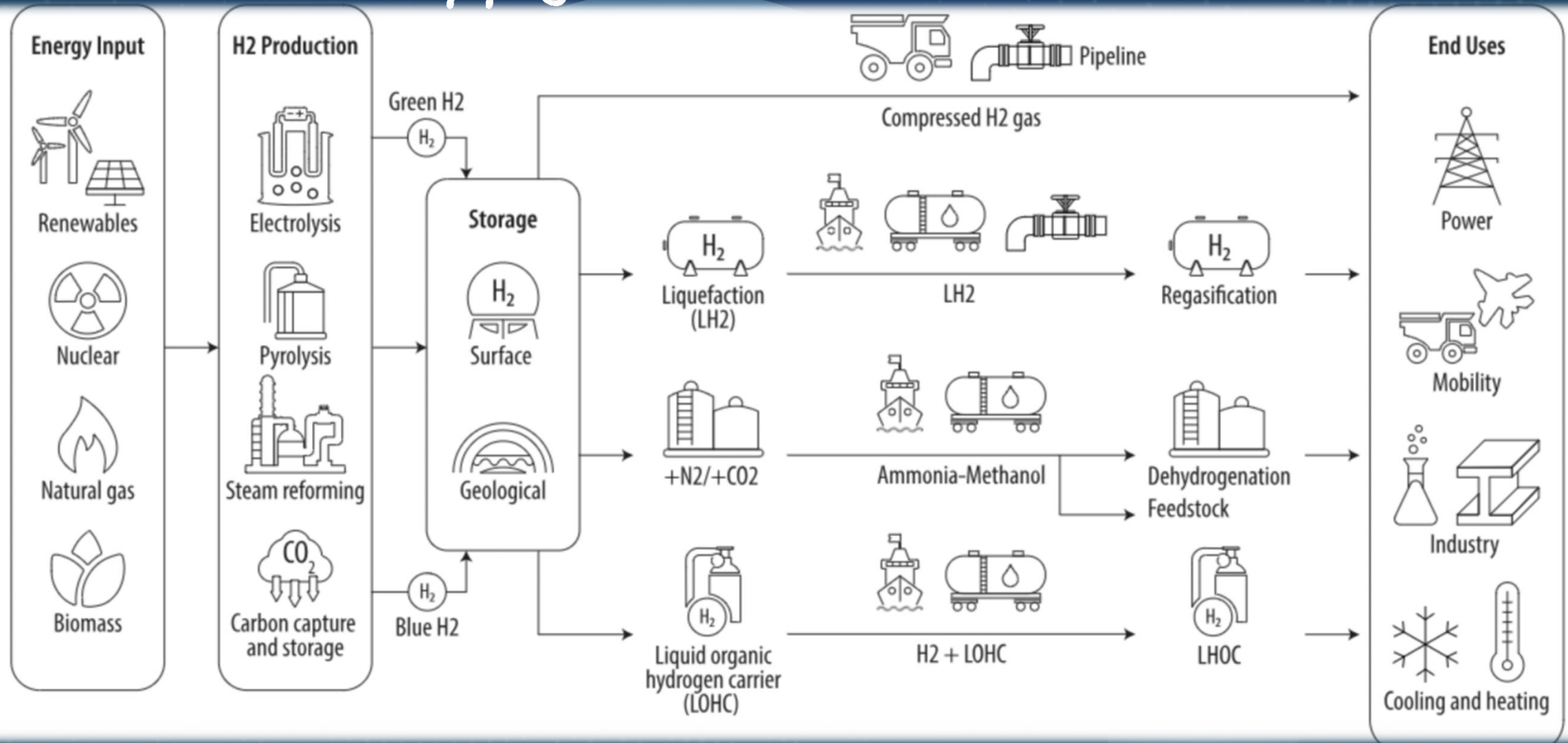


BLOCKCHAIN ENABLED SUPPLY CHAIN MANAGEMENT FOR

GREEN HYDROGEN

Presented By-
Aayushi Bhatia
Deputy Manager
Solar Energy Corporation of India Ltd.

Overall H₂ Supply Chain



PROBLEM STATEMENT

One of the significant challenges in the Green Hydrogen ecosystem is ensuring transparency, traceability, and efficiency across the entire supply chain, from production to end-use.

As the industry grows, it becomes increasingly important to verify that hydrogen is produced, transported, and used in a truly green and sustainable manner.

What is Blockchain ?

Blockchain is a distributed database that stores data in a chain of blocks that are linked together using cryptography. It's also known as Distributed Ledger Technology.

It is a distributed database that maintains a continuously growing list of ordered records, called blocks.



WHY BLOCKCHAIN IS REQUIRED IN GREEN HYDROGEN VALUE CHAIN ?

Developing blockchain-based platform to manage and optimize the Green Hydrogen supply-chain.



01

The solution will help in ensuring transparency & reducing inefficiencies.



03

This platform would track every step of the hydrogen lifecycle



02

It will also help in facilitating better decision-making across supply-chain.



04

KEY FEATURES

01

End-to-End Traceability

- ▷ By embedding data related to the **origin of hydrogen production** (e.g., renewable sources like wind, solar, etc.), blockchain ensures that end-users and regulatory bodies can verify that the hydrogen is produced in an **environmentally friendly manner**.

ICGH 2024

02

Smart Contracts for Efficiency

- ▷ Smart contracts automatically execute and enforce agreements (e.g., **energy use limits, emissions standards**) when predefined conditions are met. This reduces the **need for intermediaries, speeds up transactions**, and ensures compliance with green standards.

03

Supply Chain Optimization

- ▷ Blockchain integrates data from various stakeholders (producers, transporters, distributors) in a **single, accessible platform**. It provides insights into **supply chain inefficiencies, optimizes logistics, and reduces delays and costs** through real-time data sharing.

04

Sustainability Certification

- ▷ Blockchain records the **specific details of energy inputs**, allowing for **precise tracking of emissions and energy consumption**. This helps verify that the hydrogen is truly green and meets the required sustainability criteria. **Certification bodies** can audit these records on the blockchain, reducing fraud and ensuring compliance with green hydrogen standards.

05

Data-Driven Decision Making

- ▷ Blockchain platforms can **integrate data analytics tools** to provide insights into supply chain performance, including identifying **carbon hotspots & areas for improvement**. This data can support **informed decision-making** for optimizing operations and **reducing**

06

Reliability & Trust

- ▷ Blockchain's transparent nature builds consumer trust by providing **verifiable information on the green credentials of hydrogen**. This can enhance market access for green hydrogen producers by **meeting regulatory and consumer demands** for proof of sustainability.

GREEN H2 SUPPLY CHAIN: BLOCKCHAIN PROTOYPE

R T O O L
M O D E L I N G

SAMPLE R MODELING: BLOCKCHAIN CREATION

To develop a prototype of blockchain-enabled Green Hydrogen supply chain management platform, a sample data that simulates real-world conditions is given below:

1. Production Data

Renewable Energy Source: Type (solar, wind, hydro), location, capacity (MW)

Example: Solar, Rajasthan, 50 MW

Electrolysis Efficiency: Efficiency percentage, water consumption (liters/kg H₂)

Example: 70%, 10 liters/kg H₂

Production Rate: Amount of H₂ produced (kg/day)

Example: 10,000 kg/day

Carbon Emissions: CO₂ emissions avoided (kg CO₂ /kg H₂)

Example: 10 kg CO₂ avoided/kg H₂

2. Storage and Transportation Data

Storage Conditions: Temperature (°C), pressure (bar), storage type (compressed, liquid)

Example: -40°C, 350 bar, Compressed

Transport Mode: Type (truck, pipeline, ship), distance (km), transport emissions (g CO₂ /km)

Example: Truck, 500 km, 200 g CO₂ /km

Energy Losses: Loss during storage/transport (%)

Example: 5% during transport

3. Smart Contracts Data

Sustainability Criteria: Minimum efficiency (%), max allowable emissions (g CO₂ /kg H₂)

Example: 65%, 50 g CO₂ /kg H₂

Delivery Conditions: Delivery time, temperature, emissions threshold

Example: Within 48 hours, -20°C, < 100 g CO₂ /kg

4. Supply Chain Optimization Data

Real-Time Demand: Location, demand rate (kg/day)

Example: Delhi, 8,000 kg/day

Routing Suggestions: Current route, alternative route, time saved (hours)

Example: Current: Route A (8 hours), Suggested: Route B (6 hours)

Energy Loss Alerts: Points of high energy loss in the supply chain

Example: Storage Facility 2, 8% loss

5. Sustainability Certification Data

Certification Status: Certified/Not Certified, criteria met

Example: Certified, criteria: > 65% efficiency, < 50 g CO₂ /kg

Audit Trail: Timestamped record of certification checks

Example: 2024-09-08 10:00:00 - Efficiency Check Passed

6. Market Data for Decision Making

Production Cost: Cost per kg H₂ (\$)

Example: \$4.50/kg

Market Price: Current price per kg H₂ (\$)

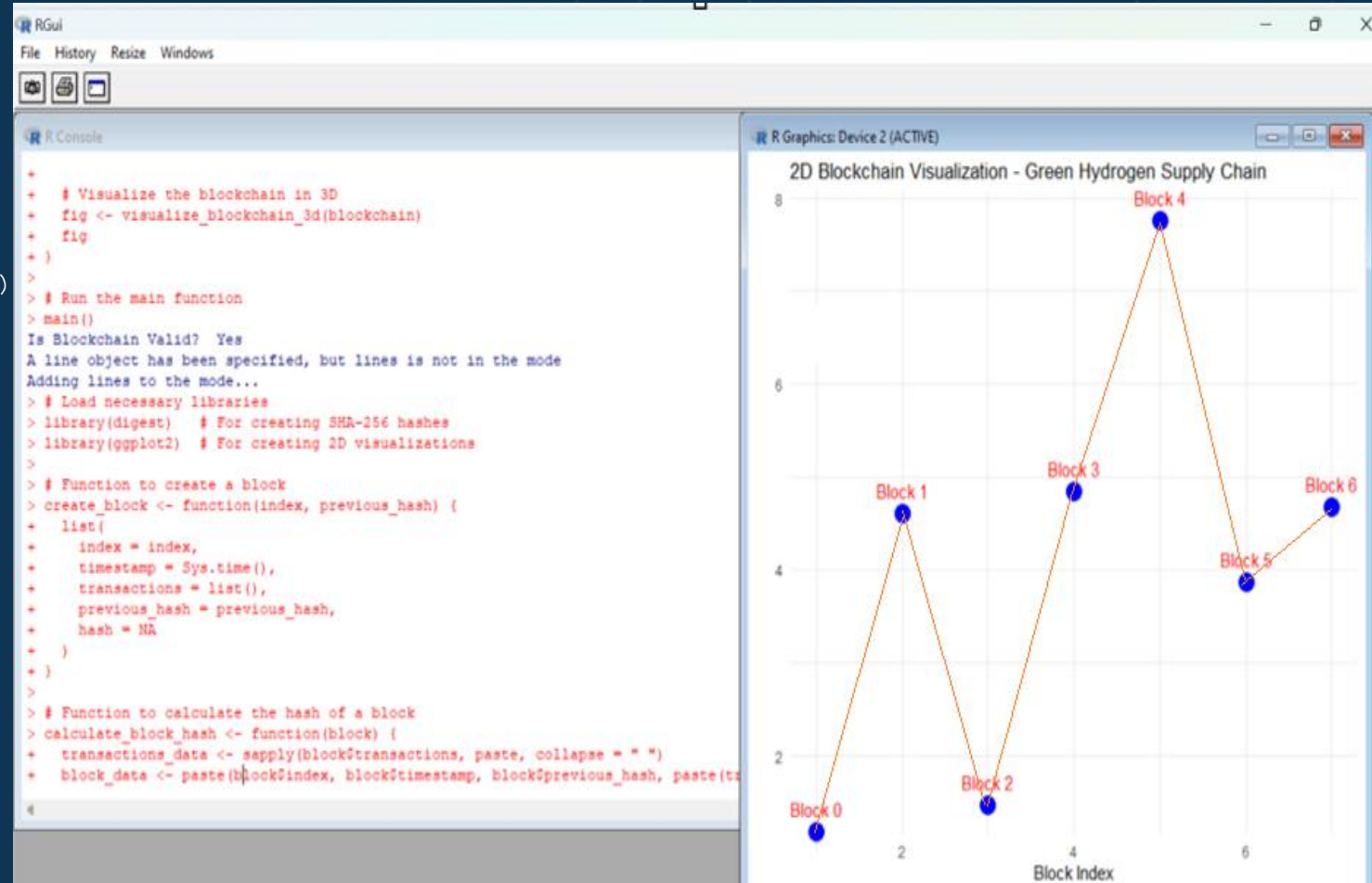
Example: \$5.20/kg

Demand Forecasts: Projected demand (kg/month)

Example: 300,000 kg/month

Supply Contracts: Contracted volumes, delivery terms

Example: Contract with XYZ Corp, 100,000 kg, monthly delivery

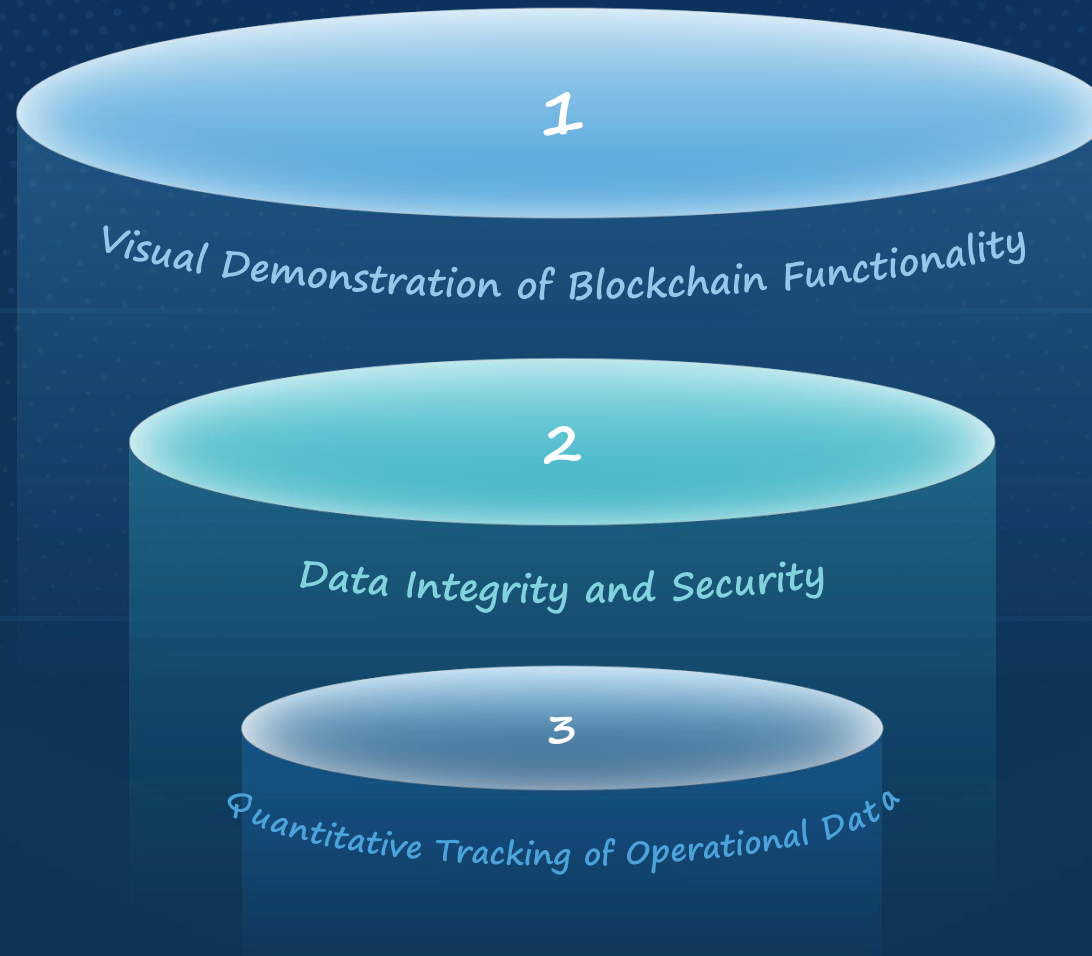


Purpose of Prototype

The prototype visually represents how blocks of data (related to production, transportation, and sustainability certification) are linked, demonstrating blockchain's core principles: immutability, traceability, and transparency.

Each block in the prototype is secured with a hash, showcasing blockchain's ability to maintain data integrity and prevent tampering.

The prototype captures detailed data on hydrogen production (e.g., emissions avoided, energy efficiency), storage conditions, and transport modes.



The 2D visualization helps illustrate how each block contributes to the chain's overall integrity.

This feature highlights the platform's capability to ensure that information related to Green Hydrogen production, storage, transportation remains secure and unaltered, which is critical for compliance and certification.

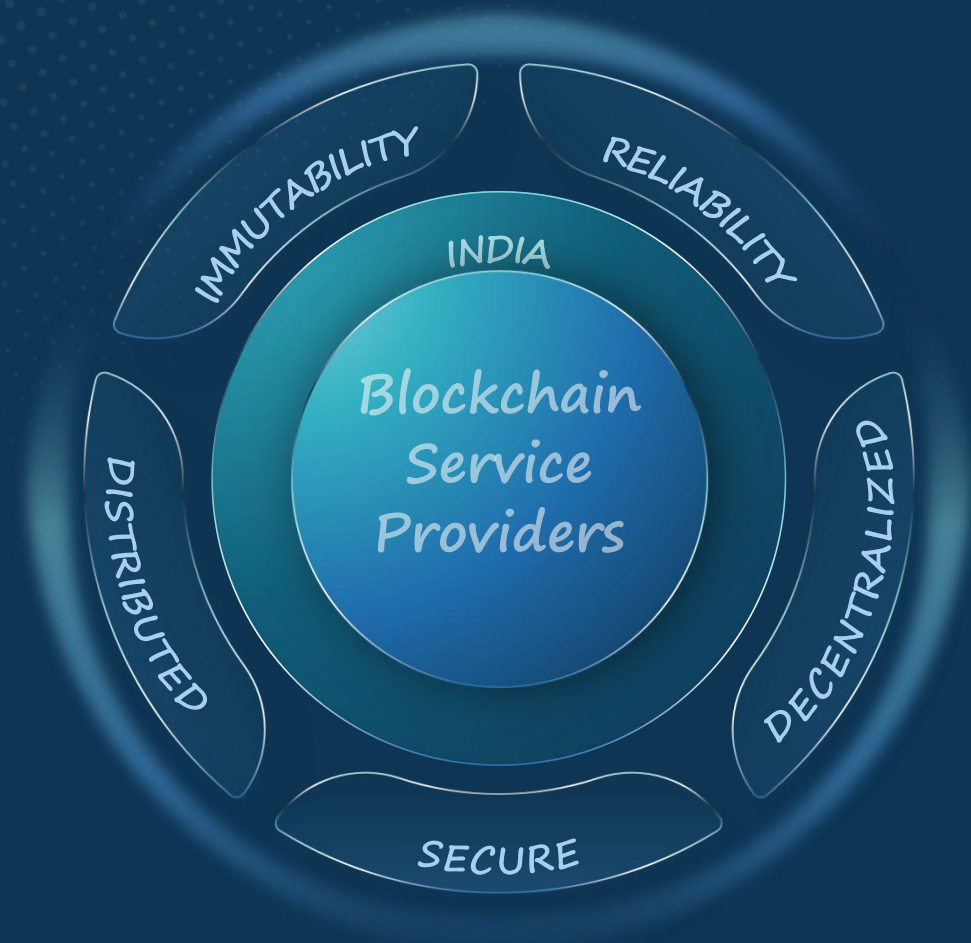
This direct tracking capability allows stakeholders to monitor and optimize performance metrics, demonstrating the financial and environmental benefits of the blockchain system.

IMPACT OF BLOCKCHAIN INTERVENTION

FEATURE	TRADITIONAL SUPPLY CHAIN	BLOCKCHAIN-ENABLED SUPPLY CHAIN	QUANTITATIVE BENEFIT	FINANCIAL BENEFIT
<i>Traceability</i>	Manual data tracking, prone to errors, mutable	Automated, real-time tracking, immutable	100% traceability of data	Reduces compliance fines by up to 25%
<i>Transaction Speed</i>	Slow, manual processes	Relatively fast	50-60% reduction in transaction time	Saves up to 30% in administrative costs
<i>Efficiency</i>	Inefficient logistics and data silos	Integrated Systems	10-12% reduction in system costs	Improves cash flow, saving 10-15% in costs
<i>Sustainability Verification</i>	Lengthy audits, high risk of fraud	Real-time, certified sustainability tracking	20% reduction in audit time	Enhances brand value, increases sales by 5-8%
<i>Decision-Making</i>	Reactive, based on historical data	Proactive, data-driven insights	15-20% reduction in excess production	Better contract terms, reducing costs by 15%
<i>Supply Chain Optimization</i>	Poor optimization	Intelligent routing and energy-efficient choices	8-10% reduction in cost	Lowers costs by 10-12%
<i>Cost of Compliance</i>	High due to manual verification	Reduced due to blockchain's audit trail	20% reduction in compliance-related costs	Reduces regulatory and legal costs
<i>Market Access</i>	Restricted due to lack of verifiable data	Enhanced due to transparent supply chain	Access to premium markets, increased demand	Potential 5-8% increase in revenue

Major Vendors (India)

1. Hyperlink InfoSystem
2. L&T Information Technology
3. Hashcash Consultants
4. Tata Consultancy Services Limited
5. Zensar Technologies Inc.
6. Infosys
7. Capgemini India Pvt Ltd
8. Fueled
9. Indra Capital
10. Lapits



*Future is
GreenH2 & Blockchain !*

