A Holistic approach for smoothing Electricity in Jharkhand State by using the Blockchain Technique

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Abstract: Jharkhand one of the richest state of natural resources comes into existence in 2000.The state faces a major difficulty in the power sector that is especially in the electricity concern. The major challenges include losses of power in transmission ,inefficient distribution of current , phase unbalancing, load shading and apart from transmission and distribution(T&D) of power one of the major cause is due to inaccurate or improper billing. The concept of introducing technology based on blockchain is to overcome this burning scenario with its transparent, effective, accurate, secure nature of billing by decentralizing method.The blockchain offers a cutting edge and prompting solution to address the ongoing issues. It is a revolutionary step towards the electricity consumption of this state.

This research proposes a blockchain-based framework that will encompass the integration of equipment's like smart meter, encourage stand-alone power supply (SAPS) especially the renewable energy system, green energy generation by reducing carbon footprint and real time data generation based on consumption and distribution system. It will help to detect the faults and alert the providers and consumers. Its will ensure tamper proof bill generating system. It will boost up the monitoring and surveillance of the installed instruments. It will allow automatic optimization grid operations and enable peer-to-peer energy trading in the entire state.

Keywords: Phase unbalancing, Inaccurate, Smart meter, Green energy generation, Carbon footprint, Tamper proof, Surveillance.

Introduction: The Jharkhand state known as the land of innovative ideas, transforming technologies and adopting new concepts that is helpful for its growth. From more than two decades, it is facing a major problem in the field of power sector. The root cause in electricity is unfair distribution, unfair billing of electricity consumption and questions on its credibility or accountability. This state is moving towards the urbanization and rapid industrialization growth with rural electrification it becoming major challenges to maintain faith and harmony between the service provider and the consumers with full transparency.

The introduction of blockchain technology in this power sector offers a hassle free and promising solution to minimize this major ongoing burning problem. The blockchain technology is known for regulating or managing the electricity consumption across the state with high transparency. It provide solution that is based on real time tracking, decentralized based system, free from any circumstances of tampering devices, high speed transparent data management capabilities, fair billing system, secure energy consumption.

Here the blockchain enable a holistic consumption model which is based the framework which integrates production, T&D, electricity consumption and tamper free feedback system in a one unified framework. This system not only ensures fair and equitable usage but also reduces energy theft apart from this it also indicate the high demand electric area on real time basis.

Thus, the system is capable for providing sustainable support for overcome energy crisis with goal orientation of proper demand and supply of electricity. Jharkhand state has diverse demographic and due to which several challenges occurs in developing intrastructure. It is the most difficult task to adopt blockchain with integrating power system while maintaining ecosystem and citizen-centric model.

- Generation (2025)

Sr.No.	Power Generating Station	Capacity existing
1	Thermal (coal)	2440 MW
2	Hydropower	190MW
3	Solar + Biomass	150MW

Table1: Power Generating Capacity

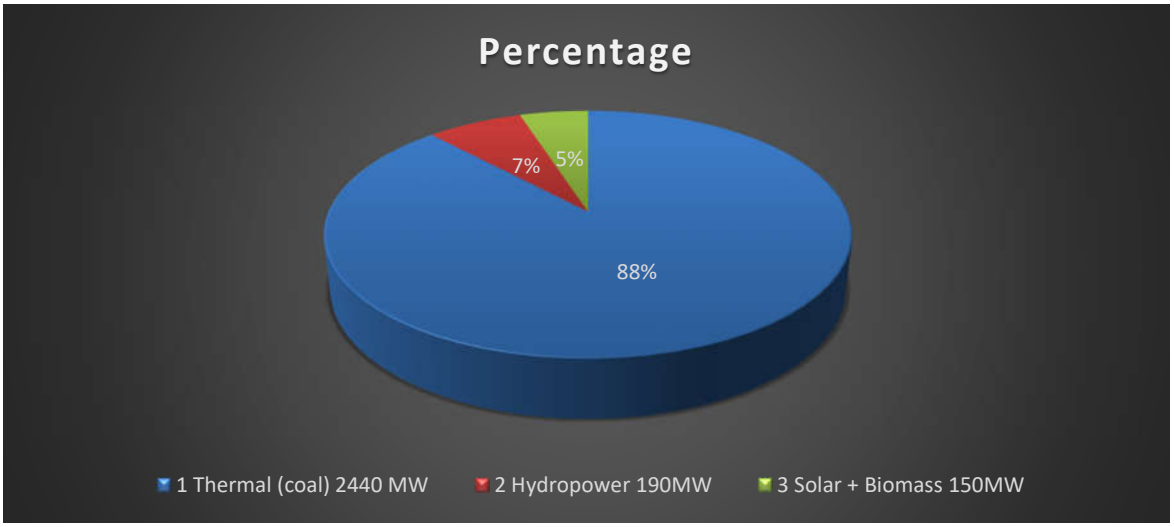

Fig1: Percentage wise Power Generating Capacity

- Transmission and Distribution

Sr.No.	Type of Area	Voltage Level	Hours of Supply	Average Supply Hours	Percentage of supply per day
1	Urban	11kV, 33KV	20-24 hrs	22	90
2	Semi Urban	11kV, 33KV	16- 20 hrs	18	75
3	Rural	11 kV, LT(220V)	8-14 hrs	11	45

Table2: Area wise T&D

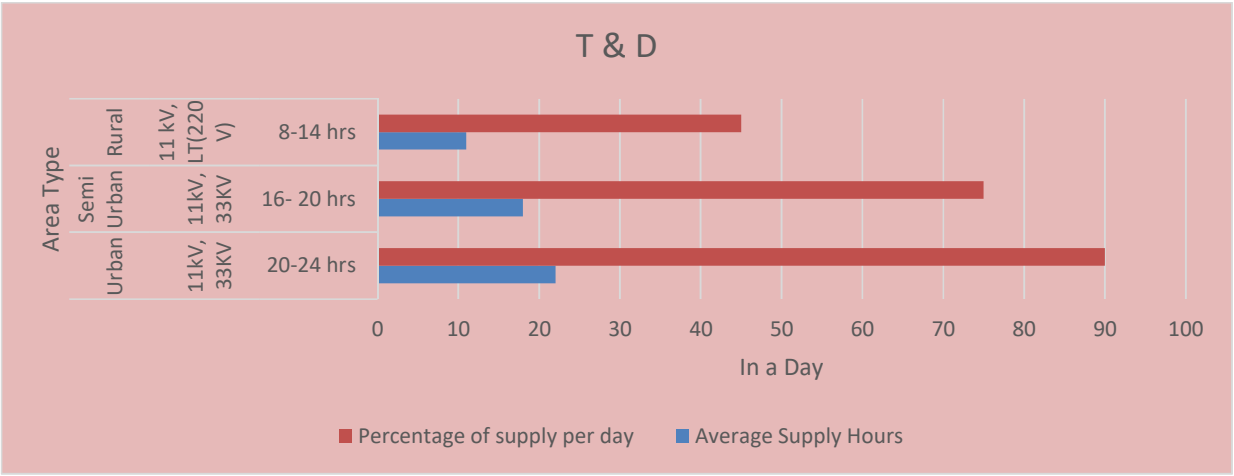

Fig2: Percentage wise Power Supply in a day

- Consumption of Power

1. Domestic (2000 to 2025) Estimated

Sr. No	Year	Per capita consumption (Kwh/Person/Year)	Households Electrified (%)	Total Consumption in GWh
1	2000 - 2002	20	Low = 20	6780
2	2009 - 2010	750	Sub Medium =30	10250
3	2016 - 2017	915	Semi Medium = 40	15060
4	2018 - 2019	938	Medium = 50	21500
5	2022 - 2023	975	Semi High =70	25320
6	2024 - 2025	1020	High = 90	27000

Table3: Domestic Power Consumption

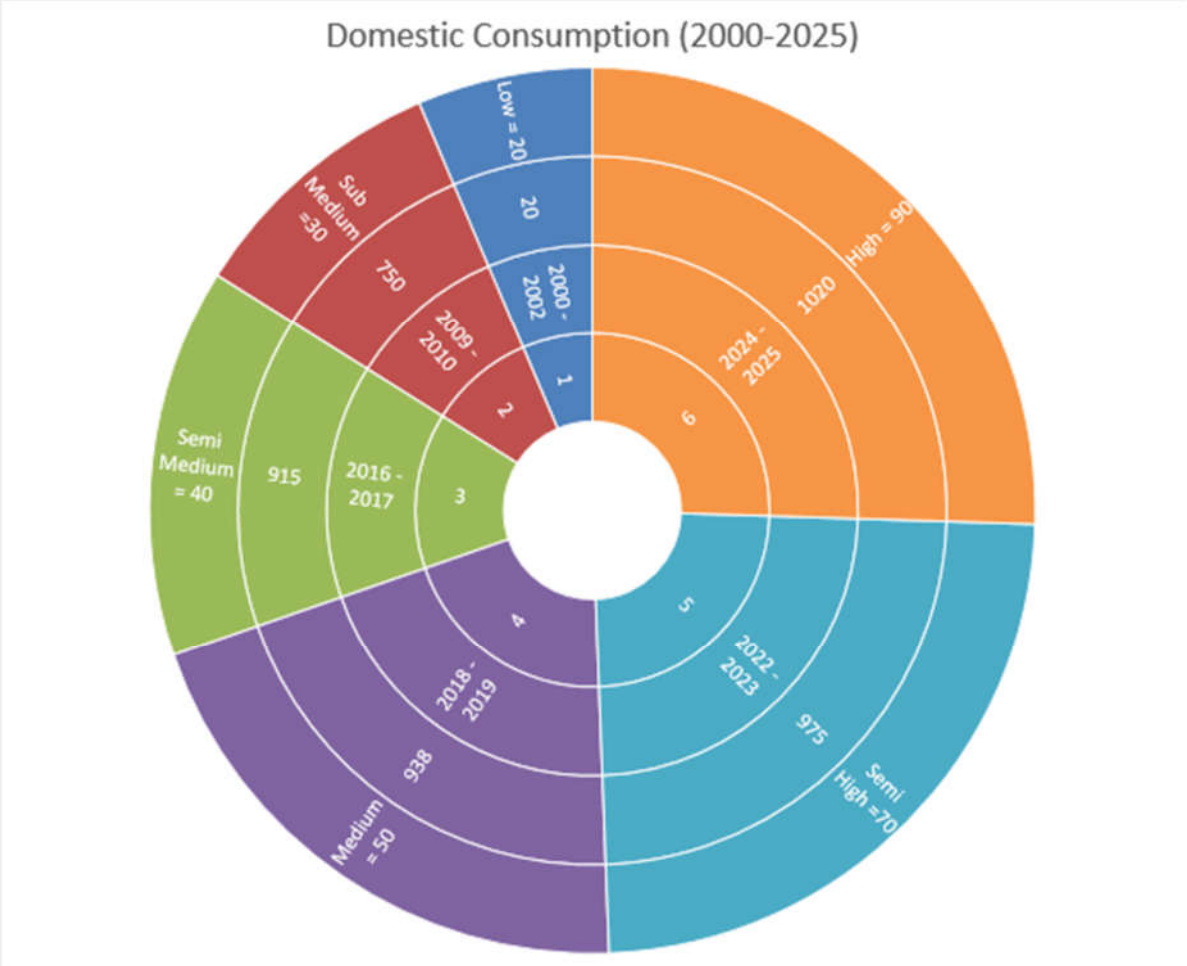

Fig3: Domestic Power Consumption

2. Industrial (2000 to 2025) Estimated

Sr.No.	Year	Estimated Industrial Consumption (Billion (KWh)
1	2000	125
2	2005	175
3	2010	245
4	2015	295
5	2020	330
6	2023	360
7	2025	390

Table4: Industrial Power Consumption

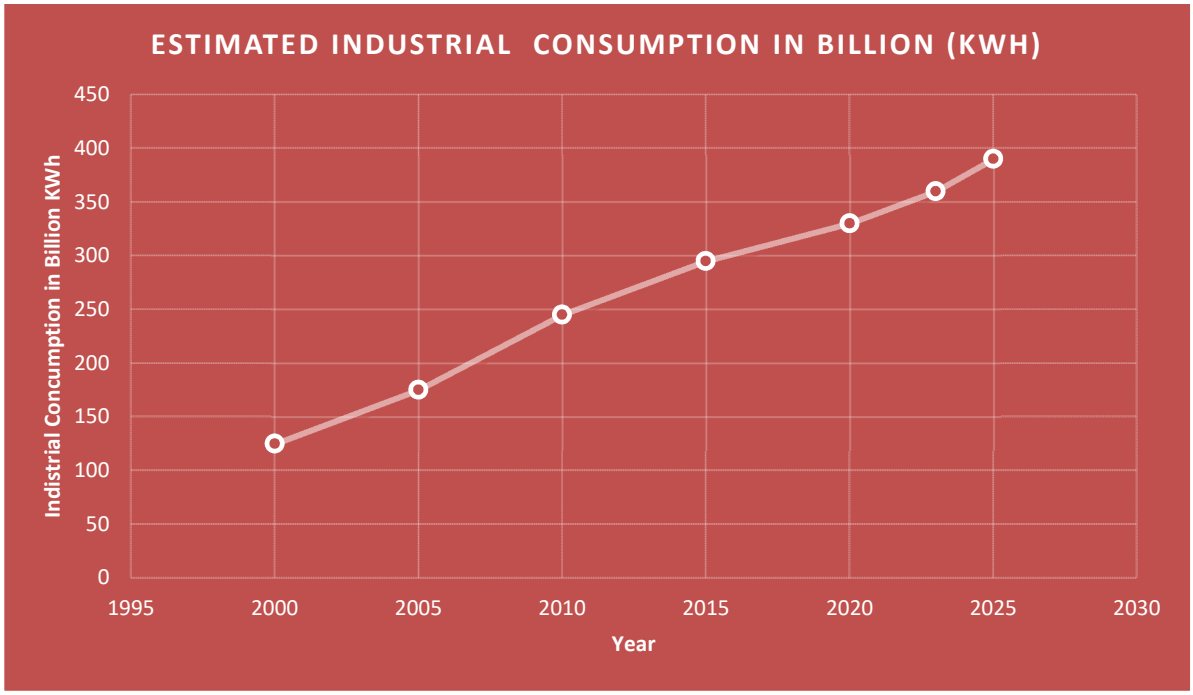

Fig4: Industrial Power Consumption

- Complain Registered regarding Billing (2000 -2025) Approximately

Sr.No.	Years	No. of Complaints (approx)
1	2000	5500
2	2005	8100
3.	2010	11400
4.	2015	18600
5.	2020	25700
6	2025	21500

Table5: No. of Complaints

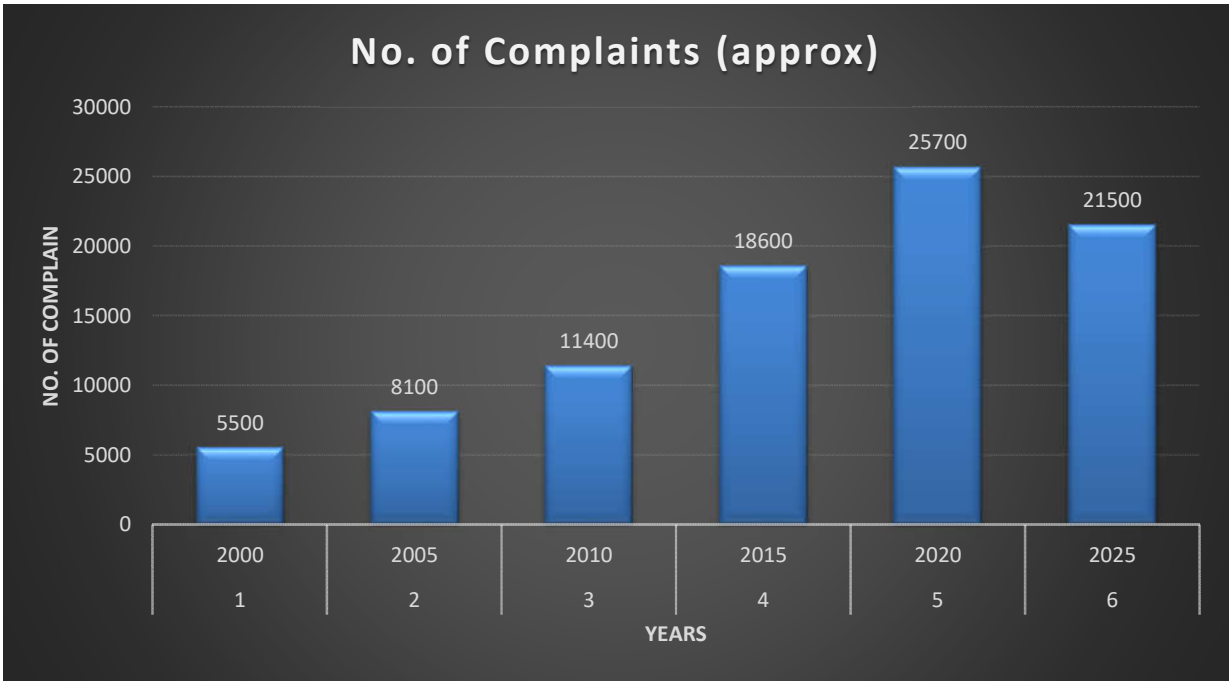

Fig5: No. of Complaints

Implementing Blockchain Technique: The introduction of integrating blockchain technique in electric generation, transmission, distribution and consumption provides an innovative solution in the entire state. It open the ample of scope to solve all types of ongoing problem that the service provider and consumer are facing. The Blockchain operates on distributed, decentralized ledger technology, which encompasses a strong secure system, maintain high transparency without tampering and processed real time base record keeping transaction. Key components:

Distributed Ledger: The data or ledger is shared to every corner through computers with high transparency as every partaker can be able to monitor or access the same data on real time base system. It is based on automation.

Decentralization: It allows the partakers to control their own system due to this technique no central authority is required. By this, every participants are able to validate, update and monitor transactions record which improve system resilience.

Immutability: In blockchain once the data is written it can't be removed, deleted, modified or altered without the unison which provide the upper-hand in a permanent audit trail

Consensus Mechanism: All computers must agree to interconnect with validity of transactions before indulging blockchain technique. It will boost up Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT)

Cryptographic Security: Transactions are encrypted using hash functions and digital signatures. As each block have their own hash of the previous block, forming a secure chain.

Fig6: Implementing Blockchain Technique

Methodology: The Taxonomy model of blockchain is best suited for this system where it provide a structural platform which have components that helps in understanding the individual blocks that have a wide variety. All the nodes of each blocks are connected with each other and forms a chain shape structure that is called blockchain.

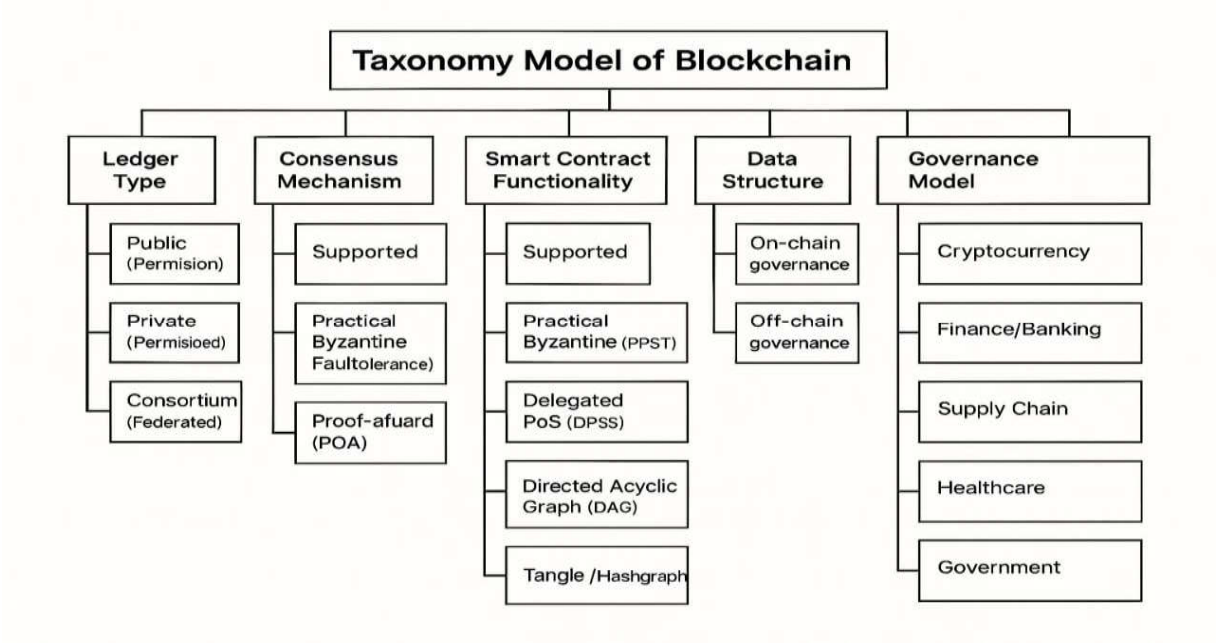

Fig7: Taxonomy Model of Blockchain

They integration of Electronics devices (IEDs) with electrical devices in power system enhance the seamless operation and help to transmit the data to the center control unit. In this SCADA plays the leading role to process the operation which connect the Remote Terminal Units (RTUs), Communication nodes network (nodes= computers), Main Station (MS) with each other for hassle free operation. By introducing blockchain in this system will boostup one-step ahead in securing the whole system with high data privacy in modern context. The sensor network structure includes sensor nodes (SNs), cluster heads (CHs), base stations (BSs) and end-users. As due to its decentralized process each participant can successfully able to open their block only by authentication passkey.

Working: The concept of blockchain is to from every unique block i.e in the form of ledger. Basically, it used to record the transactional data similar to that of notebook. Combining each block with one another form a chain. In blockchain when new data is added a new block is formed and they have a unique passkey so it can’t be tamper so it provide safe, secure and irremovable record. Any tampering of a single block will cause disturbance to the right next block, which breaks the chain. It works on algorithms.

Making node: For creating nodes we have to do the following

1. Type of node to be selected and then it should be connected with other nodes.
2. Node should be configure so that they may be able to maintain the ledger
3. Necessary software must be install and validated before adding a new block
4. Optionally , participate in consensus with communication capabilities.

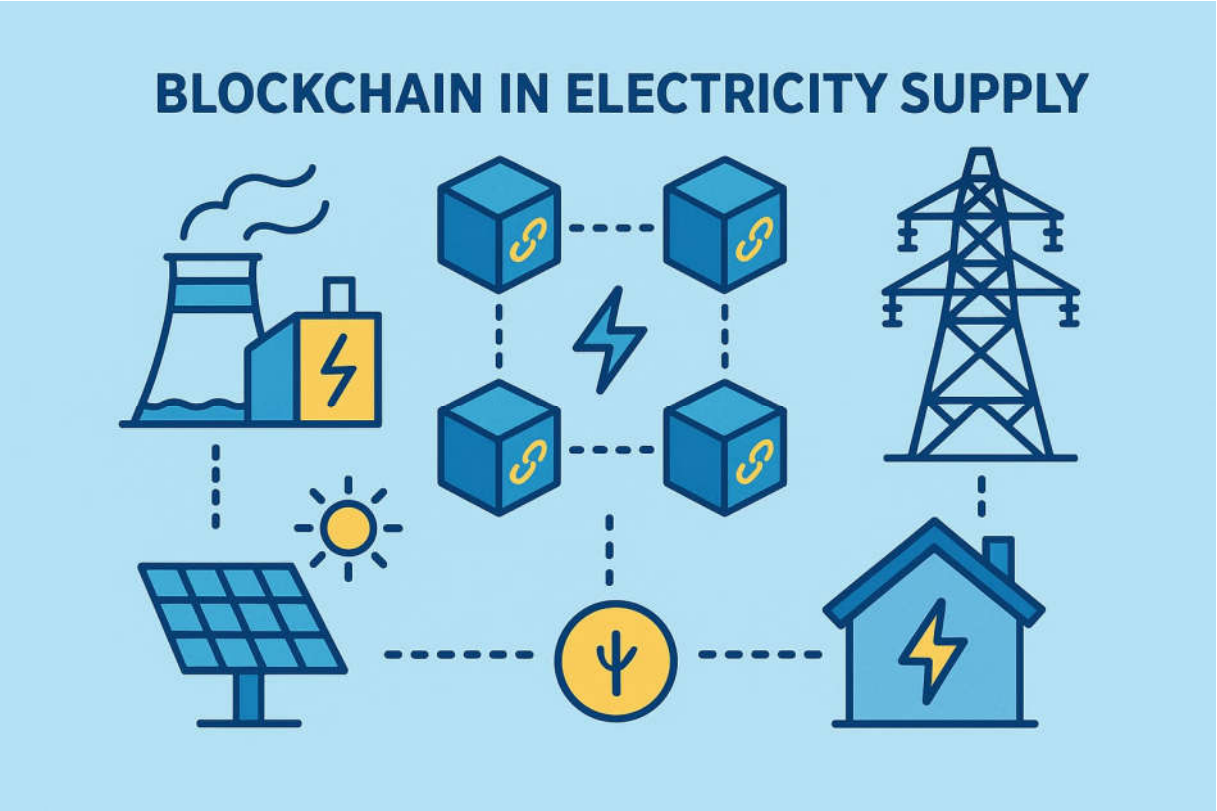

Fig8: Blockchain in Electricity Supply

Scope: The scope in context to Jharkhand state is wide and fruitful. The power infrastructure is handled by Jharkhand Bijli Vitran Nigam Limited (JBVNL)which takes care of generation and distribution of power. The JBVNL annually suffers losses of over ₹1,000 crore from billing, tampering and theft. The rest losses is due to distortion in transmission. The blockchain empowered the entire system to overcome tamper proof and minimization of unwanted issues. It also helps to maintain the proper billing cycle with high accuracy and proper transparency between the service provider and the consumer. It also encourage green and clean energy generation. It reduces the settlement time of dispute if any.

Conclusion: It works as a toolkit that is capable to deal with the structural and massive challenges that electric sector of Jharkhand is facing. It shows a promising approach to improve the systematic changes that electricity department are facing from longs. Its helps to balance the demand and supply all over the state of Jharkhand. It integrate renewable energy sources in better way. There is a phaseshift or transformation of the electric department in the state as blockchain will enhance the transparency among the trio i.e. producers, distributors and consumers on real time basis. Minimizes the revenue losses with regulatory readiness and withstand for the long-term benefits in terms of cost reduction and reliability.With state-level policy support and stakeholder collaboration, Jharkhand could become a leading case for blockchain-enabled rural electrification in India.

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