

A Blockchain-Supported LCA Framework to Strengthen Environmental and Social Governance in Renewable Energy Projects

Cesar E. Polo Castro¹, Alexander A. Bustamante¹, John A. Taborda¹, Laura A. Chia²

¹ Universidad del Magdalena, Colombia. ² Agencia Nacional de Hidrocarburos (ANH), Colombia.

cpoloc@unimagdalena.edu.co, abustamante@unimagdalena.edu.co, jtaborda@unimagdalena.edu.co, laura.chia@anh.gov.co

Trustworthy ESG Governance through Blockchain-Supported LCA A Framework for Renewable Energy Projects in Global South Contexts

<https://www.impact-energy.co/>

The ESG Trust Deficit in Renewable Energy

The Challenge:

Rapid wind and solar deployment requires transparent, credible ESG assessments to ensure a just energy transition.

Traditional LCA

Limits:
Current LCA relies on fragmented, static data and weak verification mechanisms.

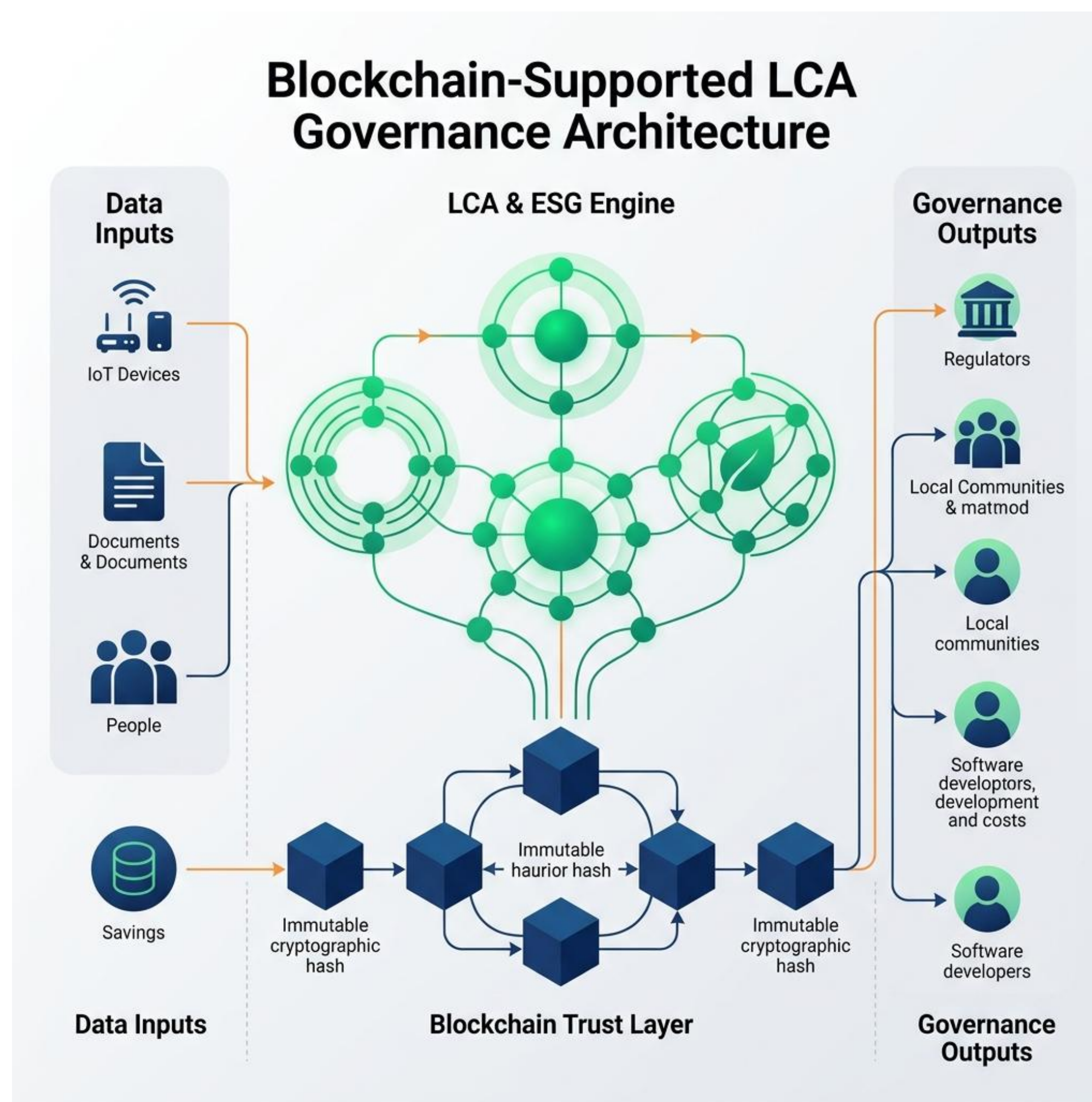
Trust Gap:

Lack of traceability undermines trust among regulators, communities, and developers.

Core Message:

**LCA provides analytical rigor;
Blockchain provides verifiable trust.**

Blockchain-Supported LCA Governance Architecture



Conclusions:

The framework operationalizes a novel digital infrastructure, proving that combining LCA's scientific foundation with blockchain's data integrity significantly strengthens ESG governance.

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Contributions & Applied Governance

Conceptual Contributions

Transparency & Trust: Systematically embeds blockchain within LCA workflows without compromising methodological rigor.
Accountability: Creates a multi-actor trust architecture.

Functional Contributions

Tamper-resistant Records: Secures life cycle indicators and governance events.
Independent Verification: Enables continuous oversight across all project phases.

Case Study: Colombia's Energy Transition

Focus: Complex institutional and social challenges in wind and solar expansion.
Impact: Scalable pathway for bridging science, policy, and practice in the Global South.

Glossary of Key Terms

- Blockchain:** A distributed and tamper-resistant digital ledger used to securely record transactions, metadata, and verification events across multiple stakeholders.
- LCA (Life Cycle Assessment):** A standardized methodology used to

evaluate environmental impacts across the entire life cycle of a product, system, or technology.

ESG (Environmental, Social, and Governance): A framework used to assess sustainability performance related to environmental stewardship, social responsibility, and institutional governance.

IoT (Internet of Things): A network of connected devices and sensors capable of collecting, transmitting, and processing real-time data.

Impact Assessment: The process of identifying, analyzing, and evaluating potential environmental and social consequences of projects or activities.

IMPACT Energy.CO: A digital platform developed by the Universidad del Magdalena and the ANH to support integrated monitoring and evaluation of environmental and social impacts in renewable energy projects.