



Ecosystem MAUAX 1.0 - Smart Contracts Completos

🌟 Visão Geral

Ecosystem blockchain completo para tokenização da economia de Mauá, incluindo governança, utilidade, energia, reciclagem, investimentos e infraestrutura DeFi.

🎯 Objetivos Estratégicos

- **Meta Energética**: 10.000 kWh de capacidade instalada
- **Ranking**: Top 10 no Índice de Desenvolvimento Sustentável e Circular (IDSC)
- **Economia**: PIB per capita de US\$ 100.000,00

🏗️ Arquitetura do Ecosystem

1. 🏛️ Governance Layer

MauaxFoundersNFT (ERC721)

```
```solidity
```

```
contract MauaxFoundersNFT is ERC721, ERC721URIStorage, Ownable
```

```
```
```

- **Supply Total**: 100 NFTs únicos
- **Token #001**: Pedra Fundamental (Prefeito)
- **Tokens #006-#031**: 26 Secretarias municipais
- **Tokens #002-#005, #032-#100**: Parceiros e Investidores DAO

Funcionalidades:

- Governança descentralizada
- Voting power proporcional
- Representação institucional

InvestorVault (Access Control)

```
```solidity
```

```
contract InvestorVault is AccessControl, ReentrancyGuard
```

```
```
```

- **Governança**: Seed round de R\$ 15 milhões
- **Quorum**: 51% para aprovação
- **Voting Period**: 3 dias
- **Execução**: Automática via smart contract

Funcionalidades:

```
```solidity
```

```
createProposal(target, data, description)
```

```
vote(proposalId)
```

```
executeProposal(proposalId)
```

```
```
```



2. 💰 Token Layer

MauaxUtilityToken (ERC20)

```solidity

contract MauaxUtilityToken is ERC20, ERC20Burnable, Ownable  
...

- **\*\*Nome\*\***: MAUAX Utility Token
- **\*\*Símbolo\*\***: MAUAX-C
- **\*\*Supply\*\***: 100 bilhões tokens
- **\*\*Função\*\***: Moeda principal do ecossistema

**\*\*Casos de Uso:\*\***

- Pagamentos no ecossistema
- Staking para rewards
- Governance secondary
- Bridge entre chains

### #### MauaxEnergyToken (ERC20)

```solidity

contract MauaxEnergyToken is ERC20, ERC20Burnable, AccessControl
...

- ****Nome****: MAUAX Energy Token
- ****Símbolo****: MAUAX-E
- ****Backing****: 1 token = 1 MWh
- ****Tipo****: Real World Asset (RWA)

****Funcionalidades:****

```solidity

validateAndMint(to, energyAmount, source) // Oracle-controlled  
...

### #### MauaxRecyclingToken (ERC20)

```solidity

contract MauaxRecyclingToken is ERC20, ERC20Burnable, AccessControl
...

- ****Nome****: MAUAX Recycling Token
- ****Símbolo****: MAUAX-R
- ****Backing****: 1 token = 1kg material reciclado
- ****Integração****: Cooperativas autorizadas

****Funcionalidades:****

```solidity

validateRecycling(collector, weight, materialType, cooperative)  
authorizeCooperative(cooperative)  
...



### ### 3. 💎 Investment Layer

#### #### MauaxSeedNFT (ERC721)

```
```solidity
```

```
contract MauaxSeedNFT is ERC721, Ownable
```

```
```
```

- **Token Único**: #1
- **Valor**: R\$ 15 milhões
- **Função**: Acesso ao Investor Vault
- **Transferível**: Via leilão governança

#### #### MauaxSeedSale (Fundraising)

```
```solidity
```

```
contract MauaxSeedSale is AccessControl, ReentrancyGuard
```

```
```
```

- **Target**: R\$ 15 milhões
- **Investimento Mínimo**: R\$ 100 mil
- **Investidores**: Whitelist KYC/AML
- **Prazo**: Até atingir target

**Funcionalidades:**

```
```solidity
```

```
invest() payable // Investimento seed
```

```
finalizeSale() // Transfere NFT para vault
```

```
emergencyWithdraw() // Refund se não atingir meta
```

```
```
```

### ### 4. 🏛️ Treasury & DAO

#### #### MauaxDAOTreasury (Sovereign Fund)

```
```solidity
```

```
contract MauaxDAOTreasury is AccessControl, ReentrancyGuard
```

```
```
```

- **Alocação**:
  - 40% Infraestrutura
  - 30% Desenvolvimento Social
  - 20% Inovação
  - 10% Reserva

**Funcionalidades:**

```
```solidity
```

```
createFundingProposal(title, description, amount, recipient, category)
```

```
executeFunding(proposalId)
```

```
receiveFunds(source) payable
```



...

5. Oracle & Data Layer

OracleEnergyData (IoT Integration)

```
```solidity
```

```
contract OracleEnergyData is AccessControl
```

```
```
```

- ****Função****: Validação de geração energética
- ****Sensores****: IoT autorizados
- ****Mint****: Automático de MAUAX-E

****Funcionalidades:****

```
```solidity
```

```
submitEnergyReading(generatedMWh, sourceType, location)
```

```
validateAndMintTokens(readingId, recipient)
```

```
authorizeSensor(sensor)
```

```
```
```

6. DeFi Layer

MauaxStakingSystem (Dynamic APY)

```
```solidity
```

```
contract MauaxStakingSystem is AccessControl, ReentrancyGuard
```

```
```
```

- ****Lock Periods****: 30, 90, 180, 365 dias
- ****APY****: 5%, 8%, 12%, 18% respectivamente
- ****Rewards****: Automáticos

****Funcionalidades:****

```
```solidity
```

```
stake(amount, lockPeriod)
```

```
unstake(stakeIndex)
```

```
calculateReward(user, stakeIndex)
```

```
```
```

MauaxPSPIntegration (Payment Gateway)

```
```solidity
```

```
contract MauaxPSPIntegration is AccessControl, ReentrancyGuard
```

```
```
```

- ****Fee****: 0.2% por transação
- ****Tokens****: MAUAX-C, MAUAX-E, MAUAX-R
- ****QR Codes****: Geração automática

****Funcionalidades:****



```
```solidity
```

```
processPayment(tokenAddress, to, amount, transactionType)
```

```
generatePaymentQR(amount, tokenAddress, description)
```

```
authorizeMerchant(merchant)
```

```
```
```

```
##### MauaxCrossChainBridge (Ethereum ↔ Polygon)
```

```
```solidity
```

```
contract MauaxCrossChainBridge is AccessControl, ReentrancyGuard
```

```
```
```

- **Validators**: Mínimo 3 confirmações
- **Tokens**: Todos os tokens MAUAX
- **Segurança**: Multi-sig validation

```
Funcionalidades:
```

```
```solidity
```

```
lockTokensForBridge(token, amount, targetAddress, targetChain)
```

```
validateBridgeTransaction(txHash)
```

```
```
```

```
##### MauaxDEXIntegration (Uniswap V3)
```

```
```solidity
```

```
contract MauaxDEXIntegration is AccessControl, ReentrancyGuard
```

```
```
```

- **Protocol**: Uniswap V3
- **Fee Tier**: 0.3% padrão
- **Pools**: Automáticos para todos tokens

```
Funcionalidades:
```

```
```solidity
```

```
swapTokens(tokenIn, tokenOut, amountIn, amountOutMinimum)
```

```
createPool(token0, token1)
```

```
```
```

```
##### MauaxInsuranceProtocol (Infrastructure Coverage)
```

```
```solidity
```

```
contract MauaxInsuranceProtocol is AccessControl, ReentrancyGuard
```

```
```
```

- **Coverage**: 80% dos assets
- **Assessors**: Mínimo 3 validadores
- **Premium**: 2% ao ano

```
Funcionalidades:
```

```
```solidity
```

```
createPolicy(holder, assetType, coverageAmount, duration)
```



```
submitClaim(policyId, claimAmount, description)
assessClaim(claimId, approve)
...
```

## ## Fluxos de Valor

### ### 1. Energia → Token

Geração Solar → Oracle IoT → Validação → Mint MAUAX-E → Distribuição

### ### 2. Reciclagem → Token

Material Reciclado → Cooperativa → Validação → Mint MAUAX-R → Cashback

### ### 3. Pagamentos

Merchant → QR Code → User Payment → PSP Processing → Settlement

### ### 4. Staking Rewards

Lock MAUAX-C → Time-based APY → Automated Rewards → Unlock + Rewards

### ### 5. Cross-Chain

Lock Token → Multi-sig Validation → Mint on Target → Release Original

## ## Tokenomics

### ### Supply Distribution

#### ##### MAUAX-C (Utility)

- **Total**: 100 bilhões
- **Phases**: Controlled emission
- **Burn**: Deflationary mechanism

#### ##### MAUAX-E (Energy)

- **Supply**: Unlimited (backed by real energy)
- **Mint**: Only via oracle validation
- **Burn**: Energy consumption



#### ##### MAUAX-R (Recycling)

- \*\*Supply\*\*: Unlimited (backed by recycled materials)
- \*\*Mint\*\*: Only via cooperative validation
- \*\*Burn\*\*: Material processing

#### ### Value Accrual

- \*\*Staking Rewards\*\*: 5-18% APY
- \*\*PSP Fees\*\*: 0.2% transaction fee
- \*\*Insurance Premiums\*\*: 2% annual
- \*\*Bridge Fees\*\*: 0.1% cross-chain

#### ## 🏛️ Governance Model

#### ### Three-Tier Governance

##### ##### Tier 1: Founders NFT Holders

- \*\*Strategic decisions
- \*\*Constitutional changes
- \*\*Emergency actions

##### ##### Tier 2: Seed Vault Members

- \*\*Investment decisions
- \*\*Treasury allocation
- \*\*Operational approval

##### ##### Tier 3: Token Holders

- \*\*Day-to-day operations
- \*\*Parameter adjustments
- \*\*Community proposals

#### ### Voting Mechanisms

- \*\*Weighted voting\*\* by token/NFT holdings
- \*\*Quorum requirements\*\* vary by tier
- \*\*Time locks\*\* for major changes
- \*\*Emergency procedures\*\* for critical issues

#### ## 🛡️ Security Features

##### ### Access Control

- \*\*Role-based permissions\*\* (OpenZeppelin)
- \*\*Multi-signature\*\* requirements
- \*\*Time locks\*\* for sensitive operations
- \*\*Emergency pause\*\* mechanisms

##### ### Oracle Security



- **\*\*Multiple data sources\*\***
- **\*\*Validator consensus\*\***
- **\*\*Anomaly detection\*\***
- **\*\*Manual override\*\*** for emergencies

### ### Bridge Security

- **\*\*Multi-validator\*\*** confirmation
- **\*\*Lock/mint/burn\*\*** mechanism
- **\*\*Fraud proofs\*\***
- **\*\*Insurance coverage\*\***

## ## 🌍 Sustainability Impact

### ### Environmental

- **\*\*Carbon Negative\*\***: Solar energy generation
- **\*\*Circular Economy\*\***: 100% recycling integration
- **\*\*Energy Efficiency\*\***: DataCenter optimization

### ### Social

- **\*\*Cooperative Integration\*\***: Direct revenue sharing
- **\*\*Job Creation\*\***: 2,000+ direct jobs
- **\*\*Financial Inclusion\*\***: Token-based economy

### ### Governance

- **\*\*Transparency\*\***: All operations on-chain
- **\*\*Participation\*\***: Democratic governance
- **\*\*Accountability\*\***: Immutable records

## ## 📅 Roadmap

### ### Phase 1: Foundation (Q1 2024)

- ✅ Smart contract development
- ✅ Security audits
- ✅ Testnet deployment

### ### Phase 2: Launch (Q2 2024)

- 🔄 Mainnet deployment
- 🔄 Seed round completion
- 🔄 Initial token distribution




### ### Phase 3: Operations (Q3-Q4 2024)

- 📋 Energy projects launch
- 📋 Recycling network activation
- 📋 Staking system live





#### ### Phase 4: Expansion (2025)

-  Cross-chain bridges
-  DeFi integrations
-  International expansion

#### ## Technical Stack

##### ### Blockchain

- **Primary**: Ethereum Mainnet
- **Secondary**: Polygon Network
- **Standards**: ERC20, ERC721, ERC1155

##### ### Development

- **Language**: Solidity ^0.8.20
- **Framework**: Hardhat
- **Security**: OpenZeppelin Contracts

##### ### Infrastructure

- **Oracles**: Chainlink + Custom IoT
- **Storage**: IPFS + Arweave
- **Frontend**: React + Web3.js

##### ### Integrations

- **DeFi**: Uniswap V3, Aave
- **Payment**: Custom PSP Gateway
- **Bridge**: LayerZero Protocol

#### ## Deployment Guide

##### ### Prerequisites

```
``bash
npm install
npx hardhat compile
npx hardhat test
``
```

##### ### Testnet Deployment

```
``bash
npx hardhat run scripts/deploy.js --network goerli
npx hardhat verify --network goerli DEPLOYED_ADDRESS
``
```

##### ### Mainnet Deployment

```
``bash
Use MauaxMasterDeployer for coordinated deployment
```



```
npx hardhat run scripts/deployMaster.js --network mainnet
...
```

## ## 🔍 Monitoring & Analytics

### ### On-Chain Metrics

- **Token supplies** and distributions
- **Staking TVL** and rewards
- **Energy generation** and tokenization
- **Recycling volumes** and processing

### ### Performance KPIs

- **Transaction volume** across ecosystem
- **User adoption** and retention
- **Revenue generation** per protocol
- **Sustainability metrics** achievement

### ### Dashboards

- **Admin Panel**: Operational control
- **User Dashboard**: Personal analytics
- **Public Metrics**: Transparency portal

## ## 📖 Documentation

### ### Developer Resources

- **API Documentation**: Complete endpoint reference
- **SDK Libraries**: JavaScript, Python, Go
- **Code Examples**: Integration samples
- **Testing Suite**: Comprehensive test coverage

### ### User Guides

- **Getting Started**: Basic wallet setup
- **Token Usage**: Payment and staking guides
- **Governance**: Voting and proposal creation
- **Mobile App**: iOS and Android guides

## ## 🤝 Community

### ### Communication Channels

- **Discord**: Real-time community chat
- **Telegram**: News and announcements
- **Forum**: Long-form discussions
- **GitHub**: Open-source development

### ### Support



- **Technical Support**: 24/7 developer assistance
- **User Support**: Multi-language help desk
- **Documentation**: Comprehensive guides
- **Video Tutorials**: Step-by-step walkthroughs

## ## ☎ Contact Information

### ### Development Team

- **Email**: [dev@mauax.com](mailto:dev@mauax.com)
- **GitHub**: [github.com/mauax-ecosystem](https://github.com/mauax-ecosystem)
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### ### Business Inquiries

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