Saki Market Game

Behnam Saki, TART Innovation Lab

The First DDFM (Democratic Decentralized Fair Market)

A Decentralized AI-Powered Energy Marketplace on the First Blockchain with Proof of Competitive Contribution (POCC)

Revolutionizing Clean Energy, Market Fairness, and Consensus Through A.I [1]Battles on the novel POCC Blockchain

Behnam Saki, Version 1.0, May 2025

Executive Summary

The global shift toward renewable and decentralized energy systems has created an urgent demand for platforms that are transparent, efficient, and resilient. In response, we present **Saki Market Game**—the world's first blockchain platform built upon the groundbreaking consensus mechanism: **Proof of Competitive Contribution (POCC)** [1].

Saki Market Game revolutionizes decentralized energy trading by converting market interactions into an AI-powered, game-theoretic optimization process. Unlike traditional blockchains that rely on energy-intensive Proof of Work [2] [2]or capital-intensive Proof of Stake[3] [3], Saki introduces a paradigm in which **solving real-world optimization problems** [4] **becomes the core mechanism for achieving consensus and adding new blocks**.

In this system, sellers and buyers are represented by autonomous artificial intelligence agents [5]. Sellers submit initial price offers for their energy products, and buyer demand activates a competitive optimization battle among the agents. Over multiple game-theoretic rounds, prices evolve through gradient descent and adaptive learning powered by the Adam optimizer [6]. The process ensures convergence toward a fair and balanced market price.

Upon reaching equilibrium, the transaction is recorded on-chain and a new block is minted. A reward equal to **1% of the total transaction value** is issued and **equitably distributed among seller agents** based on their **quantifiable contribution to the optimization process**.

Saki Market Game delivers a secure, transparent, and equitable energy trading ecosystem, while also introducing a **new economic model** for decentralized digital infrastructure. It fosters widespread participation, removes entry barriers for small producers, and lays the foundation for scalable applications across AI, IoT, and clean energy domains.

This whitepaper provides an in-depth look at the system architecture, economic mechanisms, consensus logic, and roadmap of the Saki Market Game blockchain. Our mission is to present a bold, investment-ready vision that resonates with blockchain professionals and visionary investors seeking to back the next transformative shift in decentralized technology.

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[1] Artificial Intelligence
[2] PoW
[3] PoS

Keywords:

Saki Market Game, Blockchain, Decentralized Energy Market, Proof of Competitive Contribution, POCC, AI Agents, Game Theory,

Project Introduction

The 21st century is defined by an accelerated shift toward decentralization across economic, digital, and environmental spheres [7]. Nowhere is this more evident than in the global energy sector. As the world confronts climate change, energy insecurity, and the limitations of centralized power systems, a new paradigm is required—one that demands innovation in how energy is produced, traded, and valued.

Saki Market Game is a pioneering response to these challenges. It introduces a decentralized, AI-driven, blockchain-based energy marketplace engineered to optimize both fairness and efficiency. What sets this platform apart is its **novel consensus mechanism—Proof of Competitive Contribution (POCC)**—which links blockchain validation to the real-world outcome of a market-based optimization challenge.

At its core, Saki Market Game simulates a highly competitive environment in which AI agents representing buyers and sellers engage in price negotiations. Unlike static auction-based systems or rigid pricing models, prices in Saki evolve dynamically through interactions based on reinforcement learning, game theory [8], and real-time supply-demand signals.

The project is driven by the vision that blockchain can do more than just record transactions—it can serve as the **engine of economic intelligence**. By embedding artificial intelligence and market logic directly into the protocol layer, Saki Market Game transcends traditional DeFi[4] models, setting a new standard for intelligent, sustainable, and purpose-driven blockchain infrastructure.

This introduction lays the groundwork for understanding the vision, innovation, and global impact of the Saki Market Game. It illustrates how blockchain, AI, and game theory converge to form a transformative solution to one of the world's most urgent challenges: equitable and efficient energy distribution.

Problem Statement

Centralized Energy Markets: A System Ripe for Disruption

The current global energy infrastructure is dominated by centralized entities—government-regulated utilities, national grids, and large-scale power providers. While these systems have supported industrial growth for over a century, they now face insurmountable challenges in an era defined by decentralization, electrification, and climate urgency.

Key issues in traditional energy markets include:

- **Lack of Transparency**: Pricing mechanisms are opaque, often influenced by monopolistic behavior or rigid tariffs that ignore dynamic real-time supply and demand.
- **Limited Access for Small Producers**: Distributed energy resources (DERs)—such as solar panel owners, community wind farms, and microgrids—face high entry barriers and lack equitable access to sell their surplus energy.
- **Inefficient Pricing Models**: Traditional pricing lacks adaptability and responsiveness, resulting in poor price discovery and suboptimal allocation of energy resources.
- **Centralized Vulnerabilities**: The reliance on a few centralized entities introduces points of failure that are susceptible to cyberattacks, system overload, or political influence.

[4] Decentralized Finance

- **Environmental Constraints**: Energy-intensive consensus mechanisms like Proof of Work (PoW) exacerbate the carbon footprint, contradicting the very goal of transitioning to clean energy.

Limitations of Existing Blockchain Solutions

While blockchain technology offers decentralization, most blockchain applications in the energy sector have been limited to simplistic peer-to-peer marketplaces or renewable energy certificates. These implementations fall short in terms of economic intelligence, scalability, and sustainability.

Moreover, traditional consensus algorithms—PoW, PoS, and even Delegated Proof of Stake (DPoS)—contribute nothing to solving real-world problems. They waste computational resources either through meaningless hashing or through mechanisms that disproportionately reward capital holders rather than contributors.

The Need for Intelligent, Purpose-Driven Consensus

There is a pressing need for a decentralized energy marketplace [5] that not only enables fair trade but also **rewards intelligence and contribution**. A system where economic value is created not through arbitrary stake or brute-force computation, but through **competitive optimization**, **price discovery**, and **real-time market dynamics** [9].

This is the gap that **Saki Market Game** fills.

Through its innovative POCC consensus and AI-driven mechanism design, Saki Market Game proposes a **revolutionary alternative**—one that empowers individual producers, enhances transparency, promotes energy equity, and aligns blockchain validation with solving economically meaningful problems.

System Architecture

The architecture of the **Saki Market Game** is a fusion of game theory, artificial intelligence, and blockchain engineering. At the heart of the system lies the **Proof of Competitive Contribution (POCC)** consensus mechanism, which redefines how blockchain blocks are created—not through brute computational effort or financial stake, but through the successful resolution of real-world optimization problems.

Core Components

1. AI Agents (Market Participants)

Each market participant—whether a seller or the buyer—is represented by a dedicated autonomous AI agent:

- **Seller AIs** submit initial price offers for their available energy based on cost, quality, and capacity constraints.
- **The Buyer AI** dynamically evaluates incoming offers and responds with demand-driven pressure, triggering a competitive pricing battle among sellers.

These agents utilize **gradient descent** and **reinforcement-based strategies**, including an **Adam optimizer** with adaptive learning rates, to iteratively improve pricing behavior over successive rounds [6].

2. Game-Theoretic Optimization Engine

The core mechanism simulates a multi-round market interaction where:

- Agents adjust prices in response to utility-weighted buyer shares.
- The system incorporates real-time feedback, constraints on profit margins, and anti-collusion checks.

[5] DEM

- Convergence is guaranteed via **monotonic best responses** and bounded updates, leading to a **market-clearing Nash Equilibrium** [10].
- We intelligently resolved the issue of multiple Nash equilibrium points in game dynamics using the **decay rate solution** within the **pseudo-gradient descent** technique, based on the dominant term theorem in the Hessian matrix of the profit function, which itself relies on the **Gershgorin circle theorem.**

This engine effectively transforms the process of block creation into a **computational market game**—one that has intrinsic economic value.

3. Blockchain Layer with POCC Consensus

Once the optimization converges:

- A **new block is minted**, recording final transaction data (prices, quantities, rewards).
- **Consensus is achieved** by verifying that a valid, fair market-clearing solution has been reached.
- A **reward pool (1% of transaction value)** is distributed among sellers, proportionate to their **competitive contribution**, calculated through normalized utility, supply share, profit efficiency, and energy quality.

Each block contains:

- Merkle root of the transactions
- Timestamp
- Hash of previous block
- Competitive outcome details
- Distribution metadata

4. Lightweight Node Infrastructure

To ensure scalability and inclusivity:

- Seller nodes are initialized upon entry.
- **Light synchronization** enables new nodes to onboard by downloading only the latest block, ensuring real-time participation without heavy historical data requirements [11].

5. Anti-Collusion Mechanism

The system proactively monitors:

- Sudden convergence in prices,
- Identical buyer shares across sellers,
- Low iteration counts (indicating pre-agreed outcomes).

Upon detection, a **moderator AI node** is injected implicitly into the game to destabilize potential collusion and reinitialize fair market dynamics.

Technical Summary

Component	Function
AI Agents	Price optimization via adaptive learning
Game Engine	Multi-agent iterative market negotiation
POCC Blockchain	Consensus based on contribution to equilibrium

Component	Function
Reward Algorithm	Utility-based distribution of incentives
Merkle Tree	Efficient, tamper-proof transaction validation
Light Sync	Real-time onboarding for new participants

This architecture transforms Saki Market Game into more than a blockchain—**it is a real-time economic simulation, a decentralized optimizer, and a transparent marketplace in one.**

Token and Economy

The **Saki Market Game** introduces a purpose-driven token economy engineered around real-world energy transactions and AI-optimized contribution. Instead of relying on arbitrary incentives, token issuance and distribution are directly tied to measurable performance within the system's core optimization engine—delivering both utility and intrinsic value.

Native Token: $POCC

The native token of the ecosystem is **$POCC**, named after the consensus algorithm it powers: Proof of Competitive Contribution. Unlike traditional cryptocurrencies that are mined or staked, $POCC is minted as a **byproduct of solving real energy pricing optimization problems** [12].

Utility of $POCC:

- **Reward Mechanism**: Sellers receive $POCC based on their competitive contribution to equilibrium discovery.
- **Transaction Medium**: Used for paying for energy, smart contract execution, and market participation.
- **Governance Rights**: Token holders can participate in protocol upgrades, governance votes, and strategic partnerships.
- **Reputation Weighting**: Higher $POCC holdings and past contribution scores improve seller AI reputation in the market.

Economic Model

1. Transaction-Based Minting

Each energy transaction generates a **reward pool equal to 1% of the total trade value**. This reward is issued in $POCC tokens and distributed as follows:

Category	Allocation
Competitive Contribution (Utility + Market Share)	85%
Profitability Efficiency	15%

This model ensures that rewards go to the most impactful contributors—not the wealthiest, fastest, or most connected participants.

Notice: An essential aspect of Utility factor lies in the inherent quality of the provider(seller). This quality encompasses both the technical standard of the generated electricity and the provider's effective presence in the energy supply market-each of which is verified and assured by the Energy Management System (EMS) unit.

2. No Pre-Mining, No Inflation

The supply of $POCC is entirely **demand-driven**. Tokens are created only when energy is traded through the Saki Market Game protocol. This creates:

- **Natural scarcity** aligned with market growth,
- **Zero speculative inflation** risk,
- **Built-in demand** tied to clean energy usage.

3. Sustainable Incentive Loop

The protocol creates a closed-loop ecosystem:

1. Sellers offer energy and optimize their pricing using AI.
2. Buyers purchase competitively priced energy.
3. Equilibrium pricing triggers block creation.
4. Reward is distributed in $POCC.
5. Sellers reinvest in infrastructure, buyers continue using the system, and developers build more tools atop the chain.

This loop fosters long-term engagement, rewards sustainable contribution, and continuously enhances market liquidity.

Comparative Advantage

Model	Proof of Work	Proof of Stake	Saki (POCC)
Energy Efficiency	❌ High	✅ Medium	✅ Optimized
Decentralization	✅ Partial	❌ Stake-based	✅ Fully Open
Barrier to Entry	❌ Hardware	❌ Capital	✅ Intelligent Effort
Real-World Utility	❌ None	❌ None	✅ Energy Optimization
Environmental Impact	❌ Harmful	✅ Mixed	✅ Clean Energy Aligned

With $POCC, we're not just building a cryptocurrency—we're establishing a **new unit of economic merit**, earned by contributing to global energy fairness, environmental stability, and algorithmic innovation.

Road Map

The Saki Market Game is not a theoretical concept—it is an operational prototype with a fully implemented blockchain, smart AI-agent simulations, and a functioning reward mechanism. Our roadmap outlines the phased expansion from this solid foundation to a globally adopted decentralized energy marketplace.

✅ **Phase 0: Research & Prototype (Completed)**

Defined system architecture and market logic

Designed Proof of Competitive Contribution (POCC) mechanism

Implemented the first simulation engine with AI seller and buyer agents

Developed gradient-based price optimizer using Adam with adaptive learning

Built a functioning blockchain with transaction recording, Merkle Tree, and block minting logic

🔁 Phase 1: Alpha Launch (Q2 2026)

Release private alpha version for controlled energy trading trials

Integrate real-world energy pricing datasets for training and benchmarking

Launch developer toolkit for building additional market plugins (e.g., solar, wind microgrids)

Begin security audit of core smart contracts and blockchain modules

Recruit early testers from clean energy startups and AI research communities

🚀 Phase 2: Token Launch & Beta Testnet (Q3 2026)

Launch public testnet with complete POCC functionality

Deploy the $POCC token on-chain with transparent minting policy

Begin reward distribution based on AI performance in public beta rounds

Open-source key modules and attract open developer participation

Introduce DAO[6]-lite governance for early-stage proposal voting

🌐 Phase 3: Mainnet Launch (Q1 2027)

Official launch of the Saki Market Game Mainnet

Enable live energy transactions in real microgrid environments (pilot cities selected)

Partner with IoT hardware providers for integrating metering and verification data

Launch cross-chain bridge to Ethereum and other green DeFi platforms

Begin onboarding private sellers and community cooperatives for real-world energy supply

📈 Phase 4: Expansion & Utility Ecosystem (2027–2028)

Launch Saki mobile dApp [7]and user interface for mass adoption

Expand use cases to include carbon credit exchanges, water markets, and emission tracking

Enable off-chain market arbitration and legal integration via oracles

Partner with governments and NGOs in underpowered regions to incentivize clean energy production

[6] Decentralized Autonomous Organization
[7] Decentralized Application

🌎 Phase 5: Global Decentralized Energy Mesh (2028+)

Saki becomes the foundational infrastructure for decentralized public energy systems

Launch open AI marketplaces for autonomous infrastructure planning

Establish Saki Energy Labs to fund next-gen research on AI x Energy x Blockchain

Fully autonomous DAO governance with community-led protocol upgrades

Each milestone brings us closer to a globally inclusive, clean-energy economy, where optimization, fairness, and environmental sustainability are baked into the very fabric of infrastructure.

Team and Partnerships

Behind **Saki Market Game** stands a multidisciplinary team of innovators, technologists, economists, and environmental visionaries dedicated to creating decentralized infrastructure for a sustainable future.

Core Team

Behnam Saki – ***Founder & Lead Architect***

Computer Scientist, Blockchain Developer, and AI Systems Designer
Behnam is the visionary behind Saki Market Game and the architect of the Proof of Competitive Contribution (POCC) protocol. With a background in AI-based optimization and decentralized systems, his mission is to democratize access to energy markets and pioneer blockchain systems with real-world intelligence at their core.

TART[8]

The official media and innovation partner of Saki Market Game. TART is responsible for storytelling, public education, and visualizing the invisible mechanics of blockchain through immersive content, documentaries, and interactive experiences.

YouTube channel: @Tart-Saki

University Collaborations

Saki is engaged in research partnerships with top-tier academic institutions in the fields of AI governance, decentralized markets, and environmental modeling. These partnerships ensure academic validation, peer review, and access to future talent.

[8] Technologic Art

Visionary Culture

Saki's team is not just building a product—they are championing a movement. A culture of ethical AI, open-source transparency, and mission-driven innovation powers every decision. We believe that **technology must serve both people and planet**, and with Saki Market Game, we are making that belief actionable.

Security Assurance

Security is a foundational pillar of the **Saki Market Game** ecosystem. As a blockchain platform that integrates financial transactions, autonomous AI behavior, and decentralized governance, Saki employs a **multi-layered security architecture** to ensure system integrity, data privacy, and trustless execution at all levels.

1. Consensus-Level Security

Saki introduces the **Proof of Competitive Contribution (POCC)** consensus, a mechanism that replaces traditional mining or staking with the real-time solution of an optimization problem. Each new block is validated only after successful convergence to a Nash equilibrium, verifiable through transparent, deterministic AI-agent interactions.

Key Security Benefits:

- **Bypass of Sybil resistance** via competitive AI contributions rather than pseudonymous stake or compute.
- **No hash-based mining**, eliminating vulnerabilities associated with 51% attacks and energy overuse.
- **Auditable game-theoretic outputs**—every contribution is measurable, reproducible, and recorded on-chain.

2. Smart Contract Security

All core contracts governing price dynamics, reward distribution, and market logic undergo rigorous **formal verification** and **static analysis**. Custom contracts are written with strict bounds checking and protective fallback logic, while modularization separates critical logic (such as reward distribution) from peripheral UI components.

Audit Strategy:

- Continuous internal audits by protocol developers.
- Scheduled third-party audits by vetted blockchain security firms.
- Use of battle-tested libraries and open-source cryptographic primitives.

3. AI Agent Behavior Control

Since agents autonomously compete, there's a risk of **adversarial manipulation** or collusion. To counteract this:

- **Collusion Detection Mechanism**: A built-in module flags suspicious pricing patterns, price-fixing behavior, or rapid convergence anomalies. If confirmed, the protocol can trigger a market reset with an external moderator AI [13].
- **Gradient Monitoring**: Pricing updates are bounded using adaptive learning thresholds to prevent extreme swings or manipulative gradients.
- **Zero-Knowledge Learning [9] (Planned)**: Future upgrades will explore zk-AI modules to verify AI training steps without revealing sensitive internal models [14].

4. Network and Infrastructure Security

- **Node-Level Isolation**: Seller nodes and ledgers are cryptographically segmented to prevent unauthorized access or ledger tampering.

[9] ZKML

- **Light-Sync Protection**: New nodes are synched with only the latest block via secure Merkle root validation, ensuring efficiency and protection against history poisoning.
- **DDOS[10] Prevention**: API endpoints are rate-limited and secured via reverse proxies, with optional integration of cloud-based Web Application Firewalls (WAFs).

5. Data Integrity and Ledger Immutability

- **Merkle Tree Verification**: All transactions within a block are hashed using Merkle trees. This ensures that even the slightest modification invalidates the entire block.
- **Immutable Audit Trail**: Each transaction, AI contribution, reward distribution, and collusion detection event is logged and anchored permanently on-chain.

Saki Market Game aims to set a new benchmark in blockchain security—where intelligent behavior, decentralized logic, and environmental ethics co-exist within a provably secure infrastructure.

🌎 **Global Comparison:**

Saki Market Game vs. Famous Projects in Blockchain + Energy Markets

Project	Focus Area	Tech Core	Innovation Level	Compared to Saki Market Game
Power Ledger (Australia)	P2P energy trading	Standard blockchain, token system	Moderate (trading focused)	Saki is more advanced — you have AI competition + adaptive learning + PoCC, not just peer trade.
Brooklyn Microgrid (USA)	Localized energy trade (small scale)	Blockchain + community energy	Low (small networks)	Saki is more scalable — global multi-agent competition possible, not neighborhood only.
WePower (Lithuania)	Green energy tokenization for investment	Tokenizing energy production	High (financialization focus)	Saki is more technical — focuses on real-time dynamic competition, not just funding energy projects.

[10] Distributed Denial-of-Service

SunContract (Slovenia)	Energy marketplace between consumers and producers	Blockchain + smart contracts	Moderate (decentralized trading)	Saki is more intelligent — you model price optimization and stability mathematically.
Grid+ (USA)	Blockchain for retail electricity (Texas)	Blockchain-backed payments	Low (payment optimization)	Saki is more economic — you create actual dynamic market behavior and evolution.
Electron (UK)	Energy asset registration and flexibility markets	Private blockchain, registry focus	Low (utility registry)	Saki is deeper — you create active decentralized competitive behavior, not just registries.

Usage Guide

The **Saki Market Game** is designed with usability at its core—empowering energy producers, AI developers, node operators, and ecosystem contributors to interact with the platform seamlessly and securely. Whether you're an independent seller of renewable energy or a data scientist deploying AI agents, this guide provides a step-by-step overview of how to participate in the network.

1. Getting Started

a. Saki Market Game Package

The package includes:

- A lightweight blockchain client
- Built-in AI agent template (modifiable)
- Sync utilities for connecting to the latest block

Minimum Requirements:

- OS: Linux, macOS, or Windows
- RAM: 4 GB
- Python ≥ 3.8

b. Connect to the Chain

Once installed, users can:

- Light sync with the most recent block
- View recent market activity
- Register a new seller or buyer agent

2. Creating AI Agents

a. Seller Agent Setup

To participate as a seller:

- Provide your and **production cost, maximum profit demanded by the seller**
- Choose an **initial price** within the permissible margin

The seller AI will join the competitive market battle and optimize its pricing strategy based on buyer demand and market responses.

b. Buyer Agent Role

The buyer agent sets the **total energy demand**. It then dynamically and automatically allocates purchase shares among sellers using real-time price-to-quality utility ratios.

c. EMS[11] Role in Blockchain:

- Determines the optimal number of seller participants to ensure a sustainable energy supply.
- Sets the allowable price adjustment range for each market battle round.
- Verifies and certifies each seller's energy capacity and quality rating.

3. Running a Market Simulation

Once all agents are initialized:

- The market enters an **optimization loop**, adjusting prices using the Adam optimizer.
- Game-theoretic rounds continue until convergence is detected (within a tolerance threshold).
- If collusion or stagnation is detected, a **moderator agent** is deployed to restore competition.

Each simulation concludes with:

- Equilibrium prices
- Allocated energy shares
- Utility scores
- Transaction summary

4. Blockchain Interaction

Upon convergence:

- A **new block** is minted on the POCC blockchain.
- Merkle tree hashes record all AI actions and transactions.
- Reward tokens (1% of transaction value) are distributed among seller agents based on contribution metrics.

Users can view the ledger using:

- Built-in ledger browser
- Export to Excel and JSON

[11] Energy Management System

- External blockchain explorer (coming soon)

5. Visualization and Analysis

Saki provides auto-generated plots and reports for:

- **Price evolution** over rounds
- **Market share dynamics**
- **Agent performance metrics**
- **Block metadata**

These insights empower users to audit the market behavior, tune their agents, and forecast future positioning.

6. Advanced Features

- **Custom AI Plugins**: Developers can plug in their reinforcement learning models via a standardized interface.
- **API Access**: Third-party platforms can integrate with Saki via REST APIs to query market states or submit agent parameters.
- **Simulation Mode**: Offline simulation for educational or experimental purposes.
- **DAO Participation**: Future updates will enable agents to vote on protocol parameters and reward mechanisms.

The **Saki Market Game** is not just a blockchain—it's a living economy of intelligent agents, real-world impact, and user-driven evolution. This guide is your entry point to participate in a decentralized revolution of energy fairness and AI-powered optimization.

Appendices and Resources

This section provides supporting materials, extended technical notes, references, and external resources relevant to the architecture, economics, and broader ecosystem of the **Saki Market Game** blockchain.

Appendix A: Glossary of Terms

Term	Definition
POCC	*Proof of Competitive Contribution*, the novel consensus mechanism used by Saki Blockchain.
Equilibrium Price	The stable price at which buyer demand matches the competitive supply of qualified sellers.
AI Agent	A self-optimizing software entity that represents either a buyer or a seller.
Adam Optimizer	A gradient-based optimizer used to dynamically adjust agent pricing strategies.
Game-Theoretic Round	A simulation step where agents adjust prices based on market feedback and learning rules.
Moderator Agent	A neutral entity introduced in case of collusion or price manipulation.
Utility Score	A computed metric based on price-to-quality ratio and seller capacity.
Merkle Tree	A hash-based data structure used to securely record all agent actions and transactions.
Reward Pool	A 1% fee from transaction value distributed among sellers based on contribution ranking.

Appendix B: Mathematical Summary

1. Core Definitions and Game Setup
Let N denote the number of energy sellers (players), each indexed by $i \in \{1, ..., N\}$. Each seller is characterized by:

• Price at iteration t: p_i^t

• Quality: $q_i \in \mathbb{R}^+$

• Capacity: $c_i \in \mathbb{R}^+$

• Production Cost: $c_i^{prod} \in \mathbb{R}^+$

• Profit at t: F_i^t

The buyer has fixed demand D, which is distributed across sellers using a normalized utility function:

$U_i = (q_i / p_i^t) \cdot c_i$

$s_i = D \cdot (U_i / \Sigma_j U_j)$

Prices are bounded as follows:

$p_i^t \in [c_i^{prod}, c_i^{prod} \cdot (1 + H)]$

Price changes are capped by:

$|p_i^{t+1} - p_i^t| \leq p_i^t$

2. Profit and Pseudo-Gradient Dynamics
Profit function:

$F_i(p_i^t) = (p_i^t - c_i^{prod}) \cdot s_i(p^t)$

Damped Pseudo-gradient update rule:

$p_i^{t+1} = p_i^t + \lambda_i^t \cdot (s_i^t - \alpha_i^t \ (p_i^t - c_i^{prod}))$

λ_i^t = Learning rate

$\alpha_i^t \approx \partial S_i / \partial p_i$ (innovatively proposed by Saki)

3. Proof of Uniqueness of Nash Equilibrium
We examine the Hessian matrix $H_i = \nabla^2 F_i(p_i)$ and show it is negative definite.

By Gershgorin's Circle Theorem [15], if:

$|H_{ii}| > \Sigma_{j \neq i} |H_{ij}| \rightarrow H \prec 0$

4. Closed-Loop Stability and Convergence
Define Lyapunov function:

$V(p^t) = \Sigma_i (F_i(p_i^t) - F_i(p_i^*))^2$

We show: $V(p^{t+1}) - V(p^t) < 0 \ \forall \ p^t \neq p^*$

And using Lipschitz continuity of $s_i(p)$:

$$\|p^{t+1} - p^*\| \leq (1 - \eta)^t \cdot \|p^0 - p^*\|$$

In Saki Market Game:

- The **damped pseudo-gradient update** becomes **contractive** under:
    - a properly bounded **learning rate λ**,
    - and a **Lipschitz-continuous utility allocation function $s_i(p)$** [16] ,
- Therefore, η depends on:
    - the **maximum λ allowed** (which relates to volatility damping),
    - and the **sensitivity of share allocation $s_i(p)$** to price p.

5. Design Philosophy of Alpha (α)
Alpha must enforce diagonal dominance in the Hessian matrix, avoid excessive suppression of AI autonomy, and remain adaptive to volatility. Accordingly, the alpha design ensures convergence to a unique Nash equilibrium.

6. Conclusion
This framework ensures a unique Nash equilibrium, guarantees global convergence, and maintains a decentralized, democratic pricing environment in the Saki Market Game.

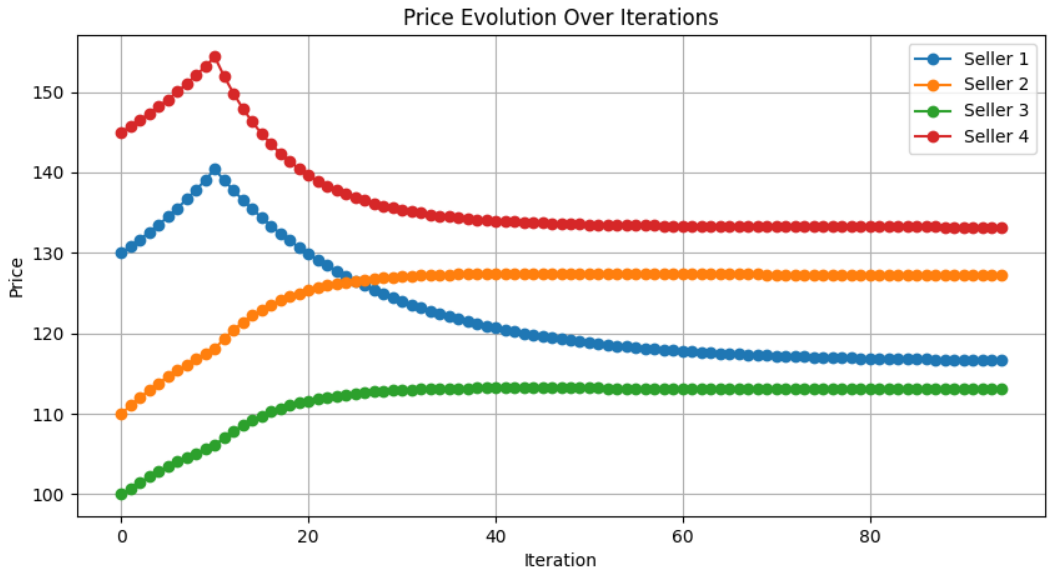

Figure 1:Block#8

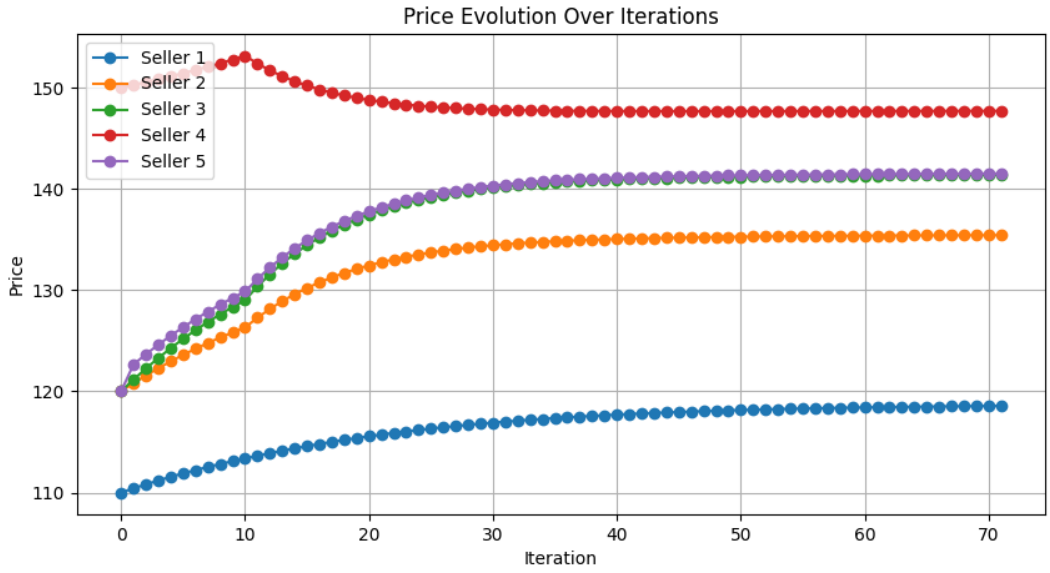

Figure 2:Block#10

Appendix C: Smart Contract Features (Planned)

Although the current Saki Market Game operates off-chain using local simulation, future versions will introduce on-chain smart contracts for:

- Agent registration
- Reward disbursement
- Market validation
- Energy certification
- DAO governance participation

Blockchain platform integration candidates:

- Energy Web Chain[12]
- IOTA[13]
- Hyperledger Fabric
- Power Ledger

Appendix D: System Diagram (Simplified)

Saki Market Game

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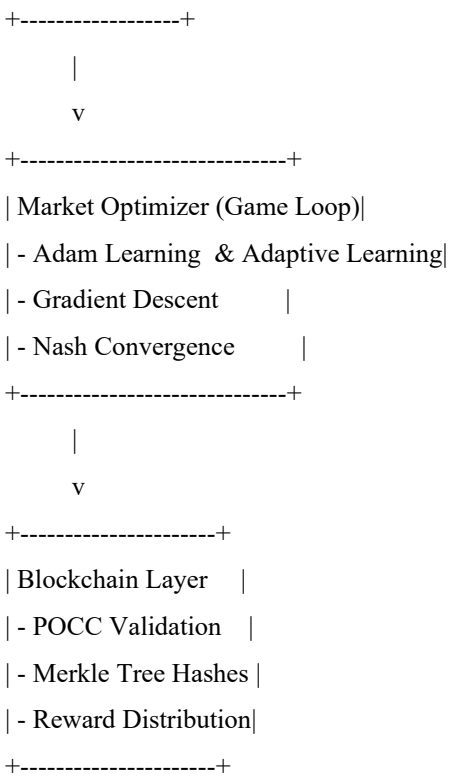
| Buyer AI Agent (Allocator with specific demand) |

| Sellers AI Agent (Competitors with initial prices) |

[12] EWC

[13] A distributed ledger technology designed for the Internet of Things



References

[1] B. saki, "POCC(Proof of Competitive Contribution) an innovative consensus method introduced by Behnam Saki," 2025.

[2] S. Nakamoto, "A peer-to-peer electronic cash system," http://bitcoin.org/bitcoin.pdf., 2008.

[3] "Proof-of-Stake Consensus Mechanisms for Future Blockchain Networks: Fundamentals, Applications and Opportunities," IEEE Access, vol. 7, pp. 85727 - 85745, 26 June 2019.

[4] E. Osaba and E. Villar-Rodriguez, "A Tutorial On the design, experimentation and application of metaheuristic algorithms to real-World optimization problems," Swarm and Evolutionary Computation, vol. Volume 64, July 2021.

[5] S. V. Albrecht and P. Stone, "Autonomous agents modelling other agents: A comprehensive survey and open problems," Artificial Intelligence, vol. Volume 258, pp. Pages 66-95, May 2018.

[6] M. Liu, D. Yao, Z. Liu, J. Guo and J. Chen, "An Improved Adam Optimization Algorithm Combining Adaptive Coefficients and Composite Gradients Based on Randomized Block Coordinate Descent," Computational Intelligence and Neuroscience, 10 January 2023.

[7] S. Feng, R. Zhang and G. Li, "Environmental decentralization, digital finance and green technology innovation," Structural Change and Economic Dynamics, vol. 61, pp. 70-83, June 2022.

[8] A. Nowé, P. Vrancx and Y.-M. D. Hauwere, "Adaptation, Learning, and Optimization," in Game Theory and Multi-agent Reinforcement Learning, Springer, 2012, p. 441–470.

[9] D. S. Ahmad, "Optimizing Dynamic Pricing through AI-Powered Real-Time Analytics: The Influence of Customer Behavior and Market Competition," Qlantic Journal of Social science, vol. Vol. 5 No. 3, SUMMER 2024.

[10] J. Shamma and G. Arslan, "Dynamic fictitious play, dynamic gradient play, and distributed convergence to Nash equilibria," IEEE Transactions on Automatic Control, vol. 50, no. 3, pp. 312 - 327, 14 March 2005.

[11] R. Blum and T. Bocek, "Superlight – A Permissionless, Light-client Only Blockchain with Self-Contained Proofs and BLS Signatures," IEEE Symposium on Integrated Network and Service Management (IM), 08-12 April 2019.

[12] S.-J. Kim and G. B. Giannakis, "An Online Convex Optimization Approach to Real-Time Energy Pricing for Demand Response," IEEE Transactions on Smart Grid , vol. 8, no. 6, pp. 2784 - 2793, 22 March 2016.

[13] X. Xian, Z. Yang, G. Zhang, T. M. d. N. S. and W. Liu, "A Complete Anti-collusion Mechanism in Blockchain," Blockchain and Trustworthy Systems , pp. 31-44, 12 November 2020.

[14] H. Sun, T. Bai, J. Li and H. Zhang, "Efficient Zero-Knowledge Proofs of Deep Learning Training," IEEE Transactions on Information Forensics and Security, vol. 20, pp. 914 - 927, 20 December 2024.

[15] R. S. Varga, Geršgorin and His Circles, Springer, 2004.

[16] X.-B. Liang and J. Si, "Global exponential stability of neural networks with globally Lipschitz continuous activations and its application to linear variational inequality problem," IEEE Transactions on Neural Networks, vol. 12, no. 2, pp. 349 - 359, 31 March 2001 .

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- https://www.youtube.com/watch?v=LB27_viGH5U

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