Microgrid Energy Trading on Blockchain

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Outline

Introduction

- **Goal:** To implement a decentralized, peer-to-peer (P2P) energy trading system for microgrids.
- **Concept:** Leverages **Ethereum-based smart contracts** to enable energy exchanges.
- **Why Blockchain?**
  - Transparency
  - Security
  - Efficiency (Automated Transactions)

Project Objectives

Decentralized Energy Trading

Facilitate direct energy exchanges without centralized intermediaries.

Transparency and Security

Securely record all transactions on the blockchain.

Automated Transactions

Use **smart contracts** to automate energy listings and trades.

Empower Microgrids

Enable microgrids to sell surplus energy directly to others.

CHALLENGES OF ENERGY MANAGEMENT

1. **Subcontracting and Affiliation Risks:**
   - Contractors without sufficient qualifications rely on affiliated enterprises to win bids, leading to variability in project quality and safety standards.
   - Excessive layers of subcontracting disrupt market order.
2. **Funds AND ENERGY Mismanagement:**
   - Delays in payment to workers and misappropriation of funds.
   - Difficulty in ensuring fair wage distribution and accountability.
3. **Lack of Transparency and Control:**
   - No effective supervision over project progress.
   - Inadequate records of worker attendance and wage payments.

Proposed Blockchain-Based Solutions

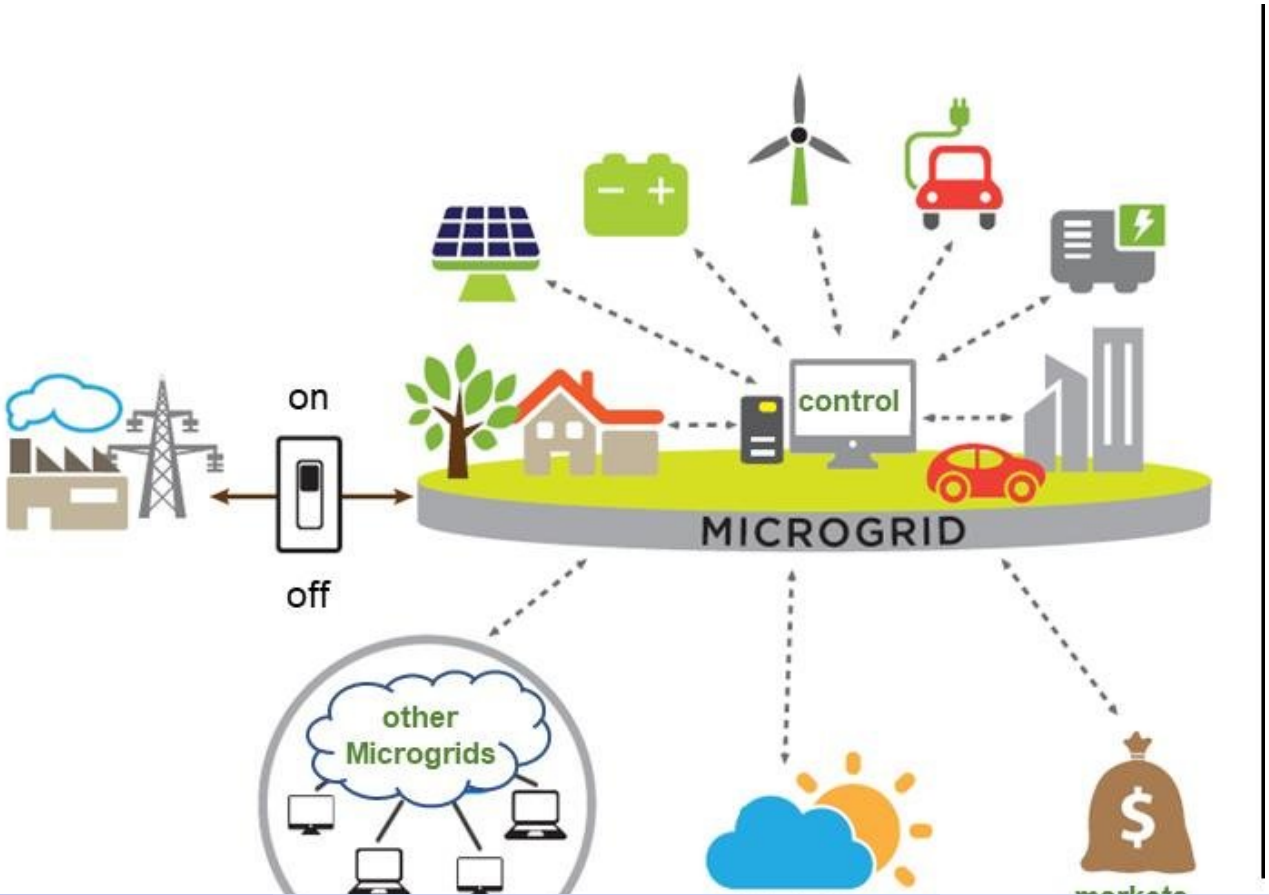
- **Data Deposit**
  - Records critical project data (e.g., contracts, payments, worker information) on a blockchain to ensure tamper-proof documentation.
  - Links project data with external administrative bodies like judicial departments and talent markets.
- **Enterprise Credit Management**
  - Uses AI to evaluate and store credit ratings of enterprises and individuals on the blockchain.
  - Facilitates informed decision-making for future bidding and enforces penalties for violations (e.g., delayed wages, poor project quality).
- **Contract Management**
  - Automates contract signing and verification via blockchain with digital signatures.
  - Tracks contract execution and ensures reliable evidence for dispute resolution.
  - Example: If a subcontractor fails to meet contractual obligations, the system records the breach in real-time.

Proposed BLockchain solutions

1. **Funds Management**
   - Establishes escrow accounts for worker wages.
   - Uses smart contracts to automate payments when conditions are met, ensuring timely and accurate fund distribution.
   - Example: A smart contract triggers wage payment upon confirmation of project milestones, reducing reliance on manual processing.
2. **Project Process Control**
   - Monitors project progress using blockchain for real-time updates on safety, quality, and adherence to schedules.
   - Example: Blockchain records on-site safety training attendance, preventing compliance violations.

System Architecture

- **Microgrids:** Energy producers or consumers.
- **Smart Contracts:** Handle registration, listings, transactions.
- **Ethereum Blockchain:** Immutable and transparent transaction records.
- **Users:** Buyers and sellers interact with the system.



EXAMPLE ARCHITECTURE

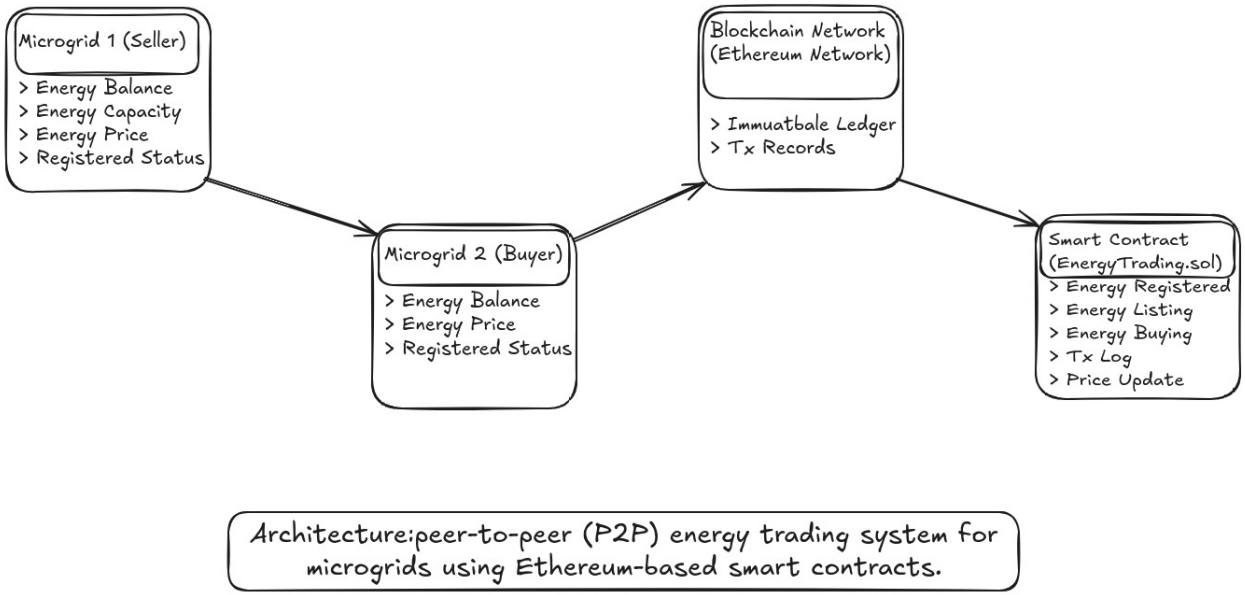


Figure: ENERGY TRADE

Microgrid Registration

- **Purpose:** To allow microgrids to participate in energy trading.
- **Details:**
  - Register energy capacity and energy price.
  - Initial energy balance matches the registered capacity.

Energy Listing and Buying

Energy Listing

- Sellers specify the amount of energy for sale.
- Smart contracts ensure valid energy balance.

Energy Buying

- Buyers purchase energy by sending equivalent Ether.
- Energy balances are updated post-transaction.

Price Updates and Withdrawals

- **Price Updates:** Microgrids adjust prices dynamically.
- **Withdrawals:** Contract owners can withdraw accumulated Ether.

Practical implementation

Figure: ENERGY TRADE using aurdinos - UNO R3

Contract Code: Key Components

- **Microgrid Structure:**
  - The Microgrid structure stores critical data for each microgrid:
  - - energyCapacity: The maximum amount of energy that can be supplied by the microgrid.
  - - energyBalance: The amount of energy currently available for sale.
  - - energyPrice: The price per kWh of energy.
  - - registered: A boolean value that ensures a microgrid is registered before performing transactions.
- **Key Functions:**
  - `registerMicrogrid()`
  - `listEnergyForSale()`
  - `buyEnergy()`
  - `updateEnergyPrice()`
  - `withdraw()`
- **Events:**
  - `EnergyRegistered, EnergyListed, EnergyBought`

Security Considerations

- **Access Control:** Only registered microgrids interact with contracts.
- **Funds Handling:** Sufficient checks for Ether transfers.
- **Immutability:** Transactions are recorded on the Ethereum blockchain.

Conclusion

- Decentralized energy trading using blockchain enhances **transparency, security, and efficiency**.
- Smart contracts ensure automated and secure operations.
- Future scalability for advanced energy management systems.

Presented By-

THANK YOU

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