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Turning EV-Charging Sites Into Structure: Credentialed Substrate That Stores, Distributes, and Settles Power in the Slab

Fast-charging sites are gated by grid interconnection limits and the capital cost of dedicated buffer batteries, so operators either wait years for a service upgrade or bolt on battery cabinets that dominate the project budget. This piece shows how that buffer, its distribution, and its grid-services accounting can instead become a credentialed property of the concrete a charging site already pours, built on the Credentialed Surfaces, disclosed in U.S. Provisional Application No. 64/050,895. The result is a charging-site substrate whose marginal storage cost approaches the cost of a structural additive rather than the cost of a battery cabinet.

What This Application Specifies

The application specifies an architectural inversion: energy storage stops being a property of dedicated devices and becomes a credentialed property of structural building material. Instead of installing a battery device as discrete equipment connected to an electrical panel, the disclosed substrate-mode architecture distributes storage across materials whose primary function is structural, and a building energy management system aggregates that distributed capacity into a coherent storage resource through credentialed admissibility evaluation.

The material primitive is a credentialed structural element comprising a structural matrix, a biomass-derived carbonaceous material distributed within that matrix, and a credentialed admissibility profile bound to the element by cryptographic signature of one or more credentialing authorities. The carbonaceous constituent is turbostratic graphene produced by flash Joule heating of a carbonaceous feedstock through a transient electrothermal pulse, with the resulting material offering accessible electrochemical surface area disclosed in the range of approximately 500 to 2,000 square meters per gram. Storage operates as electric-double-layer formation at the graphene-electrolyte interface, using either the cement pore solution alone or an engineered electrolyte phase contained in sealed cavities. The underlying materials science here is pre-existing; the invention is the architecture that treats storage, distribution, and networking as independently credentialed but composable surfaces of one structural substrate.

Each element carries an admissibility profile made of multiple property surfaces: structural, thermal, energy storage, electrical distribution, data network, water-coupled, fire-performance, and carbon-sequestration among them. Each surface is independently credentialed by an authority with declared scope, and the surfaces compose through signed, versioned composition rules held in a composition-rule registry. The whole lifecycle is recorded in a lineage chain, and biogenic carbon-credit attestations migrate with the material across material flows and structural lifetimes.

Why It Matters

An EV-charging site is a place where three problems collide. The first is interconnection: a bank of high-power chargers presents a demand spike that a distribution feeder often cannot serve, so the operator faces a utility upgrade that can take years. The second is buffering: the standard workaround is a dedicated battery cabinet that charges slowly from the constrained feeder and discharges quickly into vehicles, but that cabinet's capital cost scales with installed energy capacity and frequently dominates the site budget. The third is that a charging site is already a large civil-works project. It pours foundations, a driveway or parking pad, canopy footings, and pedestal bases regardless of whether it stores any energy.

The application's inversion matters because it maps the buffer onto mass that is being poured anyway. As disclosed, substrate-mode storage lets storage capacity operate as a credentialed property of structural mass such that the marginal cost of that capacity approaches the marginal cost of a structural-additive constituent rather than the cost of dedicated battery infrastructure. For a charging operator, that reframes the buffer from a line item that competes with the chargers into a property of concrete that would exist either way.

The primary capacitive storage class is the reason this fits charging specifically. It is disclosed with charge-discharge time scales of seconds to minutes, declared nominal round-trip efficiency in the range of approximately 90 to 95 percent, and declared nominal cycle life in the range of approximately 5,000 to 20,000 charge-discharge cycles. A fast-charge event is a short, high-power draw followed by a lull, which is exactly the surge-then-recover profile a capacitive class serves, and the many-cycles-per-day duty at a busy site is exactly where a high cycle-life class earns its keep. These are disclosed and projected ranges from the provisional, not built or benchmarked measurements.

How It Composes With the Domain

The pieces of a charging site map onto the disclosed substrate surfaces cleanly, and an enabling deployment reads as follows.

The pad and foundations become the store. A charging bay's slab, the canopy footings, and the equipment-pad concrete are poured as credentialed structural elements. The application discloses a passive substrate class for slabs and floor systems using cement pore solution alone, and an engineered cavity-bath class using sealed engineered electrolyte where higher performance is wanted. The application also discloses a pre-cast modular substrate block at masonry-compatible dimensions with top and bottom electrical terminals and a side-face cavity port, shipped as a self-contained credentialed primitive and assembled through standard construction practices, so a site can be built up from factory-made blocks rather than field-poured cells.

Voltage is composed, not fixed per element. The disclosed series-parallel composition specification forms composite voltage and capacity envelopes from block placement geometry, and the application expressly discloses reaching fast-charge-port voltage classes, naming a 400-volt class and an 800-volt class, through cumulative composition of low-voltage blocks. That is the direct hook to charging: the site's structural mass composes up to the voltage class the vehicles expect.

The canopy and pedestal skins carry the power. A credentialed structural panel can carry a distribution admissibility surface declaring a conductive-layer topology, surface-attachment classes, per-zone current limits, a voltage-class declaration, and a fault-response specification. As disclosed, the panel-as-distribution-substrate primitive composes with the storage surface for local source-load coupling and building-bus arbitration, with an aggregate copper reduction disclosed in the range of approximately 50 to 80 percent relative to conventional branch-circuit topology. A charging pedestal or canopy underside becomes both structure and busway, and a charger head attaches through a credentialed surface attachment whose attachment event is signed by both parties and recorded in lineage.

The site manager is a building energy management system. The disclosed BEMS discovers credentialed elements, characterizes and attests their state of health, aggregates them into a coherent resource, and dispatches energy to credentialed loads through governed actuator execution. At a charging site, that dispatch module is what meters the buffer into a charging session and refills it from the feeder within the interconnection limit. Because the panel can also carry a data-network admissibility surface, the site's session data, metering, and fault signaling ride the same credentialed substrate rather than a parallel network.

Grid participation is settled directly and by duration. The application discloses pair-settled direct grid services in which the BEMS and a grid-service authority settle bilaterally through their credentialed identities, without an intermediary aggregator, for services including frequency regulation, capacity reserve, demand response, and renewable time-shifting. Critically, the BEMS issues duration-attested commitments that declare provable kWh-over-time profiles rather than instantaneous power. A charging site's buffer therefore offers the grid a duration profile matched to its chemistry class, and the vehicles it serves are recognized as one more federated substrate: the application discloses cross-substrate federation at a property spanning a building substrate, a paved-surface substrate (driveway, parking pad), a rooftop photovoltaic substrate, vehicle storage when present, and the grid connection.

What This Enables

The most immediate enablement is interconnection-limited deployment. A site whose feeder cannot serve peak charger demand can still operate high-power chargers if the poured structure buffers the surge and recharges within the feeder's limit, and the BEMS is the component that keeps draw inside that envelope while dispatching to sessions.

It enables charging sites as grid assets. Because storage is distributed across mass poured anyway and settled through duration-attested commitments, a network of sites federates into a larger credentialed storage resource. The application discloses grid-scale long-duration energy storage in which substrate-mode capacity across building, infrastructure, and engineered-works elements is aggregated through cross-building federation, with marginal cost approaching that of the graphene additive rather than dedicated battery infrastructure.

It enables carbon accounting that travels with the site. The flash Joule heating pathway admits an organic-waste feedstock class and issues a methane-avoidance attestation, recorded in lineage and queryable by environmental-credit authorities, and the closed-loop carbon recovery pathway lets end-of-life concrete's carbon fraction be recovered and re-credentialed. A charging operator can hold a carbon-sequestration surface on the same concrete that stores the buffer.

It enables the substrate to double as a site sensor. The disclosed distributed physical-state observatory lets the BEMS read the substrate's electrical state for wet events, thermal events, settling, and proximity, which at an outdoor charging site is useful for both safety interlocks and condition monitoring.

Boundary Conditions

The honest limits track the disclosure. The primary capacitive class is a low-energy-density, high-power, high-cycle store, disclosed at approximately 0.1 to 3 watt-hours per kilogram of cementitious composite under realistic-deployment conditions. It buffers surges and shifts short windows; it is not a multi-day energy reserve on its own, and sizing a charging buffer means committing large structural mass, which suits a site's civil works but is not a small retrofit component.

The disclosed performance figures are provisional ranges framed as disclosed or projected. Nothing here is built, validated, or benchmarked, and no performance number should be read as a measured result. Cold-climate inland deployment depends on electrolyte freezing-point selection for the closed-cell class, since the native-pore-solution class has a limited cold-climate window without supplementary thermal management.

Code and voltage boundaries matter at a charging site. The application notes that operating voltages typically below 60 volts DC qualify as Class 2 or Class 3 wiring under the relevant electrical-code articles; composing up to a 400-volt or 800-volt fast-charge class raises the substrate above that low-voltage regime and pulls in the full arc-flash, shock-protection, grounding, and isolation requirements the application states the structural-to-electrical interface must satisfy. Any real deployment is gated by the credentialing authorities named in the profile: a structural authority, a fire-marshal authority, and a utility or building-code authority must each sign their surface before the site operates.

Disclosure Scope

The invention described here is disclosed in U.S. Provisional Application No. 64/050,895, which specifies a multi-function credentialed structural substrate carrying energy storage, electrical distribution, data networking, thermal coupling, and carbon sequestration as composed, independently credentialed property surfaces of building material. All statements about what the invention does, including substrate-mode storage, the primary capacitive class, panel-as-distribution and panel-as-network substrates, series-parallel composition to fast-charge voltage classes, pair-settled duration-attested grid services, cross-substrate federation, and cradle-to-cradle credentialing, trace to that disclosure and to its disclosed or projected parameter ranges rather than to any built or measured system. The underlying materials science, including flash Joule heating of biomass to turbostratic graphene and electric-double-layer capacitance, is pre-existing; the novelty is the credentialed multi-surface architecture and its composition, not new basic science. The EV-charging framing, including interconnection limits, buffer-battery economics, and fast-charge voltage classes, is external domain and regulatory context provided as an enabling implementation setting; it is concrete and faithful to the domain but is not itself part of the disclosed invention, and any named voltage class or code provision reflects the domain and the application's own recitations rather than a claim of the invention.

Credentialed Surfaces (/credentialed-materials)

All 40 steps → (/inventive-steps)

Building surfaces as credentialed agents that participate in the structure's networking and electrical systems.

Provisional application

PRIMARY TECHNICAL DISCLOSURE

- Credentialed Building Materials: Cryptographic Admissibility for Structural Surfaces (/articles/credentialed-building-materials-cryptographic-admissibility-for-structural-surfaces)

SECONDARY TECHNICAL

- Carbon-Sequestration Admissibility Surface (/articles/credentialed-materials/carbon-sequestration-property-surface)
- Composition Rules Governing Surface Interactions (/articles/credentialed-materials/composition-rules)
- Decommissioning And Re-Credentialing Attestation (/articles/credentialed-materials/decommissioning-and-recredentialing)
- Electrical-Distribution Admissibility Surface (/articles/credentialed-materials/distribution-property-surface)
- End-Of-Storage-Life Attestation (/articles/credentialed-materials/end-of-storage-life-attestation)
- Energy-Storage Admissibility Surface (/articles/credentialed-materials/energy-storage-property-surface)
- Lineage Chain Across Material Lifecycle (/articles/credentialed-materials/lineage-chain-across-lifecycle)
- Authority Signatures Block Binding Property Surfaces To Material Identity (/articles/credentialed-materials/master-credential-binding)
- Multi-Authority Signature Block (/articles/credentialed-materials/multi-authority-signature-block)
- Data Network Admissibility Surface (/articles/credentialed-materials/network-property-surface)
- Profile Versioning Continuity (/articles/credentialed-materials/profile-versioning-continuity)
- Structural Admissibility Surface (/articles/credentialed-materials/structural-property-surface)
- Thermal-Property Admissibility Surface (/articles/credentialed-materials/thermal-property-surface)
- Versioned Admissibility Profiles With Lineage Chain (/articles/credentialed-materials/versioned-profiles-with-lineage)

- Water-Coupled Admissibility Surface (/articles/credentialed-materials/water-coupled-property-surface)

APPLICATIONS · GENERAL

- Credentialed Structural Materials for Construction and Civil Infrastructure: Carrying Strength, Mix, and Provenance as Multi-Authority Attestations (/articles/credentialed-materials/construction-and-infrastructure)
- Carbon-Credit-Bearing Building Materials: Sequestration Attestations That Survive Incorporation, Transfer, and Decommissioning (/articles/credentialed-materials/carbon-credit-materials)
- Building-Product Compliance and Code Approval: Property-Surface Profiles as Machine-Evaluable Admissibility Evidence (/articles/credentialed-materials/building-product-compliance)
- Credentialed Building Materials for Real Estate Valuation, Insurance, and Disclosure: A Property History That Binds to the Asset (/articles/credentialed-materials/real-estate-and-asset-lifecycle)
- Recredentialing Recovered Materials: Verifiable Lineage for Reuse and Decommissioning in the Circular Economy (/articles/credentialed-materials/circular-economy-and-decommissioning)
- Energy and Grid-Coupled Surfaces: Crediting Stationary Storage in Structural Mass Without Trusting the Cell (/articles/credentialed-materials/energy-and-grid-surfaces)
- Credentialed Surfaces for Water and Environmental Infrastructure: Signed Performance and Compliance Attestations on Water-Coupled Concrete (/articles/credentialed-materials/water-and-environmental-infrastructure)
- Data-Center Infrastructure Substrate: Collapsing UPS Rooms, Cooling Distribution, and Raised-Floor Wiring Into One Credentialed Structural Surface (/articles/credentialed-materials/data-center-infrastructure)
- **Turning EV-Charging Sites Into Structure: Credentialed Substrate That Stores, Distributes, and Settles Power in the Slab (/articles/credentialed-materials/ev-charging-infrastructure)**

APPLICATIONS · SPECIFIC

- Circularise, a blockchain-based supply-chain traceability and digital-product-passport platform for materials vs credentialed material surfaces: attestations bound to the physical material (/articles/credentialed-materials/circularise)
- EC3 (Embodied Carbon in Construction Calculator) by Building Transparency vs a credentialed carbon-sequestration surface bound to the material (/articles/credentialed-materials/ec3-building-transparency)
- CarbonCure Technologies, which injects and mineralizes CO2 into concrete during mixing vs a credentialed carbon-sequestration attestation architecture (/articles/credentialed-materials/carboncure)

- Sublime Systems, maker of low-carbon cement via an electrochemical (ambient) process vs a credentialed carbon-sequestration surface bound to the material (/articles/credentialed-materials/sublime-systems)
- Brimstone carbon-negative portland cement vs credentialed material attestations: process decarbonization or per-element carbon accounting? (/articles/credentialed-materials/brimstone)
- The EU Digital Product Passport (DPP) under the Ecodesign for Sustainable Products Regulation (ESPR) vs credentialed surfaces: a data-carrier standard next to a material-bound attestation architecture (/articles/credentialed-materials/eu-digital-product-passport)
- One Click LCA, a life-cycle-assessment and EPD software platform for construction vs a credentialed carbon-sequestration property surface bound to the material (/articles/credentialed-materials/one-click-lca)
- Concrete.ai vs credentialed carbon-sequestration surfaces on structural materials (/articles/credentialed-materials/concrete-ai)
- Madaster alternative: material passports as a building registry vs credentialed surfaces bound to the physical material (/articles/credentialed-materials/madaster)

Credentialed Surfaces overview → (/credentialed-materials)