PEER-TO-PEER ENERGY TRADING PLATFORM ON ETHEREUM

SolarPro

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1 Introduction

This project report documents the development process of a Peer-to-Peer (P2P) Energy Trading Decentralized Application (DApp). The platform is named SolarPro to emphasize its commitment to renewable energy and sustainability. Our undertaking aims not only to develop a cutting-edge application but to fundamentally reshape how users consume and trade energy. By leveraging the Ethereum blockchain, SolarPro eliminates intermediaries, fosters transparency, and directly involves users in the peer-to-peer exchange of energy assets. Our objectives align with exploring agile software engineering approaches, organizing comprehensive requirements, building and iterating prototypes, and addressing potential implementation challenges.

In our collaborative journey, we utilized an array of tools, including Trello for project management, Draw.io for architectural exploration, Figma for user interface (UI) prototyping, and a suite of other tools for the implementation phase This report captures the essence of our journey, highlighting the innovative strategies, technological integrations, and community-centric focus that define SolarPro's identity in the ever-evolving energy market.

2 Product Vision

2.1 App Vision

SolarPro represents a ground-breaking initiative aimed at transforming the landscape of energy consumption and trading. This innovative project envisions a future where individuals actively engage in sustainable energy practices through a decentralized and user-centric P2P DApp built on the Ethereum blockchain, SolarPro is poised to revolutionize energy management by eliminating intermediaries, fostering transparency, and empowering users to directly trade energy assets.

At its core, SolarPro leverages innovative energy tokenization to ensure secure and efficient energy trading. The integration of advanced energy efficiency analytics, real-time price charts, and Internet of Things (IoT) control within smart homes further enhances the platform's capabilities. Notably, the project employs Automated Market Makers (AMM) for fair pricing mechanisms, promoting equity and efficiency in energy trading without the need of a centralised party. SolarPro goes beyond being a mere trading platform; it serves as a community hub for social interactions, information sharing, and advocacy for sustainable energy practices.

Distinguished by its forward-thinking approach, SolarPro sets itself apart from existing applications in two key ways. Firstly, our platform implements a fair pricing mechanism through an AMM, departing from traditional double auction-based approaches[1]. This innovative feature ensures transparency and efficiency in energy pricing, providing users with a reliable and dynamic market experience. Secondly, our platform boasts high scalability by creating multiple liquidity pools across different regions. This strategic design allows for seamless and widespread energy trading, accommodating a growing user base and distinguishing our platform as a leader in the realm of decentralized energy exchange.

In summary, SolarPro is not just a DApp; it is a vision for the future of energy trading—one that embraces decentralization, transparency, and sustainability. The project's pioneering spirit, coupled with its cutting-edge technologies, positions SolarPro as a transformative force in the evolving energy market.

3 Requirements Gathering

3.1 Primary Findings

In our project, we have opted for an innovative approach to requirements gathering, primarily leveraging research articles. Recognizing the importance of staying informed about the latest advancements and insights in the energy trading domain, we conduct extensive reviews of relevant research articles. This technique allows us to extract valuable information on emerging technologies, industry best practices, and novel approaches to P2P energy trading.

In the context of the rising demand for a P2P energy trading app, several key findings have emerged. Firstly, there is a prioritization of renewable energy, indicating a strong emphasis on facilitating the trading of energy generated from renewable sources[2][4]. This aligns with the increasing global focus on sustainable energy practices and the growing adoption of renewable energy technologies[4]. Secondly, the importance for consumers to know the source of their energy has been highlighted[4]. This reflects a significant consumer preference for transparency and accountability in energy sourcing, particularly in the context of renewable energy[4]. Finally, the rising cost of energy has underscored the need for more efficient and cost-effective energy trading solutions[3]. As energy costs continue to increase, there is a growing demand for platforms that enable consumers to engage in direct energy trading to potentially mitigate the impact of rising energy prices[3].

In the context of technologies adopted, [5] highlights the transformative potential of blockchain technology in P2P energy trading, emphasizing its role in enhancing security, transparency, and decentralization. Another emerging technology was also suggested which is the integration of sophisticated Artificial Intelligence (AI)-driven control mechanisms and adaptive learning algorithms emerges as a pivotal aspect for elevating the efficiency, security, and economic viability of P2P energy systems. These mechanisms facilitate real-time adjustments in energy outputs and parameters, promising optimized security performance and economic operations. The research signals a shift towards more responsive and dynamic energy systems, particularly in renewable energy-rich and resource-limited settings, underscoring the move towards model-free, adaptive management systems driven by AI innovations.

3.2 Application Core Features

A further analysis is conducted on existing energy trading solutions in the market to determine the core features of the applications.

Platforms	Key Features
Piclo	Facilitates consumer-prosumer connections based on location and preferences. Provides data visualizations and transparency for users. Balances electricity generation peaks and valleys. Manages contracts and billing.
Transactive Grid	Integrates computers with solar panels for accurate energy measurement. Utilizes blockchain for secure and transparent transactions. Constantly updates a shared transaction ledger to prevent fraud.
SolShare	Allows clients to install mini-grids for local energy trading. Enables prosumers with solar panels to share excess energy. Manages energy flows using bidirectional metering.
Lumenaza	Saas platform supporting energy trading on local, regional, and national levels. Visualizes energy flows, controls demand and supply. Offers a product catalog for users to choose diverse energy products.
Vandebron	Facilitates direct electricity trading between consumers and prosumers. Provides prosumers with power generation forecasting data. Operates on a subscription model with a $12 monthly fee.

Table 3.2.1: Key Features Of Existing Energy Trading Platforms

In the development of SolarPro, we aim to incorporate key features inspired by successful industry leaders. Drawing inspiration from Piclo, our app will prioritize the facilitation of consumer-prosumer connections, allowing users to seamlessly connect based on location and preferences. We recognize the importance of data visualization and transparency, a characteristic prominent in Piclo's offerings, and will integrate these elements to empower users with insights into their energy usage.

Taking cues from Transactive Grid, we understand the significance of accurate energy measurement. Therefore, our platform will integrate smart meters with solar panels to ensure precise and reliable data on energy production. Embracing blockchain technology, similar to Transactive Grid, will be a cornerstone of our app, fostering secure and transparent transactions while mitigating the need for intermediaries, aligning with the principles of decentralization.

Inspired by Lumenaza's success, our app will support energy trading on multiple levels—local, regional, and national. To enhance user experience and decision-making, we will implement features to visualize energy flows and provide controls over demand and supply, much like Lumenaza's functionality.

In summary, SolarPro seeks to combine the best features from industry leaders, fostering seamless consumer-prosumer connections, data transparency, precise energy measurement, blockchain security, and the scalability of a SaaS platform.

3.3 Personas

Based on the research findings, 5 personas for SolarPro have been created that illustrates the different types of potential users of the app. (Appendix 9.1)

- **Green enthusiast :** an environmentally conscious individual who prioritizes sustainability in lifestyle choices.
- **Budget-conscious** : a cost-conscious individual aims to optimize energy costs through surplus energy trading.
- **Tech-savvy** : an early tech adopter and entrepreneur enthusiastic about innovative energy trading solutions.
- **Local prosumer** : a renewable energy producer with solar panels on their property
- **Community leader**: a community leader and advocate for decentralized practices within my local community.

These personas represent diverse potential users for SolarPro, each with unique needs, preferences, and motivations.

3.4 Estimation Of User Stories

User stories are created based on the five main personas for the application. The platform is designed to cater to a diverse range of users, emphasizing community collaboration and sustainable energy practices. Through user stories, it becomes evident that the platform will serve individuals who prioritize sustainability, seek cost-efficient energy solutions, embrace technology, and value self-sufficiency in rural living. The focus on information sharing among communities is apparent, with features supporting transparent data visualizations and fostering connections between prosumers and consumers. Energy trading is a key element,

facilitating the exchange of surplus energy among users, with real-time updates on token pricing through AMM mechanism, whether they are eco-conscious individuals, budget-focused users, or tech-savvy entrepreneurs. Furthermore, SolarPro's commitment to data analytics ensures comprehensive insights into energy production, sources, and consumption patterns, enabling informed decision-making for users across various demographics and lifestyles. The emphasis on community, trading, and analytics positions the platform as a holistic solution for sustainable and collaborative energy practices.

4 Analysis And Design

4.1 Entity-Relationship Analysis

From the requirement gatherings from different research articles and existing solutions, we have gathered five main core features for the initial development of the application.

1. User can tokenise energy produced locally through smart meter
2. User can trade energy from different locations
3. User can receive real-time token pricing
4. User can track energy usage and sources as well as any relevant data analytics
5. User can contribute ideas and socialise among local communities

An Entity-Relationship Diagram (ERD) is illustrated to showcase the relationships between each entity in the system. Due to the decentralised nature of the application, not all data can be stored on the blockchain as all data transacted on blockchain needs to go through consensus from all nodes. To ensure smooth user experience, data captured from the frontend are separated into two storages. Trade transactions are processed on Ethereum to ensure no centralised entity is required to monitor the trading activities whereas other data like energy consumption and production as well as published threads are stored off-chain to avoid congestion in the system.

The diagram below covered the core functions listed above. Firstly, users connect to the platform through user's wallets. Each user should have a smart meter installed on their local appliances including solar panels to monitor the energy movement. For local prosumers, energy produced from the solar panels will be captured through the smart meter and can be minted into energy tokens based on user's region. The transaction will be written on Ethereum public ledger waiting for approval from other nodes. The token balance will be updated on user's wallet address.

For local consumers, energy consumption data will be captured through the smart meter and stored off-chain. This data can be published as a thread on the community forum, where users can discuss and share information related to energy consumption and production. Each thread is associated with a specific community forum, which in turn is associated with a particular region.

The energy consumption and production data, as well as the published threads, can be viewed and analysed in various ways. For example, the total energy consumed and produced in a particular region can be calculated, and the energy consumption and production trends can be analysed.

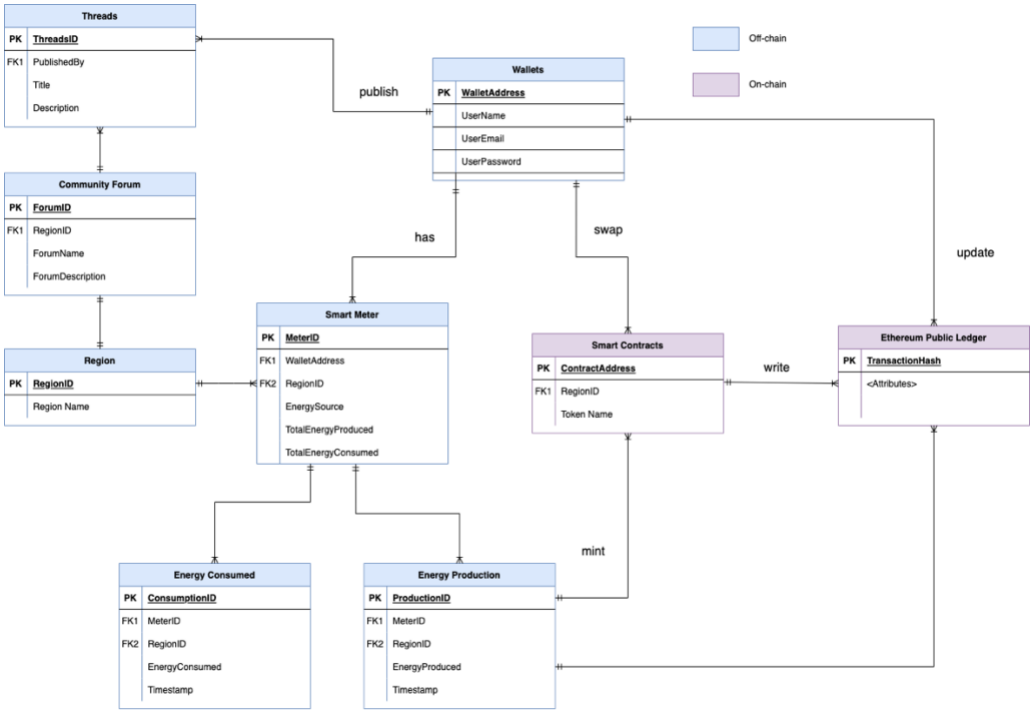


Figure 4.1.1: Entity-Relationship Diagram

4.2 System Architecture

For this project, we have chosen Thirdweb as the main infrastructure for building the web3.0 application. Thirdweb offers powerful SDKs, audited smart contracts, and developer tools for Ethereum and over 700 EVM chains, aiming to simplify web3 app development. SolarPro is a blockchain-based platform that utilizes the Ethereum blockchain network for trading activities. This architecture incorporates a robust combination of layers and components that work together seamlessly to provide a unique Web3.0 experience for users.

The frontend of the system is built using popular frameworks which are React and Next.js, providing a responsive and user-friendly interface. We want to take advantage of the server-side rendering capabilities of Next.js and the component-based architecture of React to build a fast, user-friendly web. The frontend communicates with the backend through Remote Procedure Call (RPC) protocol, enabling seamless data transfer between the two layers.

The core of the system is built on Ethereum and Polygon blockchains, which offer the infrastructure for deploying and executing smart contracts. Ethereum serves as the primary blockchain for deploying smart contracts, while polygon provides layer 2 scaling, enabling faster and cheaper transactions. The system uses several smart contracts, including AMM contracts and token contracts namely LDN, EST, NTH, STH, and WST, to provide decentralized exchange functionality. These smart contracts are audited and provided by Thirdweb, ensuring their security and reliability.

Interplanetary File System(IPFS) is utilized for decentralized storage of files and data, enabling users to access and share data without relying on centralized servers. It is used to capture the off-chain data from activities outside energy trading on the platform. This technology is used to ensure data integrity and immutability on the platform without sacrificing user's experience. Message Queuing Telemetry Transport (MQTT) is employed for decentralized messaging and data transfer, enabling real-time communication between

different components of the system from the smart meters to enable the platform receives data captured from the devices.

SolarPro uses Thirdweb as the service provider to access Ethereum's network of nodes without the need to maintain one. Thirdweb's Application Programming Interface (API) is used to interact with the Ethereum blockchain, making it easier to deploy smart contracts, execute transactions, and fetch data from the blockchain. It handles all the backend operations, ensuring SolarPro remains decentralized and scalable. Non-custodial wallets including MetaMask and WalletConnect, are supported to enable users to manage their digital assets and interact with the system. As the data from trading activities are stored on-chain, The Graph is used to query data from Ethereum for further data analysis on user's activities. This allows the platform to generate data visualization on not just user's energy usage but also token trades.

Overall, the system architecture is designed to provide a seamless and secure Web3.0 experience for users, enabling them to interact with decentralized applications, exchange digital assets, and participate in decentralized governance. The use of Thirdweb's SDKs, audited smart contracts, and developer tools simplifies the development process, enabling us to build and deploy Web3.0 applications faster and more efficiently.

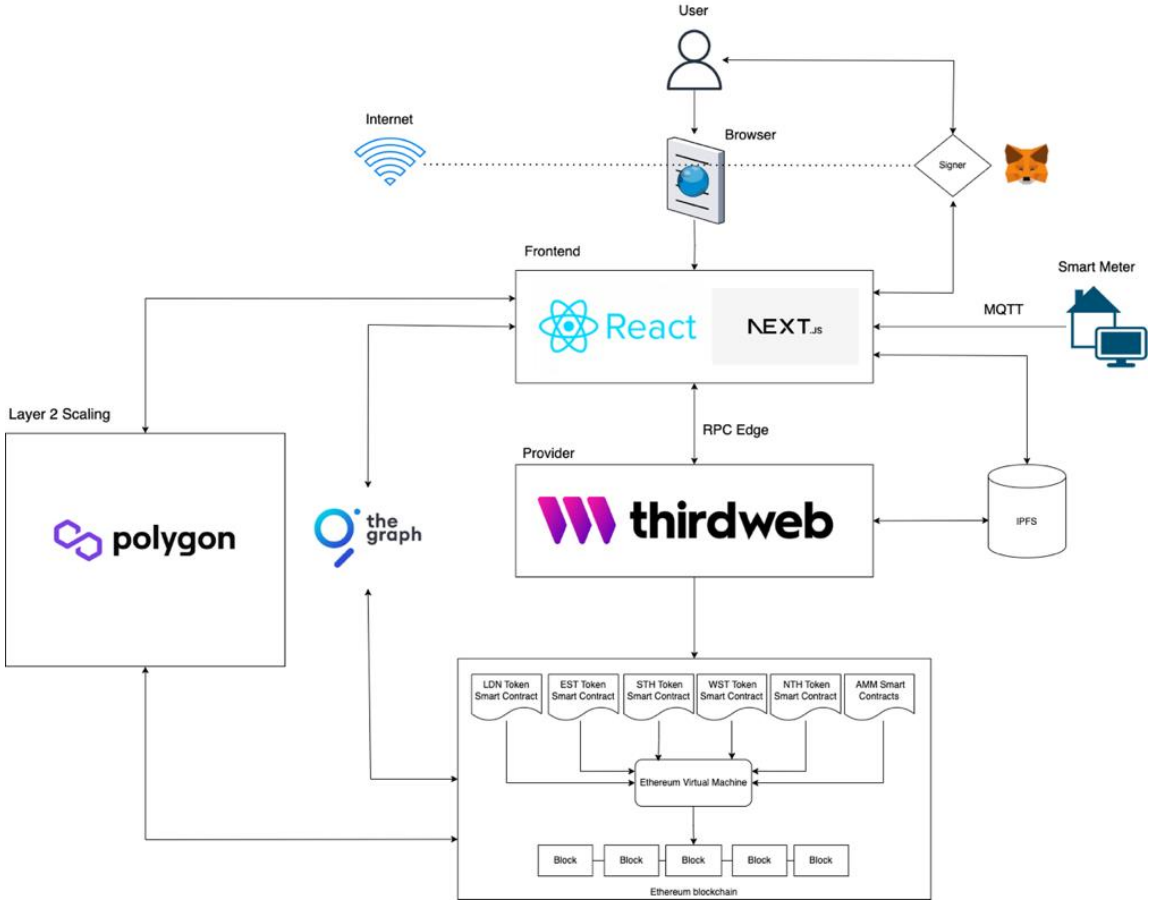


Figure 4.2.1: System Architecture Diagram

5 Prototype

5.1 Acceptance Criteria

Task ID	User	User Stories	Acceptance Criteria
1.1	Green Enthusiast	I want to easily connect my smart meter to the platform to monitor and analyse my energy consumption and production	Button to connect to smart meters
1.2		I want to participate in discussions on the community forum to share and gain insights into sustainable energy practices.	Publish threads on community forum
1.3			View threads on community forum
2.1	Budget-Conscious	I want to trade energy with local prosumers to optimize my energy costs	Purchase solar tokens (platform's token) with fiat currency
2.2			Swap energy tokens with solar tokens purchased
2.3		I want to view detailed analytics of my energy usage and expenses to identify areas for cost savings.	View charts of monthly energy consumption for each house appliance
3.1	Tech-Savvy	I want to seamlessly connect my wallet, such as MetaMask, to the platform for secure and convenient transactions.	Connect wallet to the platform
4.1	Local Prosumer	I want to mint energy tokens based on the energy produced by my solar panels and trade them with other users	Mint energy tokens from energy produced(kwh)
4.2			Add energy tokens to liquidity pool within the region
4.3			Exchange solar tokens into fiat currency
5.1	Community Leader	I want to monitor the overall energy trends and activities within my community for advocacy and planning.	View energy charts published by other users on community forum
5.2			Publish energy charts pn community forum

Table 5.1 Acceptance Criteria

5.2 Low Fidelity Prototype

Figma was used to design our low fidelity prototype, the core features of the application were outlined on the prototype. There are a total of five tabs on the application on the bottom navigation bar, a user profile on the top left corner and a search bar on top of the application. The application was intended to be built on mobile which is why a mobile UI at the stage of designing the low fidelity prototype. However, we have switched to web application due to technical issues within React Native script during implementation stage which will be further explained in project management section.

Based on Task 1.1, this is the launching page of the application of a new user. New users need to connect to existing non-custodial wallets to access the application.

Users are then directed to sign up an account on the app.

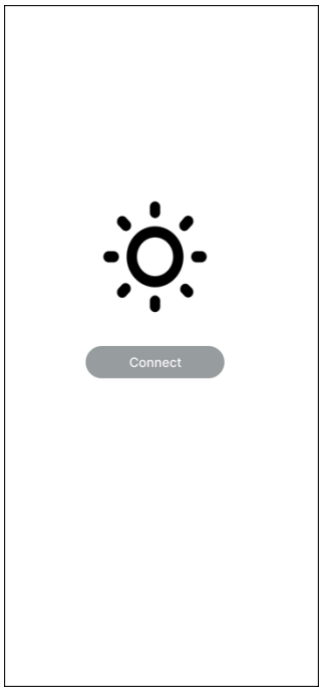
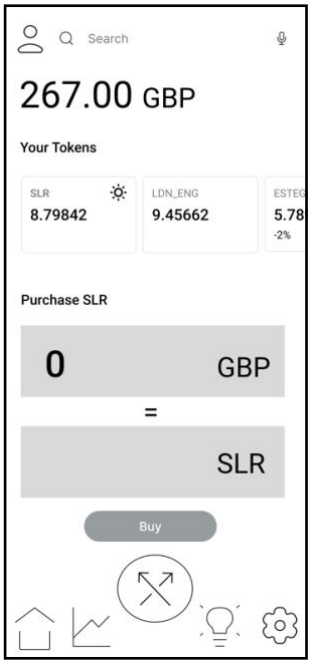
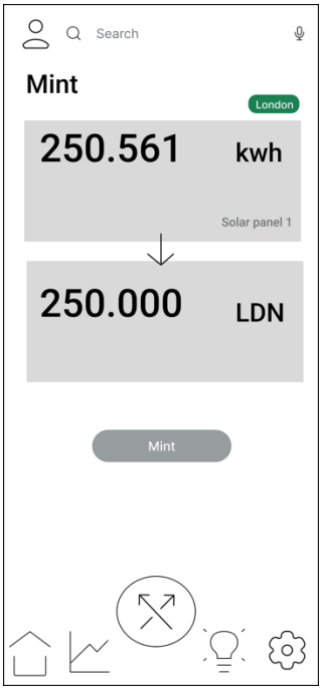


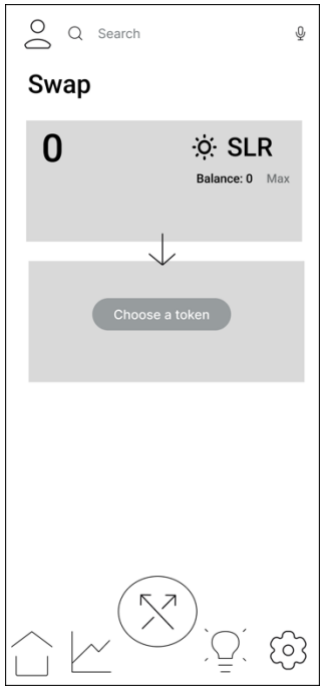
Figure 5.2.1 Launch Screen **Figure 5.2.2 Create Account**



The home screen shows the total value in fiat currency of user's tokens in the wallet. It also shows the balance of each token on the platform. Users can purchase Solar Token (SLR), our ecosystem's currency with fiat currency on the home screen which is one of the requirements listed in the user stories — Task 2.1.

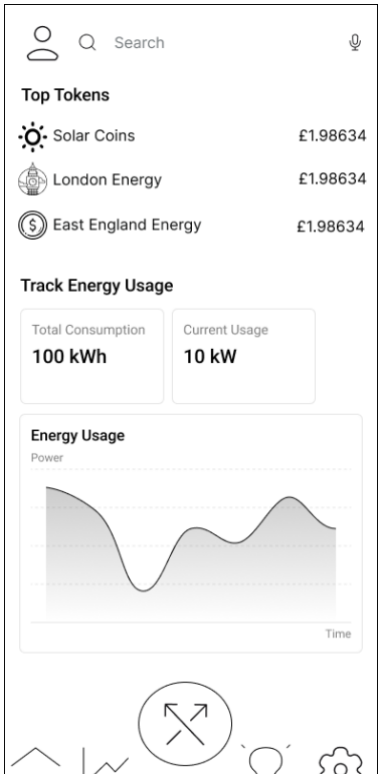
Figure 5.2.3
Home Screen





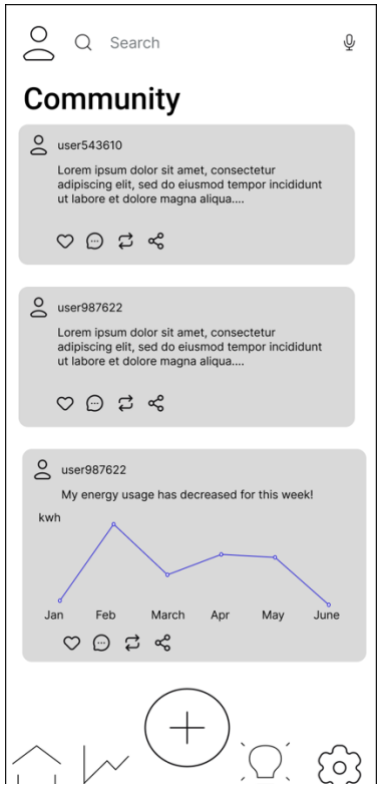
Task 4.1 and 2.2 are illustrated on both mint screen and swap screen where prosumers can mint energy produced from local solar panels into energy tokens based on user's region while consumers can swap SLR with any chosen regional energy tokens.

Figure 5.2.4 Mint Screen **Figure 5.2.5 Swap Screen**



The analytics screen illustrates the pricing data of the tokens where users can check on real-time to make informed trading decisions on the platform. Users can also monitor energy consumption on the application which fulfils Task 2.3

Figure 5.2.5 Analytics Screen



Task 1.2, 1.3, 5.1 and 5.2 are illustrated on the community screen where users can publish and view threads within the community. They can also view and publish energy charts from analytics screen

Figure 5.2.6 Community Screen

6 Implementation and testing

6.1 Low fidelity prototype testing

During the low-fidelity prototype testing phase, the UI was evaluated by five users in London who manage utility bills. Positive feedback was received for the community screen, emphasizing the collaborative and informative aspects of the community forum. Two users expressed a desire for more extensive analytics and detailed charts, aligning with the platform's Task 2.3 for providing comprehensive insights into energy usage and expenses. Despite the need for more analytics, users responded positively to functions such as wallet connection, token trading, and energy minting, finding them innovative.

6.2 High Fidelity Prototype

The high-fidelity prototype of SolarPro builds upon the lessons learned from the low-fidelity prototype testing, aiming to deliver an elevated and sophisticated user experience. The implementation for SolarPro was organized into three main components which are further documented in 6.2.1, 6.2.2 and 6.2.3 each contributing to the overall functionality and proof of concept.

6.2.1 User Interface Design

The redesigned interface features a futuristic and dark-themed UI, enhancing visual appeal and aligning with modern design aesthetics. One of the key improvements in response to user feedback is the redesigned analytics screen, addressing the demand for more extensive analytics and charts. The analytics screen is now split into two pages, providing users with a focused and in-depth view of token pricing data and energy analytics. This modification caters to users' desires for comprehensive insights into energy usage and expenses, offering a more refined and user-centric data visualization experience.

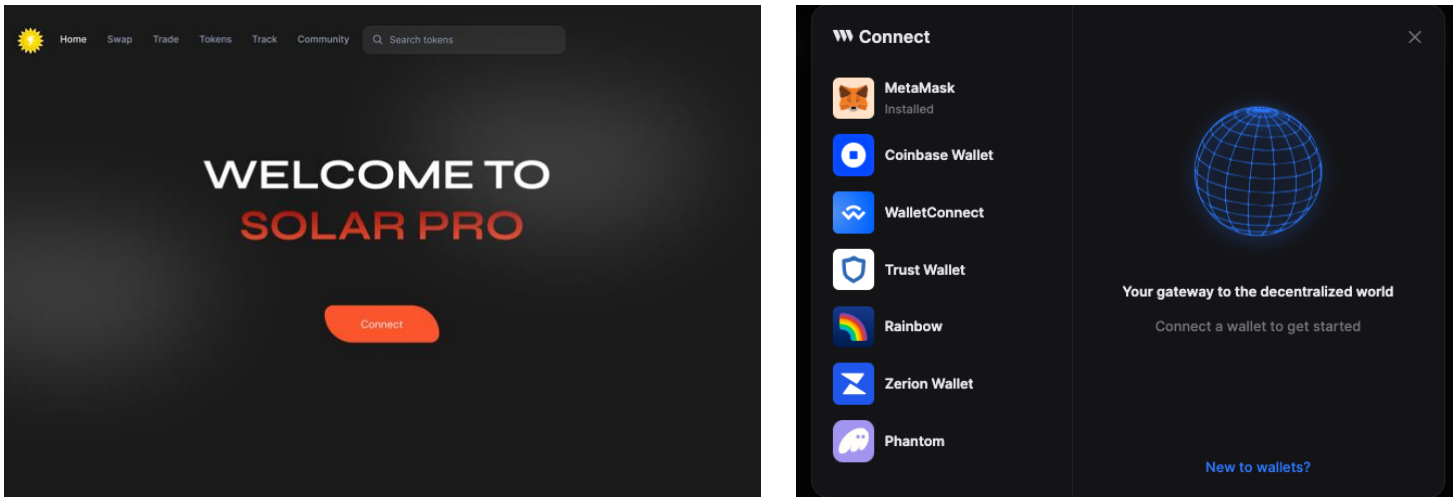


Figure 6.2.1 Launch Screen

The launch screen introduces the platform as SolarPro, emphasizing its commitment to renewable energy. New users are directed to connect their crypto wallet to the platform, with multiple wallet options supported through Thirdweb's wallet connection button.

We have made some changes from the low fidelity prototype on the home screen where users are prompted to mint energy produced instead of purchasing SLR. This is because we have moved the purchase function to an additional screen which is as shown in Figure 6.2.3.

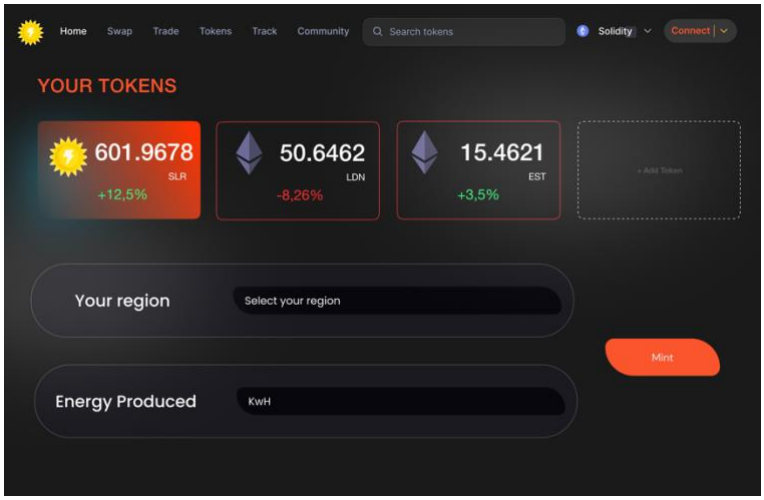
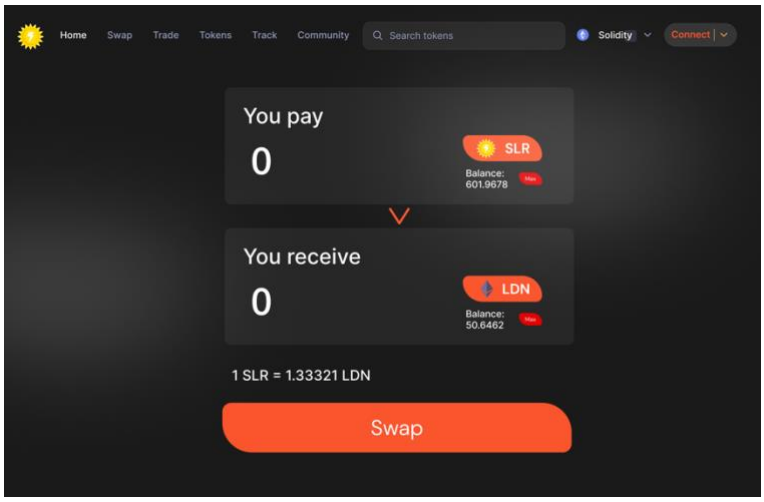


Figure 6.2.2 Home Screen



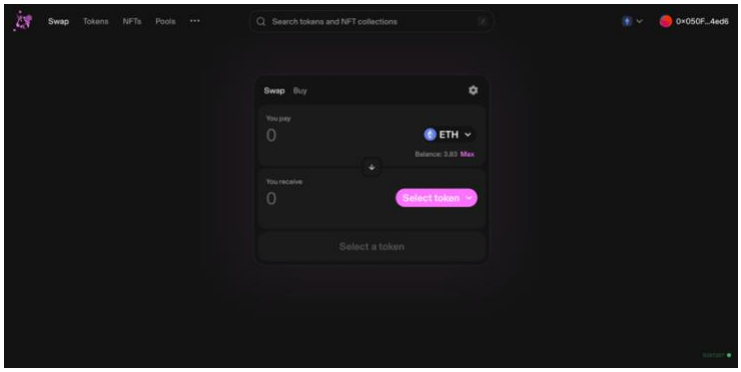


Figure 6.2.3 Swap Screen

When user click on "Swap" on the navigation bar, they will be directed to swap screen as shown on Figure 6.2.3. The design of the application is inspired from Uniswap v3 UI design (Figure 6.2.4) where we aim to be as straightforward and user-friendly as possible.

We realised we did not include the sell function in our low fidelity prototype which will greatly reduce the feasibility and value of our platform if users are unable to exchange SLR into fiat currency. Hence the sell function is included in the latest prototype where users are free to purchase and sell the SLR which makes our exchange platform more feasible.

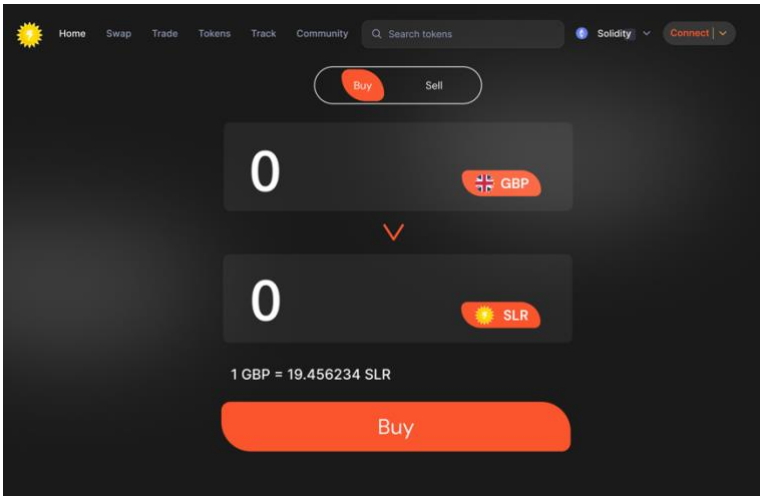
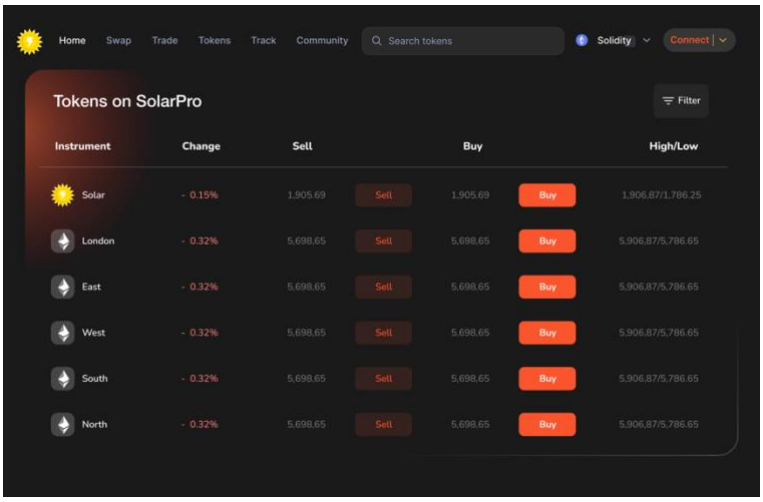


Figure 6.2.5 Trade Screen



The tokens screen shows all the ERC20 tokens on SolarPro where users can view the real-time trade price of each token. There are also sell and buy buttons added on the screen to make trading activities more convenient for users. When users click on either button, they will be directed to trade screen as shown in Figure 6.2.5. A filter button is also added to allow users to filter and sort tokens.

Figure 6.2.6 Token Screen

Compared to low fidelity prototype, we have added a new screen in our high fidelity prototype where this page is dedicated to providing data visualisation on user's personalised energy analytics. Users can track various metrics from the screen. We have also added power control on the platform where users can not only track energy usage of each local appliance but also turn on/off the appliance. We think this is a very high value feature as users who use our platforms are transitioning into a smart home model.

Figure 6.2.7 Track Screen

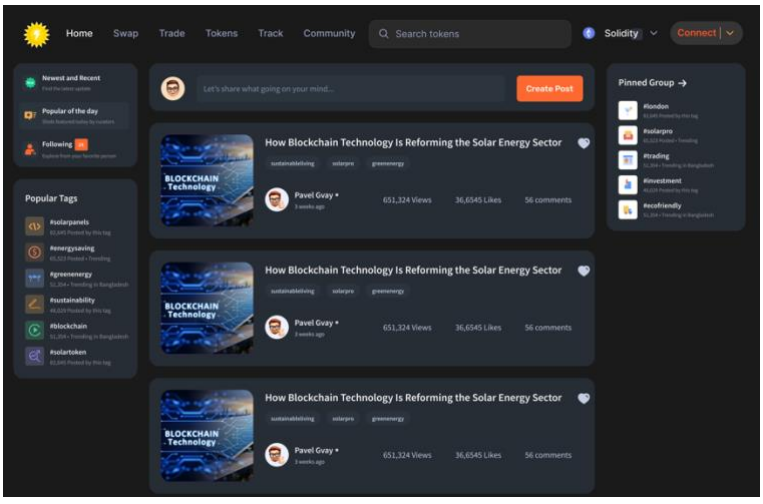


Figure 6.2.8 Community Screen

Lastly, we have enhanced the community screen as this was the most favourited section from the low fidelity testing. We have added some features that made the screen more like a social media platform rather than just a forum. From the left, there are shortcut buttons that directs users to the latest content on the platform as well as allowing users to follow each other where they can check their following's postings. The second section on the left allows users to directly explore popular content through tags. The middle section of the screen act as a feed page where users can view all type of postings by other users. Users can click into the post and interact with the post. The right section is a shortcut for users to access groups within the platform where they can form public group chats on preferred topics. The design of this screen only extended on the feed page without going into the details functions listed above. This is because we want to show users the functions on high level first without spending too much time on designing the details page.

6.2.2 Features and Logic

SolarPro introduces a novel approach to establish a decentralized trading platform by tokenizing energy units, employing multiple Liquidity Pools (LPs) to facilitate the exchange of SLR. The platform covers regions designated as London, East, South, North, and West within the UK. The smart contracts designed for Energy Tokens across all regions incorporate functionality to retrieve energy data from smart meters. Users can seamlessly initiate the token minting process by clicking the "mint" button, triggering an automatic generation of tokens corresponding to the energy produced. The initial conversion rate for this calculation is set at 1 token per 1 kilowatt-hour (kWh), establishing a straightforward and transparent valuation mechanism.

In parallel, the SLR contract is structured with an initial token supply of 1000 units. This supply serves to facilitate the swapping process between LDN and SLR. While the platform envisions real-world users acquiring SLR through fiat currency transactions, the exchange rate will dynamically respond to the market supply and demand within the LP. Furthermore, an AMM contract is specifically created for the LP established between LDN and SLR. This contract empowers users to seamlessly swap between these tokens, providing liquidity and fostering an efficient market for energy trading.

6.2.3 Integration of Smart Contracts with Frontend

With time constraints in mind, the third component concentrated on integrating the developed smart contracts with the frontend design. This proof of concept aimed to showcase the fundamental functionalities of the platform. Due to limited time, the integration was focused on essential aspects.

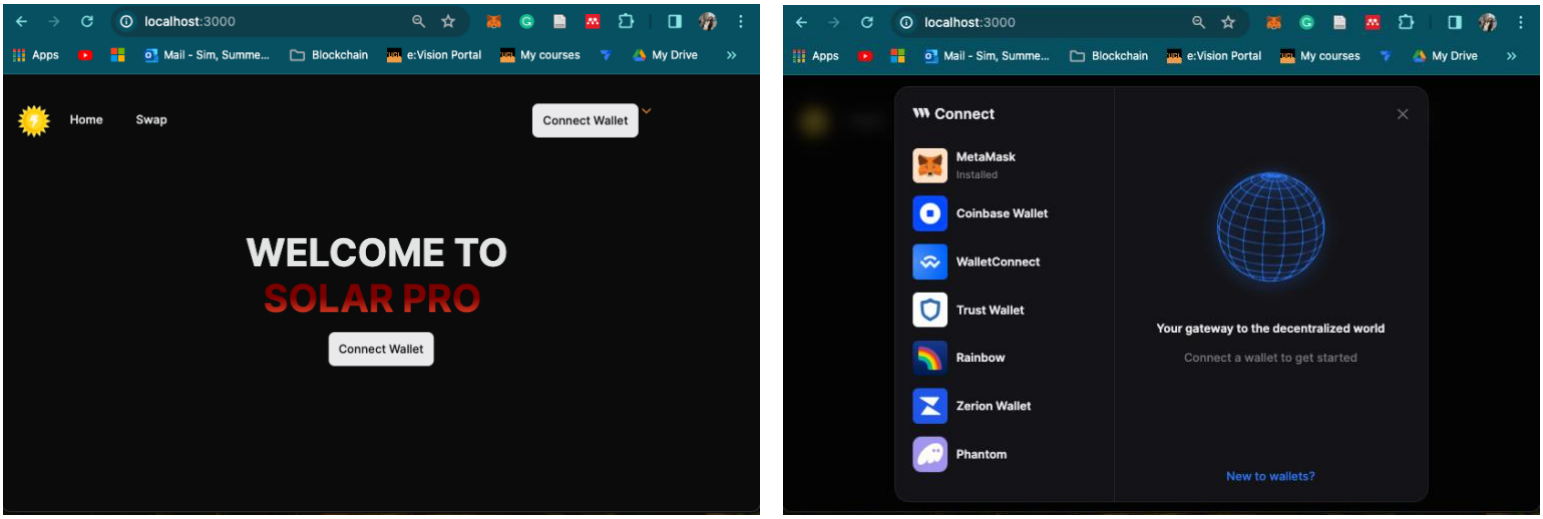
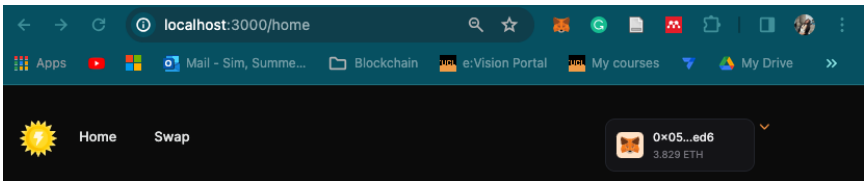


Figure 6.2.3.1 Connect Screen

Users could utilize the Connect button to establish a connection to their non-custodial wallets. This feature enabled seamless interaction with blockchain technology, providing users with secure access to trade on SolarPro. Thirdweb's ConnectWallet component is configured for the Connect function.



When a wallet is connected, the top right corner will show user's wallet address. The navigation bar allows direct users to the selected screen.

Figure 6.2.3.2 Navigation Bar

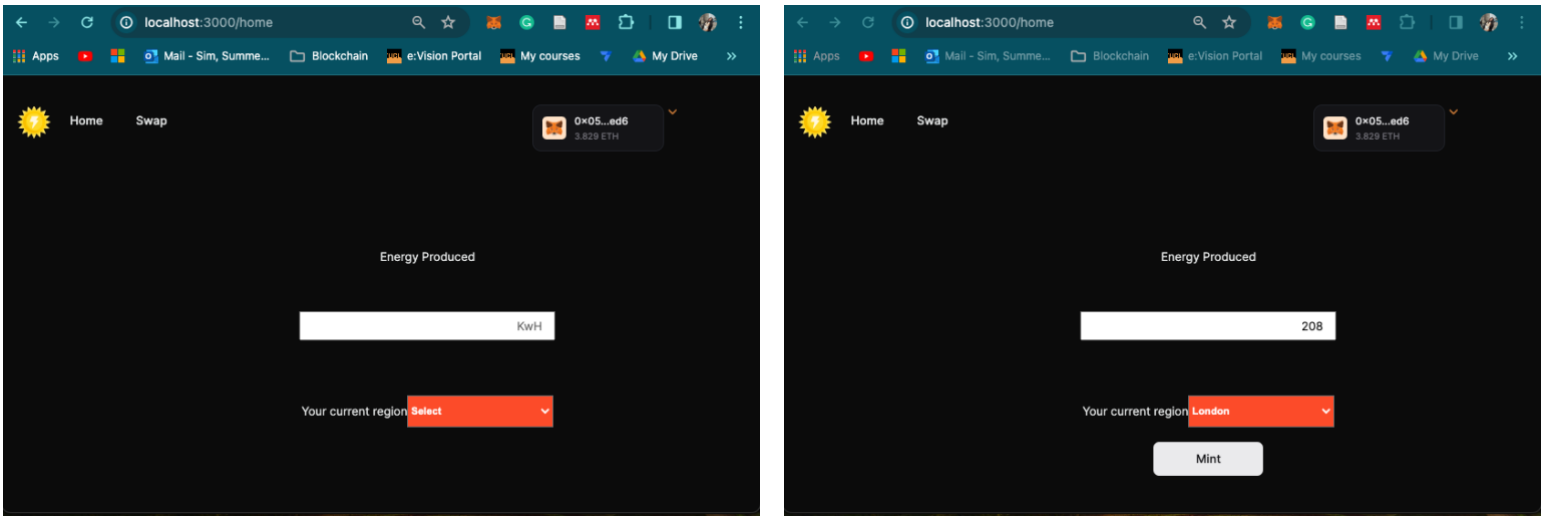


Figure 6.2.3.3 Home Screen

The Home screen features a placeholder for "energy produced," prompting users to manually input the relevant value. In this current stage of development, no integrated smart meters are available to connect with the frontend. Additionally, users are required to select their region to mint tokens, and the minted tokens will be based on the chosen region.

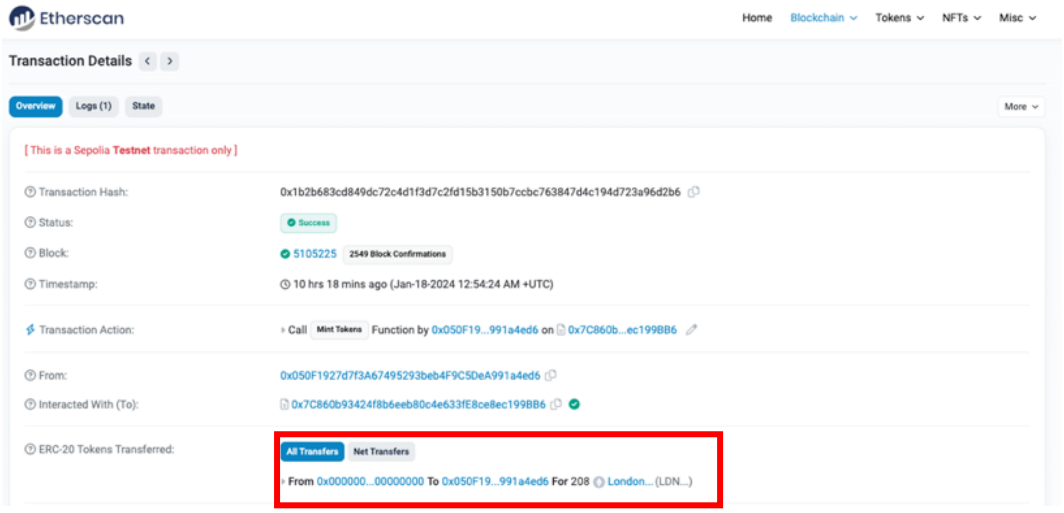


Figure 6.2.3.3 showcase the Mint function executed by users through SolarPro's frontend where 208 of LDN are minted to user's wallet.

Figure 6.2.3.4 Mint transaction on blockchain

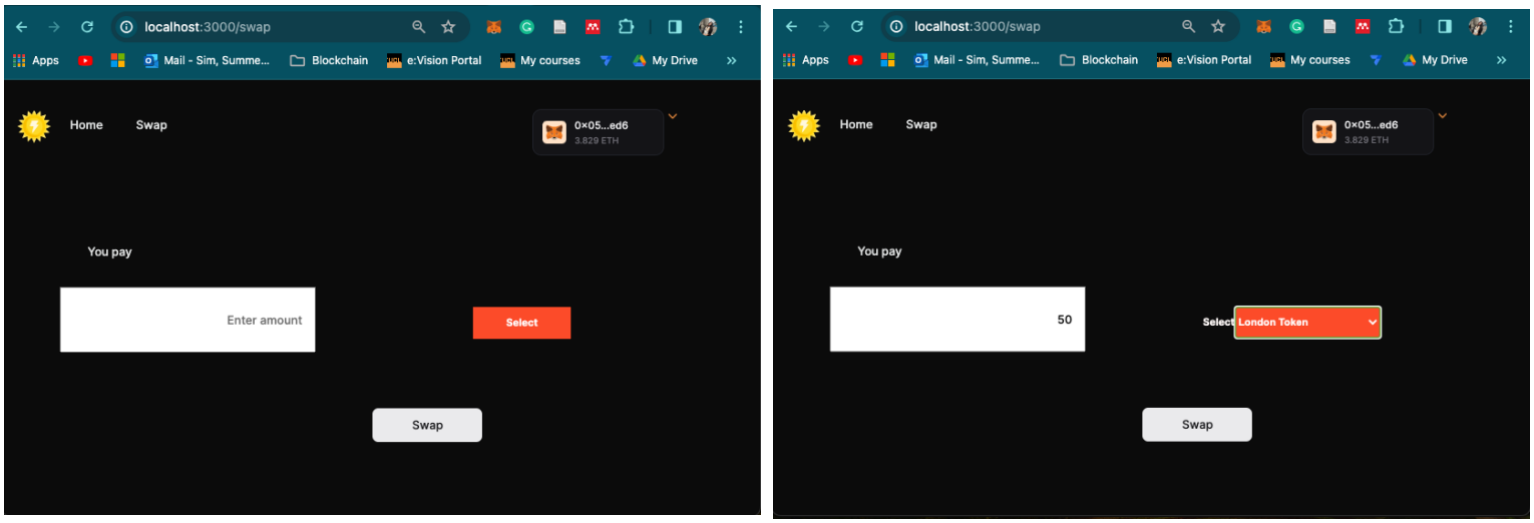


Figure 6.2.3.5 Swap Screen

The Swap screen features a placeholder where user can input the amount of Energy tokens they want to swap with SLR through selecting the tokens and inputting the amount to swap.

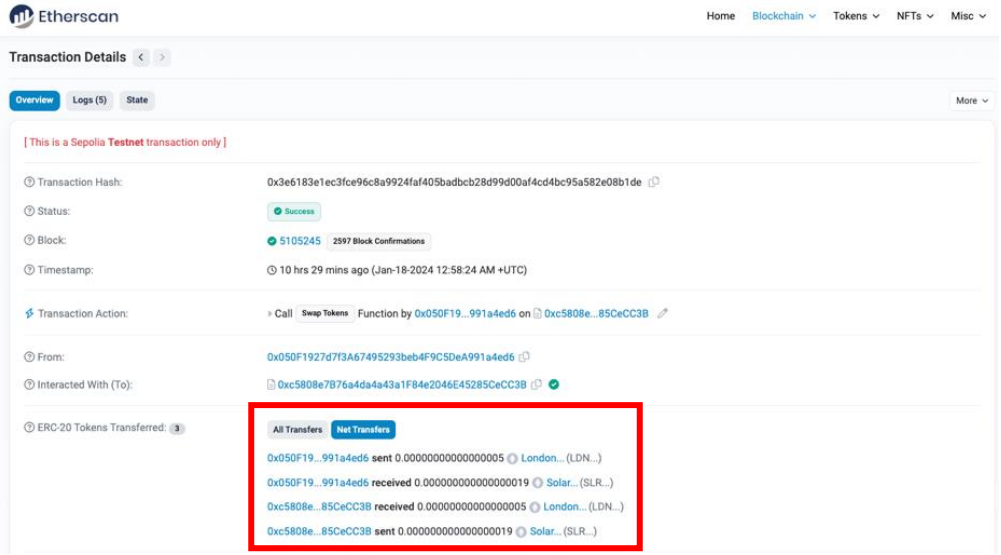


Figure 6.2.3.6 showcase the Swap function executed by users through SolarPro's frontend where 50 LDN are added into the LP and 190 SLR are added into user's wallet. The exchange rate of both tokens are determined by the supply and demand of both tokens within the LP hence no centralised party is required for a fair pricing mechanism.

Figure 6.2.3.6 Swap transaction on blockchain

6.3 High Fidelity Prototype Testing

The high-fidelity prototype of the SolarPro underwent two distinct testing parts. The first part focused on user experience (UX) where five users explored the web application to evaluate the complete UI design. The overall testing results were positive, with users expressing satisfaction with the visually appealing and user-centric design of the interface. The futuristic and dark-themed UI received particular praise, contributing to a positive user experience.

In the second phase, users engaged in a proof-of-concept testing where they explored the functionalities presented in the prototype's functional codes. This included connecting wallets, minting energy, and swapping tokens. All functions are working well where users can interact with their wallet and interact with smart contracts.

Although the prototype had limitations in full functionality, users positively anticipated the upcoming upgraded prototype. They eagerly looked forward to the introduction of more functions and additional pages, recognizing the potential for a more comprehensive and feature-rich energy trading platform in subsequent iterations.

In conclusion, the two-phase testing approach for the high-fidelity prototype proved successful, with positive feedback on both UI design and functionalities. This serves as valuable validation for the design decisions made so far, and users' anticipation underscores their engagement and interest in the continued development of SolarPro with enhanced features and expanded capabilities.

7 Project Management

Our project management approach integrates Agile principles to foster flexibility, collaboration, and iterative progress. Our Agile methodology, combining Scrum and Kanban principles, forms the backbone of our project management strategy. We emphasize planned iterations, regular stakeholder engagement, and visual management of tasks to ensure a dynamic and adaptable development process.

7.1 Agile Tools for Task Management

In our Agile project management approach, we employ key tools to enhance task management, with a focus on the Product Backlog. Trello serves as the primary platform for backlog management, user story creation, and task progress tracking during sprints. It provides a visual representation of tasks, aiding in organization and prioritization. GitHub Projects seamlessly integrates version control and project management, allowing for Kanban boards directly linked to repositories, ensuring alignment between code changes and tasks. Locofy acts as a synchronization tool for real-time collaboration in the JavaScript codebase, minimizing conflicts and promoting efficiency. The incorporation of these Agile tools demonstrates our commitment to a collaborative and flexible development process, ensuring synchronized code and a streamlined workflow for effective task management. The integration of version control, branching strategies, and continuous integration through GitHub showcases our dedication to delivering a high-quality energy trading platform.

7.2 Planning and Outcomes

The SolarPro project embraced an agile project management approach, emphasizing planned iterations and flexible outcomes. Our initial roadmap focused on the development of a mobile application, and we meticulously crafted low-fidelity and high-fidelity prototypes for the mobile UI. The intention was to iterate through these prototypes, gradually refining the design based on user feedback.

However, as we transitioned to the implementation stage, we encountered formidable challenges with React Native packages, preventing the successful deployment of the app on Expo Go. The inability to visualize our codebase hindered progress significantly. Despite persistent efforts to debug and troubleshoot the issues, we reached an impasse. In the spirit of agile principles, we swiftly pivoted our strategy and explored the possibility of a web application.

Turning to web development, we experimented with a template downloaded on Figma, which ran seamlessly using the Next.js and TypeScript framework on a local server. Recognizing the viability of this alternative, we decided to shift our focus to building a high-fidelity prototype based on the previously designed low-fidelity mobile UI. This strategic shift allowed us to leverage the existing design and expedite the development process.

Although this decision led to a sacrifice in the depth of functionalities, we prioritized the importance of visualization for end-users. The belief that users are more inclined to engage with a visually appealing interface guided our decision-making. Despite the deviation from the original plan, we managed to implement three crucial functions: connecting wallets, minting tokens, and swapping tokens. These functionalities served as a proof of concept, showcasing the platform's capability for users to interact and execute smart contracts seamlessly.

In essence, the agile principles of adaptability and swift decision-making played a pivotal role in steering SolarPro through unforeseen challenges, allowing us to maintain momentum and deliver a functional proof of concept within the dynamic landscape of our development journey.

8 Next Iterations

8.1 Future Features And Priorities

In the upcoming iteration of SolarPro, the primary objectives revolve around elevating the platform through essential functionality completion, refining the UI design, and integrating advanced features such as AI for Energy Optimization and Forecasting.

Functionalities Enhancement

Functionality enhancements will encompass finalizing core features for seamless energy trading, minting energy tokens, and community participation. The Power Control feature will be expanded to enable users not only to monitor energy usage but also to remotely control and optimize connected devices..

UI Design Refinement

UI design refinement will focus on developing detailed screens for each application section, ensuring a comprehensive and visually appealing user experience. The mobile application, addressing technical issues from the initial attempt, will be completed to cater to users who prefer a mobile platform. Responsive design across devices is prioritized for a consistent experience on desktop and mobile.

AI Integration for Energy Optimization and Forecasting

The integration of AI-driven mechanisms for real-time energy optimization and forecasting is a key highlight. AI algorithms will dynamically adjust energy outputs based on user preferences, increasing efficiency and cost-effectiveness. Forecasting energy consumption patterns empowers users with predictive analytics for informed decision-making in energy trading and consumption.

8.2 Future Roadmap

Looking ahead, the future roadmap involves incorporating user suggestions, prioritizing features based on user needs and industry trends, and staying updated on blockchain innovations. The iterative development approach ensures adaptability to evolving requirements, culminating in a SolarPro Energy Trading Platform that is functionally comprehensive and offers an enhanced user experience, solidifying its position as an innovative solution in the energy trading domain.

9 Appendix

9.1 Acknowledgement

I acknowledge the use of ChatGPT 3.5 to summarise my initial notes and to proofread my final draft.

9.2 Personas

Personas.pdf

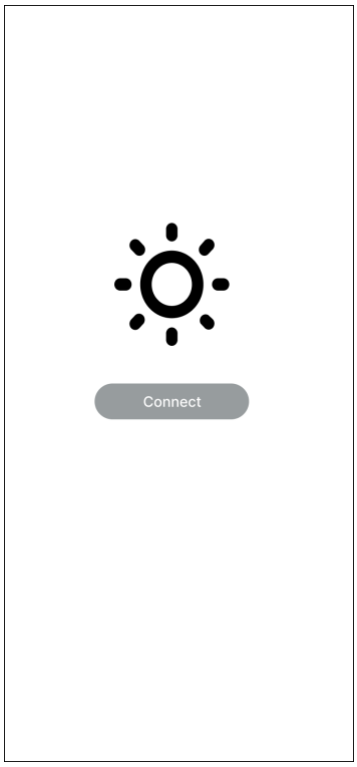
9.3 Product Backlog (Kanban Board)

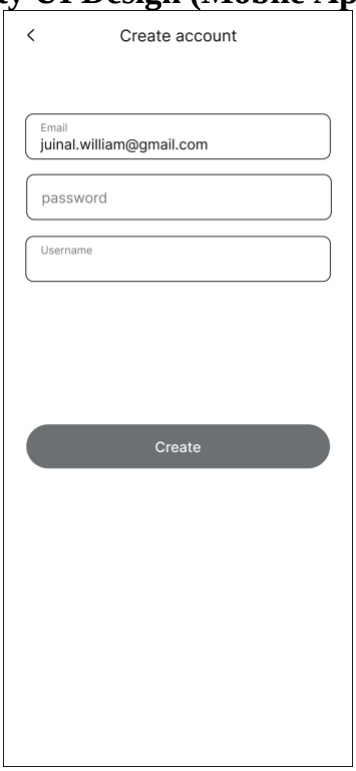
Product Backlog.pdf

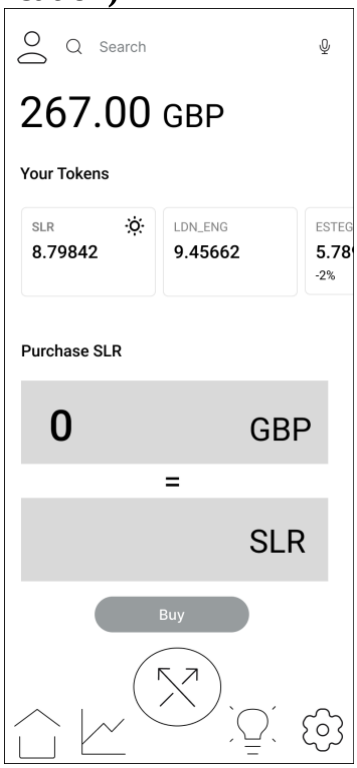
9.4 User Stories

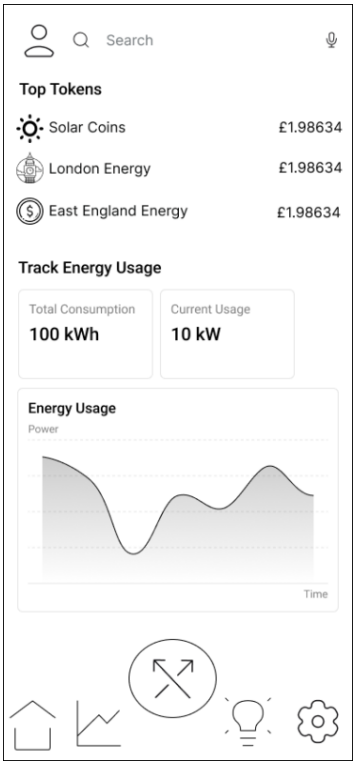
As A/An	I Want To…	So That I Can…
Green Enthusiast	Create an account on the platform	Monitor and analyse my energy consumption and production
	Participate in discussions on the community forum	Share and gain insights into sustainable energy practices
	Receive personalized forecasts of my future energy consumption	Plan and optimize my usage.
Budget-Conscious	Trade surplus energy with other users	Optimize my energy costs
	Receive real-time updates on energy prices and trends	Make informed decisions about trading
	View detailed analytics of my energy usage and expenses	Identify areas for cost savings.
Tech-Savvy	Seamlessly connect my wallet, such as MetaMask, to the platform	Have secure and convenient transactions
	Explore advanced features such as executing custom smart contracts	Explore energy trading strategies
	Leverage data analytics tools	Visualize and analyse energy consumption and production trends.
Local Prosumer	Mint energy tokens based on the energy produced by my solar panels	Trade them with other users.
	Receive notifications when there is demand for energy in my region	Maximize trading opportunities.
	Connect with other prosumers in my community	Collaborate energy initiatives.
Community Leader	Facilitate communication and collaboration within my local community	Organize and host community events or challenges related to sustainable energy practices
	Monitor the overall energy trends and activities within my community	Advocate and plan sustainability activities

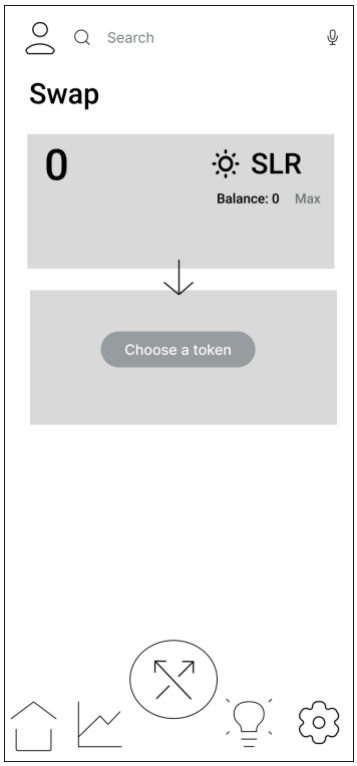
9.5 Low Fidelity UI Design (Mobile Application)

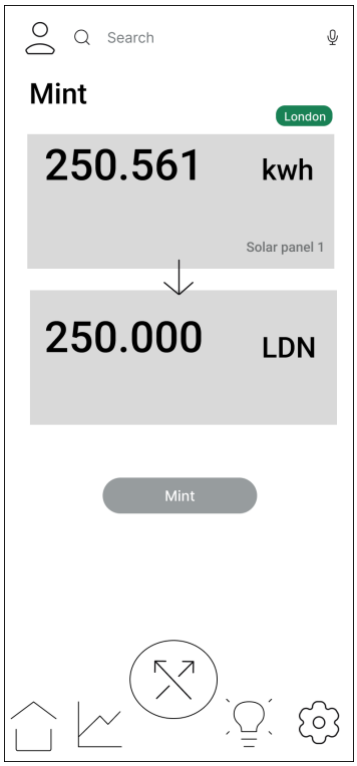


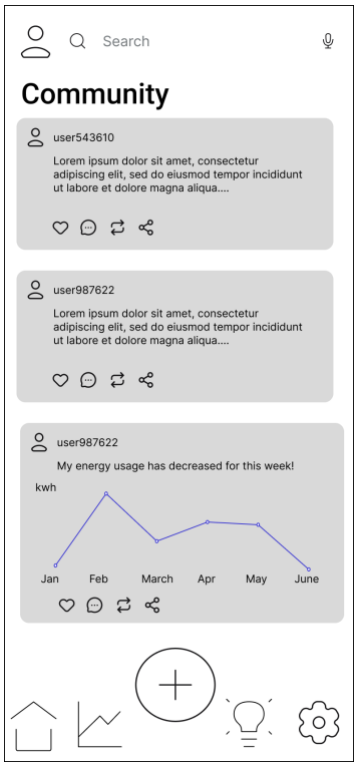




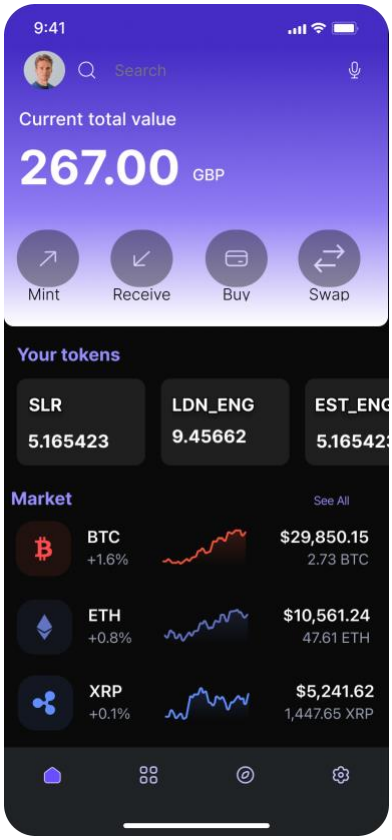


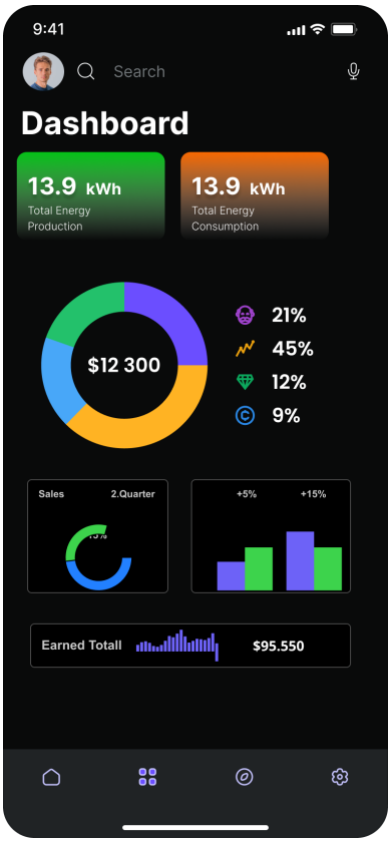


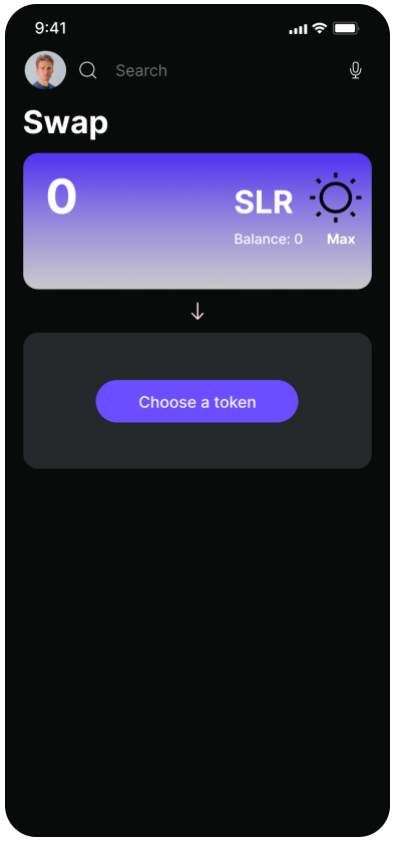




9.6 High Fidelity UI Design (Mobile Application)







9.7 High Fidelity UI Design (Web Application)

https://www.figma.com/proto/LjYtZT7BASLsNHULPsyigJ/SolarPro?type=design&node-id=1964-55&t=7rn8QljbxoH8RJJp-1&scaling=scale-down&page-id=1960%3A6048&starting-point-node-id=1960%3A6049&mode=design

9.8 Smart Contract Addresses

SLR Token	0xD922D67eF6Cb7c330732eAF2Dbc31642C4eEDF26
LDN Token	0x7C860b93424f8b6eeb80c4e633fE8ce8ec199BB6
EST Token	0x0DaB5fcCe5A7af3f241b6f0f864Fad0f6672225C
STH Token	0x2f05494B3d4ABE4BaECD2Ca4b0fB8D079041168F
WST Token	0x48515A0F219A50C231bf5d346d83928745DA2B83
NTH Token	0xAd96CF5f8039A4fd61673c8c139d05A2854A8F53
AMM LP (SLR-LDN)	0xc5808e7B76a4da4a43a1F84e2046E45285CeCC3B

(4929 words)

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