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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

The EU Digital Product Passport (DPP), introduced under the Ecodesign for Sustainable Products Regulation (ESPR), gives products a standardized, machine-readable record of their sustainability and circularity data, reachable through a data carrier on the product. The domain problem it addresses is trust in product-level environmental and lifecycle claims across a supply chain. This article positions that regulatory regime against a different kind of object: the credentialed admissibility profile of the Credentialed Surfaces, disclosed in U.S. Provisional Application No. 64/050,895, which binds signed, policy-evaluable property claims to the physical material itself and evaluates them at the moment of use.

What The EU Digital Product Passport (DPP) under the Ecodesign for Sustainable Products Regulation (ESPR) Does

The EU Digital Product Passport is a regulatory instrument established under the Ecodesign for Sustainable Products Regulation, the EU framework that replaced and broadened the earlier Ecodesign Directive. In broad terms, the ESPR empowers the

European Commission to set product-specific ecodesign requirements and to require that many product categories carry a Digital Product Passport. The passport is a structured, machine-readable set of information about a product covering matters such as material composition, durability, repairability, recycled content, substances of concern, and end-of-life handling, made accessible through a data carrier such as a QR code or comparable identifier physically present on the product, its packaging, or its documentation.

The DPP is a genuinely significant piece of infrastructure, and it does several things well. It establishes a common, regulated expectation that lifecycle and circularity data travel with the product rather than living only in a manufacturer's internal systems. It is designed around open standards and interoperability so that consumers, repairers, recyclers, customs authorities, and market-surveillance authorities can read the same record. It sets legal accountability for the accuracy of the declared information under EU law. And it is being rolled out on a category-by-category basis, with batteries among the early movers, so that requirements are tailored to what each product class actually needs. As a policy-and-data-standard layer for the single market, it is a well-conceived approach to a real problem.

What the DPP standardizes is the record and its accessibility: what data fields exist, who is responsible for them, and how a reader reaches them through the carrier. It does not, and is not intended to, specify the physics of any particular product or the internal mechanism by which a specific material proves what it is.

The Architectural Axis

The axis this comparison turns on is where the trustworthy claim lives and when it is evaluated.

A Digital Product Passport is, structurally, a data carrier plus a referenced record. The carrier is affixed to the product; the record is held in a repository reachable through that carrier. The binding between the physical object and its data is the identifier printed or embedded on the object, and the authority behind the data is principally the economic operator who places the product on the market, within a regulated compliance regime. The passport is oriented toward disclosure and market oversight: it makes information available to be read, largely by people and systems acting after the fact of manufacture and sale.

The invention disclosed in the provisional occupies a different position on that same axis. It is not a disclosure record to be read; it is a credentialed admissibility profile designed to be evaluated as a gate on operations. The distinction is not that one is digital and the other is not. Both are digital. The distinction is that the passport describes a product for readers, whereas the disclosed profile is a signed, machine-evaluable object that a consuming system checks before it admits energy, data, a device attachment, or a grid commitment. This is a difference in role, not a defect in the passport; the two objects are built for different jobs.

How the Disclosed Approach Differs

The Credentialed Surfaces architecture, as disclosed in U.S. Provisional Application No. 64/050,895, centers on the credentialed admissibility profile. Per the specification, this is a structured data object that declares one or more property surfaces of a material, element, or assembly, where each surface declares property-specific parameters and admission conditions, and the profile is bound to the identity of the material through cryptographic signature by one or more credentialing authorities.

Several structural features follow from the specification and mark the difference from a data-carrier passport:

Multi-authority, per-surface credentialing. The disclosed profile carries independently signed property surfaces, so that, in the specification's examples, a structural engineering authority signs the structural surface, a fire-marshal authority signs the fire-performance surface, an environmental-credit authority signs the carbon-sequestration surface, and a utility or building-code authority signs the storage surface. Responsibility is decomposed across authorities per surface rather than resting on a single declaring operator.

Composition rules evaluated at admission time. The specification discloses a composition-rule registry holding signed and versioned composition-rule artifacts, each declaring a scope, a composition logic, a version vector, a conflict-resolution policy, and an authority signature. These rules are consumed by a building energy management system at admissibility-evaluation time. This is the load-bearing difference: the disclosed object is not merely read, it is evaluated against published policy to produce admit, deny, or partial-admit determinations before an operation proceeds. The specification gives concrete examples, including a fire-event rule that reduces storage admissibility to zero when a fire-performance surface declares fire-event detection.

Binding to the physical material and its state. Where a passport's binding is an affixed identifier, the disclosed architecture contemplates identity classes including a physical-fingerprint identity derived from a hash of physical characteristics such as the element's unique impedance signature, signed by the manufacturer authority. The specification further describes the substrate operating as a distributed physical-state observatory, so the credentialed claims can be re-evaluated against observed state rather than frozen at manufacture.

A lineage chain across lifetimes. The specification discloses a lineage chain recording pre-installation credentialing, in-service operation, state-of-health attestations, end-of-storage-life, decommissioning, recycling-grade re-credentialing, and re-installation, with continuous re-credentialing across in-service material flows and migrating carbon

attestations that travel with the substrate across structural lifetimes. The record is a running ledger of signed transitions rather than a snapshot maintained by the placing operator.

The novelty asserted here is architectural: the combination of material-bound cryptographic credentialing, per-surface multi-authority signing, and policy artifacts evaluated at the point of admission. The underlying materials science referenced in the specification, including flash Joule heating of biomass to turbostratic graphene and cementitious composites, is pre-existing; the disclosure does not claim to have discovered it. What is disclosed is the credentialing and composition architecture layered over such materials.

Where They Fit Together

These are complementary, not rival, objects, and the honest framing is composition rather than competition.

The DPP defines what environmental and circularity information a regulated product must expose, who is accountable for it, and how a reader reaches it. The credentialed admissibility profile defines how a signed property claim is bound to a physical material and evaluated as a gate on operations. A credentialed material could serve as an unusually strong substrate underneath a DPP: the passport's carrier and standardized fields provide the regulated disclosure surface a reader expects, while the profile's per-surface signatures, lineage chain, and migrating carbon attestations supply verifiable, authority-attested provenance for the very fields the passport wants to publish. In the specification's terms, an environmental-credit authority's carbon-sequestration surface and methane-avoidance attestation are exactly the kind of content a circularity passport aims to carry, produced here as signed, queryable events.

Put plainly: the passport is a standardized way to publish and read product data for a regulated market; the disclosed architecture is an enabling way to produce, bind, and evaluate that data at the material. One could satisfy the other. Neither makes the other unnecessary.

Boundary Conditions

Honesty requires being clear about the asymmetry. The EU Digital Product Passport is a live regulatory regime with legal force, defined standards, and category rollouts already underway; economic operators are building to it today. The subject of the comparison on our side is a provisional patent disclosure of an architecture. It has not been built, validated, benchmarked, or certified against the DPP or any other standard, and this article makes no such claim. Any numeric parameters that appear in the specification are declared design parameters within that disclosure, not measured results, and the underlying materials chemistry is prior art rather than a new discovery.

There are further limits worth stating. The disclosed evaluation-time gating model presupposes credentialing authorities, a composition-rule registry, and consuming systems that honor them; that ecosystem is described in the specification, not deployed. The physical-fingerprint and observatory features assume instrumentation and interfaces that a plain data-carrier passport does not require, which is precisely why a passport is simpler to adopt for ordinary consumer goods. And nothing here should be read as identifying any deficiency in the DPP: the passport is doing what it was designed to do, and its design choices are reasonable for its regulatory purpose.

Disclosure Scope

The technical claims about the disclosed approach in this article trace to U.S. Provisional Application No. 64/050,895, titled for a multi-function credentialed structural substrate, which is the ground-truth source for every statement about what the invention does, including the credentialed admissibility profile, per-surface multi-

authority credentialing, composition rules evaluated at admission time, the lineage chain, and migrating carbon attestations. All description of the EU Digital Product Passport, the Ecodesign for Sustainable Products Regulation, and the surrounding market and regulatory landscape is external context provided for orientation only; it is not part of, and is not a claim of, the filing. This article does not assert any defect, noncompliance, or shortcoming in the EU Digital Product Passport or in any entity implementing it; the comparison is confined to genuine architecture-level differences in where a trustworthy claim is bound and when it is evaluated, and any regulatory positioning is offered as commentary rather than as a representation of the patent's scope.

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)

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)

Credentialed Surfaces overview → (/credentialed-materials)