# EcolithSwap - Complete Platform



EcolithSwap Logo

**EcolithSwap** is a comprehensive African-first electric battery swapping and recycling platform designed for urban and rural users in Kenya. The platform enables battery swaps, charging, plastic waste redemption for credit, and environmental impact tracking.

## 🏗️ Architecture Overview

The EcolithSwap platform consists of three main components:

### 1. **Mobile App** (React Native)

* **Location**: /EcolithSwap/
* **Platform**: Cross-platform (iOS & Android)
* **Features**: Battery swapping, station finder, plastic waste submission, user dashboard
* **Technology**: React Native, Expo

### 2. **Admin Dashboard** (React Web App)

* **Location**: /ecolithswap-admin/
* **Platform**: Web-based admin panel
* **Features**: User management, station management, battery tracking, analytics
* **Technology**: React, TypeScript, Vite, Tailwind CSS

### 3. **Backend API** (Node.js + MySQL)

* **Location**: /EcolithSwap-Backend/
* **Platform**: RESTful API server
* **Features**: Authentication, data management, real-time updates, payment processing
* **Technology**: Node.js, Express, MySQL, JWT, Socket.IO

## 🚀 Quick Start

### Prerequisites

* **Node.js** (v16 or higher)
* **MySQL** (v8.0 or higher)
* **npm** or **yarn**
* **Expo CLI** (for mobile development)
* **Git**

### 1. Clone the Repository

git clone <repository-url>  
cd ecolithswap-platform

### 2. Backend Setup

# Navigate to backend directory  
cd EcolithSwap-Backend  
  
# Install dependencies  
npm install  
  
# Set up environment variables  
cp .env.example .env  
# Edit .env with your MySQL credentials  
  
# Set up database  
npm run setup-db  
  
# Seed with sample data (optional)  
npm run seed-db  
  
# Start the server  
npm start

The backend will be running on http://localhost:3000

### 3. Admin Dashboard Setup

# Navigate to admin directory  
cd ecolithswap-admin  
  
# Install dependencies  
npm install  
  
# Set up environment variables  
cp .env.example .env  
# Edit .env if needed  
  
# Start development server  
npm run dev

The admin dashboard will be running on http://localhost:5173

### 4. Mobile App Setup

# Navigate to mobile app directory  
cd EcolithSwap  
  
# Install dependencies  
npm install  
  
# Start Expo development server  
npx expo start

Use the Expo Go app on your phone or an emulator to run the mobile app.

## 🔐 Default Login Credentials

After running the database seeding script, you can use these test accounts:

### Admin Dashboard

* **Admin**: admin@ecolithswap.com / password123
* **Station Manager**: manager@ecolithswap.com / password123

### Mobile App

* **Customer 1**: john.doe@email.com / password123
* **Customer 2**: jane.smith@email.com / password123

## 📱 Mobile App Features

### Core Features

* **Battery Swapping**: Rent and return batteries at charging stations
* **Station Finder**: Locate nearby charging stations with map/list view
* **Plastic Waste Recycling**: Submit plastic waste and earn EcoCredits
* **Payment Integration**: M-Pesa and credit-based payments
* **Impact Tracking**: Monitor environmental impact and savings
* **Offline Support**: Basic functionality works without internet

### User Interface

* Clean, intuitive design optimized for low-end Android devices
* Support for multiple languages (English, Swahili)
* Low-bandwidth optimized for intermittent connectivity
* Accessibility features for diverse user base

## 🖥️ Admin Dashboard Features

### Management Capabilities

* **User Management**: View, edit, activate/deactivate user accounts
* **Station Management**: Add, edit, monitor charging stations
* **Battery Management**: Track battery inventory, health, and usage
* **Waste Management**: Verify plastic waste submissions
* **Payment Management**: Monitor transactions and process refunds

### Analytics & Reporting

* **Revenue Analytics**: Track income from rentals and services
* **Usage Analytics**: Monitor station utilization and battery performance
* **Environmental Impact**: Track plastic waste processed and CO2 savings
* **User Analytics**: Understand user behavior and engagement

### Real-time Features

* Live dashboard updates via WebSockets
* Real-time station status monitoring
* Instant notifications for critical events

## 🔧 Backend API Features

### Core Services

* **Authentication**: JWT-based auth with refresh tokens
* **User Management**: Registration, profile management, role-based access
* **Station Management**: CRUD operations with location-based queries
* **Battery Management**: Inventory tracking with real-time status updates
* **Rental Management**: Complete rental lifecycle management
* **Waste Management**: Plastic waste submission and verification
* **Payment Processing**: M-Pesa integration and credit system
* **Analytics**: Comprehensive reporting and insights

### Technical Features

* RESTful API design with consistent error handling
* Database migrations and seeding
* Rate limiting and security middleware
* Real-time updates via Socket.IO
* Comprehensive logging and monitoring
* API documentation and health checks

## 🗄️ Database Schema

The MySQL database includes the following main tables:

* **users**: User account information
* **user\_profiles**: Extended user profile data and credits
* **stations**: Charging station information and locations
* **batteries**: Battery inventory and status tracking
* **battery\_rentals**: Rental transactions and history
* **plastic\_waste\_logs**: Waste submission records
* **payments**: Payment transactions and history

## 🌍 Environment Configuration

### Backend Environment Variables

Key configuration options in /EcolithSwap-Backend/.env:

# Database  
DB\_HOST=localhost  
DB\_PORT=3306  
DB\_USER=root  
DB\_PASSWORD=your\_password  
DB\_NAME=ecolithswap  
  
# JWT Authentication  
JWT\_SECRET=your\_secret\_key  
JWT\_EXPIRES\_IN=24h  
  
# M-Pesa Integration  
MPESA\_ENVIRONMENT=sandbox  
MPESA\_CONSUMER\_KEY=your\_key  
MPESA\_CONSUMER\_SECRET=your\_secret

### Frontend Environment Variables

Admin dashboard configuration in /ecolithswap-admin/.env:

VITE\_API\_BASE\_URL=http://localhost:3000/api  
VITE\_APP\_TITLE=EcolithSwap Admin

## 🚦 API Documentation

### Authentication Endpoints

* POST /api/auth/register - User registration
* POST /api/auth/login - User login
* POST /api/auth/logout - User logout
* GET /api/auth/profile - Get user profile
* PUT /api/auth/profile - Update user profile

### Station Endpoints

* GET /api/stations - List all stations
* GET /api/stations/:id - Get station details
* POST /api/stations - Create new station (admin)
* PUT /api/stations/:id - Update station (admin)

### Battery & Rental Endpoints

* GET /api/batteries - List batteries
* POST /api/rentals - Rent a battery
* PATCH /api/rentals/:id/return - Return a battery
* GET /api/rentals - Get rental history

### Waste Management Endpoints

* POST /api/waste - Submit plastic waste
* GET /api/waste - Get waste submission history
* PATCH /api/waste/:id/verify - Verify waste (admin)

### Payment Endpoints

* POST /api/payments/mpesa - Process M-Pesa payment
* POST /api/payments/credits - Process credit payment
* GET /api/payments - Get payment history

## 🔒 Security Features

* **JWT Authentication**: Secure token-based authentication
* **Role-based Access Control**: Admin, Station Manager, Customer roles
* **Rate Limiting**: Prevent API abuse
* **Input Validation**: Comprehensive data validation
* **SQL Injection Protection**: Parameterized queries
* **CORS Configuration**: Controlled cross-origin requests
* **Security Headers**: Helmet.js for security headers

## 📊 Monitoring & Analytics

### Application Monitoring

* Health check endpoints for system status
* Comprehensive error logging and tracking
* Performance monitoring and optimization
* Database query optimization

### Business Analytics

* User engagement and retention metrics
* Revenue tracking and financial reporting
* Environmental impact measurement
* Station utilization and efficiency metrics

## 🚀 Deployment

### Production Deployment Steps

1. **Database Setup**
   * Set up MySQL server
   * Run migrations: npm run migrate
   * Configure backup strategy
2. **Backend Deployment**
   * Deploy to cloud provider (AWS, Digital Ocean, etc.)
   * Set production environment variables
   * Configure SSL certificates
   * Set up process manager (PM2)
3. **Admin Dashboard Deployment**
   * Build for production: npm run build
   * Deploy to static hosting (Netlify, Vercel, etc.)
   * Configure environment variables
4. **Mobile App Deployment**
   * Build for iOS: expo build:ios
   * Build for Android: expo build:android
   * Deploy to App Store and Google Play

### Docker Deployment (Optional)

Docker configurations are available for containerized deployment.

## 🧪 Testing

### Backend Testing

cd EcolithSwap-Backend  
npm test

### Frontend Testing

cd ecolithswap-admin  
npm test

### Mobile App Testing

cd EcolithSwap  
npm test

## 🤝 Contributing

1. Fork the repository
2. Create a feature branch
3. Commit your changes
4. Push to the branch
5. Create a Pull Request

## 📄 License

This project is licensed under the MIT License - see the LICENSE file for details.

## 🆘 Support

For support, please contact: - **Email**: support@ecolithswap.com - **Documentation**: [API Docs](http://localhost:3000/health) - **Issues**: [GitHub Issues](repository-issues-url)

## 🙏 Acknowledgments

* Ecolith Africa Solutions team
* Open-source community contributors
* Beta testers and early adopters

**Built with ❤️ for sustainable technology in Africa**