by 90°, the dielectric boundary of a Repeller can recoil it by 270°. H moves in time because H exists in space, and space can impose geometric delays.

E does not move because E exists in time, and time does not wait.

This is why every phasor diagram in history anchors on E:

- **E is not the reference by convention.** E is the reference by physics.
- **E is not chosen as the fixed axis.** E is the fixed axis — it is the temporal dimension of the Poynting Vector.
- **"Current lags voltage by 90°"** actually means: H has been displaced 90° from the time continuum by the Saboteur's geometry. E didn't move. E can't move.
- **"Current leads voltage by 90°"** actually means: H appears 90° ahead due to a 270° recoil delay from the previous cycle (Law V). E still didn't move.

You don't measure time relative to something else. Everything else is measured relative to time. E is the clock. H is the hand that can be pushed forward or pulled back by the geometry of the circuit. The phasor diagram is not a convention — it is a map of temporal displacement, with E as the fixed meridian.

Every instructor who has ever said "we use voltage as our reference" was stating a consequence of Noether's Theorem without knowing it.

XIII. The Unstated Prohibition — Why E Never Returns

The Mystery

Every law, every equation, every textbook in electrical theory describes what E does — it is generated, it propagates, it drops across loads, it sums to zero around a loop. Kirchhoff's Voltage Law accounts for where E is spent. Noether's Theorem explains why E is conserved. Poynting's theorem describes how E propagates through space.

Yet nowhere in the literature — in 160 years of electromagnetic theory since Maxwell — is there an explicit statement of what E **cannot** do: accompany H back to the source. The prohibition is assumed. It is embedded in the mathematics. It is relied upon in every circuit calculation. But it was never written down as a law.

The Conventional Explanation

There is none. The prohibition is so deeply assumed that it has never been articulated. No textbook contains a section titled "Why E Does Not Return." No standard addresses the question. The concept is simply absent — a negative space in the theory that no one noticed was empty.

The Burton-Poynting Resolution

Governing Law: Law IX (Forward Commitment — The "Therefore" Law)

Law IX states the prohibition directly:

> In a closed electromagnetic circuit, the Electric component (E) of the Poynting Vector is irrevocably committed to forward propagation from its point of conception. E may be harvested at a load, reflected at a dielectric boundary, or exhausted through resistance — but E may never accompany H on the return path to the source. Only H returns.

This is the "therefore" law — the concluding prohibition that follows from the preceding nine laws but was never explicitly stated:

- KVL (Law III) says E is spent → but does not prohibit its return
- Noether's Theorem (Law VIII) says E is time-locked → but does not state a directional constraint
- Law 0 says H must return → but does not state that E must not

Each describes a property. None states the operational consequence. Law IX provides the therefore.

Why it matters for circuit analysis:

The forward commitment of E and the mandated return of H together create the informational asymmetry that makes electromagnetic feedback possible:

- **Forward path:** E + H travel together (energy delivery)
- **Return path:** H alone (load information feedback)

If E could return, both paths would carry identical information. There would be no asymmetry, no feedback signal, and no mechanism for the source to sense load demand. The PID loop that governs every generator, every alternator, every power station depends on this asymmetry.

Why it matters for this treatise:

Every mystery in this document ultimately depends on the forward commitment of E. The Widowed Field exists because E doesn't return. The PID loop works because the return path carries only H. The ammeter's "double vision" persists because the instrument cannot distinguish between married H (supply) and widowed H (return) — a distinction that only exists because E is absent on the return path.

Law IX is not an addition to the Burton-Poynting Codex. It is the keystone — the prohibition that was always implicit in every law, every equation, and every measurement, waiting 160 years to be written down.

"Everyone described what E does. Nobody said what E cannot do." — K. Burton, 2026

Conclusion

The Vision of Inebriation

Consider the ammeter — the most common instrument in the electrical trades. Place one clamp on the supply conductor: it reads 0.80 A. Place another on the return conductor: it reads 0.80 A. The same number. The same instrument. The

natural conclusion — the one every apprentice is taught — is that the "same current" flows in both directions.

This is the electrical equivalent of double vision. The ammeter, blind to E (it senses only H), presents two readings that appear identical. The operator, trained in drift-velocity thinking, interprets them as the same phenomenon measured twice. But they are not the same phenomenon:

- **Supply conductor:** 0.80 FA of H accompanied by 120 V of E — a married Poynting Vector carrying 96 V(FA) (Volt-Field Amplitude) of electromagnetic energy toward the load.
- **Return conductor:** 0.80 FA of H alone — a Widowed Field, stripped of E at the load, completing its mandated return to source carrying zero energy.

The ammeter reports the same number because it cannot see the difference. It is H-blind to E. The drift-velocity framework reinforces the confusion by labelling both readings "current" — as though the supply and return paths carry identical physical entities. They do not. One is a married field. The other is a widow.

The entire conventional framework suffers from this inebriation — a persistent double vision induced by instruments that see only half the Poynting Vector and a vocabulary that was never built to describe the whole.

The Reconciliation

The phenomena catalogued in this document are not anomalies. They are not edge cases or curiosities. They are everyday electromagnetic realities encountered by every electrician, every engineer, and every physicist working with AC circuits. They persist as "mysteries" only because the conventional drift-velocity framework lacks the physical vocabulary to explain them mechanistically.

The Burton-Poynting Framework does not replace the mathematics of conventional circuit theory. The numbers remain the same. Kirchhoff's Laws still balance. Ohm's Law still computes correct results. The framework replaces the physical interpretation — the mental model — that practitioners carry when they apply those mathematics.

The shift is from:

- **Electrons flowing through wires → Fields propagating through space**
- **Current as the primary quantity → The Poynting Vector (S = E × H) as the primary quantity**
- **Ammeter reads current → Ammeter reads H-field intensity**
- **Same current in, same current out → Married field in, Widowed Field out**
- **Displacement current → Dielectric field coupling**
- **Back-EMF → Widowed Opposition by Counter-Pole**
- **Power factor correction as current cancellation → Echo Cancellation as geometric field restoration through dielectric coupling**
- **Capacitor "leads" → Capacitor recoils with 270° delay**
- **Unconnected capacitor plates "somehow work" → Dielectric-coupled mirror pairs**
- **Energy carried by electrons → Energy carried by the Poynting Vector; electrons are bystanders**

Every mystery in this document was always solvable. The mathematics always contained the answer. It required only the physical interpretation to catch up with the equations.

The Burton-Poynting Codex (Laws 0–VIII) provides that interpretation.

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"The Law came first, all other things are governed by law. Remove matter and you are still left with law." — Kevin Burton

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Document signed:

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