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End-Of-Storage-Life Attestation

When the realized energy-storage capacity of a credentialed structural element degrades below a declared threshold, an end-of-storage-life transition updates the energy-storage admissibility surface to zero or reduced storage capacity while the structural admissibility surface continues to support the element's structural function. The same physical element remains in place and continues to carry its other admissibility surfaces. The transition is a credentialed event signed by the building energy management system under evidential weighting and recorded in the material's lineage chain, with the credentialed admissibility profile re-evaluated so that downstream consumers read the updated storage state through the credential.

Mechanism Of The Surface-Specific Transition

Credentialed structural elements in the disclosed framework carry a credentialed admissibility profile comprising a plurality of admissibility surfaces, each declaring property-specific parameters and admission conditions for one property category. Property surfaces include structural, thermal, energy storage, electrical distribution, data network, water-coupled, thermal-coupling, fire-performance, and carbon-sequestration admissibility surfaces. The end-of-storage-life transition is a credentialed lifecycle transition in which the realized energy-storage capacity has degraded below a declared threshold: the credentialed admissibility profile is updated to reflect zero or

reduced storage capacity while the structural admissibility surface continues to support the element's structural function. The element remains in place. Its physical envelope, its structural geometry, its thermal mass, and its embedded conductive pathways are all undisturbed.

The transition is signed by the building energy management system under evidential weighting. The building energy management system discovers and characterizes the storage capacity distributed across structural elements, and it is admitted to sign the end-of-storage-life substate as a credentialed lifecycle transition. When the realized energy-storage capacity has degraded below the declared threshold, the transition is recorded as a credentialed event in the lineage chain, and the credentialed admissibility profile is re-evaluated to reflect the updated storage state. Downstream consumers read the credential and observe that the storage surface now carries zero or reduced storage capacity, with the transition preserved in the lineage chain.

The transition is signed under evidential weighting, meaning the building energy management system records the credentialed event on the basis of weighed evidence of the capacity decline rather than on a single unverified reading. The disclosed architecture also admits state-of-health rules within the composition-rule architecture, including a carbonation-tracked state-of-health rule and derated-capacity rules, which characterize how the storage admissibility surface's capacity envelope is evaluated over the element's service life.

Once the transition is recorded, the building energy management system re-evaluates the element's composite admissibility profile against the updated storage state. Because dispatch operates through composite admissibility evaluation and governed actuator execution, a dispatch evaluated against a storage surface that now declares zero or reduced capacity is governed accordingly. The other admissibility surfaces of the same element are unaffected: the structural admissibility surface continues to support the element's structural function, and the element continues to carry its remaining surfaces.

Recording And Evaluation Of The Transition

The end-of-storage-life event is recorded in the lineage chain as a credentialed lifecycle transition. The disclosed lineage chain is a persistent record of credentialed events associated with a credentialed material, element, or assembly, including pre-installation credentialing, in-service operational dispatch events, state-of-health attestations, end-of-storage-life updates, decommissioning attestations, and re-credentialing attestations. The end-of-storage-life update declares that the realized storage capacity has degraded below the declared threshold and that the credentialed admissibility profile is updated to zero or reduced storage capacity, while the structural admissibility surface continues in service. The element may continue under a reduced storage capacity rather than a fully zeroed surface, as the profile is updated to reflect zero or reduced capacity.

The transition is recorded as a credentialed event and bound to the element's credentialed identity through the credentialing signature block, so that downstream consumers reading the credentialed admissibility profile observe the updated storage state. Because dispatch is governed through composite admissibility evaluation, a dispatch evaluated against the updated profile reflects the reduced or zeroed storage capacity, and the event remains recorded in the lineage chain for later review.

The capacity threshold is a declared threshold expressed within the credentialed admissibility profile rather than being set unilaterally at the moment of transition. The storage admissibility surface declares its property-specific parameters and admission conditions, and the surfaces compose through declared composition rules to produce a composite admissibility profile. State-of-health and derated-capacity rules within the composition-rule architecture govern how the storage surface's realized capacity is evaluated against its declared bounds. The architecture binds these declarations to the element through the credentialing signature block and re-evaluates the composite admissibility profile against the cumulative state rather than only at original installation.

Versioning is handled through the composition-rule architecture, which holds signed and versioned composition-rule artifacts in a composition-rule registry. Each composition rule carries a scope of property surfaces and conditions, composition logic, a version vector for deterministic conflict resolution, a conflict-resolution policy, and an authority signature. The version vector and conflict-resolution policy allow composition rules to evolve while preserving deterministic evaluation, so that the credentialed admissibility profile of an element installed under an earlier rule set remains interpretable as rules are updated.

Alternative Embodiments

Although the principal embodiment updates the energy-storage surface specifically, the same surface-specific transition applies to any other admissibility surface whose function may change independently of the others. Because the credentialed admissibility profile comprises a plurality of independently declared admissibility surfaces composing through declared composition rules, a transition affecting one surface leaves the remaining surfaces in service. An end-of-storage-life transition is in this way distinct from end-of-structural-life decommissioning, which is a separate credentialed event signed by a licensed demolition or deconstruction contractor admitted under credentialed scope.

In an alternative embodiment, the storage surface is not zeroed but updated to a reduced capacity, consistent with the disclosed transition in which the credentialed admissibility profile is updated to reflect zero or reduced storage capacity. The element then continues in service at the reduced storage capacity while its structural and other admissibility surfaces continue. State-of-health rules within the composition-rule architecture, including a carbonation-tracked state-of-health rule and derated-capacity rules, characterize how the storage surface's realized capacity is evaluated as the element approaches and crosses the declared threshold.

A multi-authority embodiment relies on the multi-authority credentialing of the structural-storage element, in which the credentialing signature block binds the credentialed admissibility profile through one or more cryptographic signatures of credentialing authorities admitted to the architecture. The cross-building federation embodiment further contemplates optional credentialed observers, including a regulatory authority and a carbon-credit authority, participating in the federation. These signing arrangements are governed by the credentialed scope declared for each authority rather than by a single operational actor.

A continuous re-credentialing embodiment ties end-of-storage-life to the disclosed metabolic-lifetime model of building operation. Under this model, end-of-storage-life of the original substrate composition does not require demolition of the structural element; the structural element continues in service while incoming material flows refresh, augment, or substitute the storage substrate within the cumulative composite admissibility profile. Each such material flow is a credentialed event signed by an installer authority and recorded in the lineage chain, supporting structural lifetimes that substantially exceed the storage-chemistry cycle life of any individual substrate composition.

A federated embodiment operates across a cross-building federation, in which a plurality of credentialed substrates federate across multiple properties, neighborhoods, utility territories, or jurisdictions through a federation orchestrator that coordinates cross-substrate operations under credentialed scope declared by the participating building energy management systems. A cross-building lineage chain records credentialed events across the federation, so that an end-of-storage-life transition recorded for one element is reflected in the federated record as the element participates across operator and jurisdictional boundaries.

Composition Of The Lineage Record

The lineage chain is a persistent record of credentialed events associated with a credentialed material, element, or assembly, including pre-installation credentialing, in-service operational dispatch events, state-of-health attestations, end-of-storage-life updates, decommissioning attestations, and re-credentialing attestations. The end-of-storage-life update occupies one credentialed event in this record, declaring that the realized storage capacity has degraded below the declared threshold and that the credentialed admissibility profile is updated to zero or reduced storage capacity. The credentialed admissibility profile is bound to the element through the credentialing signature block by cryptographic signature of one or more credentialing authorities, so that consumers reading the credential observe the updated state with provenance.

Because the credentialed admissibility profile comprises a plurality of distinct admissibility surfaces, the storage transition does not require restructuring of the profile itself. The profile continues to enumerate the same property surfaces, but the storage surface now declares zero or reduced storage capacity while the structural admissibility surface continues to support the element's structural function. The building energy management system and other consumers evaluate the surfaces relevant to their operation, so the updated storage state is reflected in composite admissibility evaluation where it bears on a given operation.

The end-of-storage-life update composes with the other credentialed events recorded in the lineage chain. State-of-health attestations may precede it, characterizing the storage surface's capacity as the element approaches the declared threshold. End-of-structural-life decommissioning and recycling-grade re-credentialing may follow, the former signed by a licensed demolition or deconstruction contractor and the latter performed by a recycler authority producing a new admissibility profile at recycled grade. The end-of-storage-life update occupies one position in this lifecycle, and its meaning is defined relative to the other credentialed transitions in the lineage chain.

Prior-Art Distinctions

Existing energy storage systems treat energy storage as a property of dedicated devices. Batteries, capacitors, flywheels, pumped-hydro reservoirs, hydrogen tanks, and compressed-air vessels are engineered as discrete devices whose function is to store energy. When such a device's storage capability degrades, the entire device is treated as the unit of decommissioning, regardless of whether other functions of its host structure might continue. Existing structural-battery research treats structural integration as embedding a battery device into a host material rather than as a property of the host material, so the storage device remains the architectural primary.

The end-of-storage-life transition disclosed here departs from this pattern because storage is a credentialed property of a structural element rather than a property of a dedicated device. The storage admissibility surface is one surface among a plurality of independently credentialed property surfaces that compose through declared composition rules. When the realized storage capacity degrades below a declared threshold, the storage surface is updated to zero or reduced capacity while the structural admissibility surface continues to support the element's structural function, allowing the element to remain in service while bearing load, conducting heat, or routing signals through its other surfaces.

Existing building energy management systems treat installed batteries as discrete connected loads or sources, with no provision to characterize the admissibility of distributed storage, to aggregate it into a coherent storage resource, or to record a surface-specific transition against a structural element. The disclosed architecture instead treats the building energy management system as the aggregation primitive and records the end-of-storage-life transition as a credentialed event signed under evidential weighting, so that the element's other admissibility surfaces are unaffected by the storage transition.

Lifecycle Economics And Auditability

Because storage is a credentialed property of structural mass that would otherwise be present for structural reasons, an end-of-storage-life transition does not end the element's usefulness. The element continues to carry its structural, thermal, distribution, network, and carbon-sequestration admissibility surfaces under the same credentialed admissibility profile. The transition is recorded as a credentialed event in the lineage chain rather than as a removal, so the element's continued participation in its other surfaces remains evaluable through the credential.

The lineage record also supports carbon-sequestration reporting. The disclosed architecture admits migrating carbon attestations, in which biogenic carbon-credit attestations bound to a credentialed substrate migrate with the substrate across material flows and across structural lifetimes through credentialed transactions signed by an environmental-credit authority and recorded in the lineage chain. Because the storage transition is recorded as a credentialed event and the element continues in service, a carbon-credit authority reading the lineage chain can confirm that the substrate's carbon mass remains sequestered within the structural element across its continuing service life rather than released through scrapping.

Disclosure Scope

The subject matter described here is disclosed in U.S. Provisional Application No. 64/050,895. This disclosure encompasses any system in which a credentialed structural element's energy-storage admissibility surface is updated to zero or reduced storage capacity when the realized storage capacity has degraded below a declared threshold, while the structural admissibility surface continues to support the element's structural function and one or more other admissibility surfaces remain in service, the transition being a credentialed event signed by the building energy management system under evidential weighting and recorded in the lineage chain.

Scope further extends to multi-authority credentialing of the structural-storage element, to cross-building federation under a federation orchestrator with optional credentialed observers, and to the continuous re-credentialing and metabolic-lifetime model in which incoming material flows refresh, augment, or substitute the storage substrate within the cumulative composite admissibility profile while the structural element continues in service. It includes the composition-rule architecture by which versioned, signed composition rules and state-of-health rules govern evaluation of the storage surface's capacity against its declared threshold. Disclosure is not limited to any particular building system, grid-management protocol, or registry implementation within the multi-function credentialed structural substrate framework.

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

- credentialed-materials/carbon-sequestration-property-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)

- **credentialed-materials/end-of-storage-life-attestation (/articles/credentialed-materials/end-of-storage-life-attestation)**
- credentialed-materials/energy-storage-property-surface (/articles/credentialed-materials/energy-storage-property-surface)
- Lineage Chain Across Material Lifecycle (/articles/credentialed-materials/lineage-chain-across-lifecycle)
- Master Credential Signature Binding All Property Surfaces (/articles/credentialed-materials/master-credential-binding)
- Multi-Authority Signature Block (/articles/credentialed-materials/multi-authority-signature-block)
- Data-Networking Admissibility Surface (/articles/credentialed-materials/network-property-surface)
- Profile Versioning Continuity (/articles/credentialed-materials/profile-versioning-continuity)
- credentialed-materials/structural-property-surface (/articles/credentialed-materials/structural-property-surface)
- credentialed-materials/thermal-property-surface (/articles/credentialed-materials/thermal-property-surface)
- Versioned Admissibility Profiles With Lineage Chain (/articles/credentialed-materials/versioned-profiles-with-lineage)
- credentialed-materials/water-coupled-property-surface (/articles/credentialed-materials/water-coupled-property-surface)

Credentialed Surfaces overview → (/credentialed-materials)