
DESIGN OF USER CENTERED SOLUTION

User Experience Design

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PROBLEM STATEMENT

Modern households face several challenges related to energy consumption, such as rising utility costs, environmental concerns, and the inefficiency of existing systems. Many homeowners are unaware of which appliances consume the most energy, leading to unnecessary expenses. Traditional energy bills provide limited insights, often showing only total consumption without details about specific appliances or time-of-use patterns. If it is possible to monitor and optimize energy usage, we can collectively reduce our carbon footprint. Addressing these issues through a solution provides significant benefits, including cost savings, environmental sustainability, and enhanced convenience.

PART 1: USER RESEARCH

User Research Report

Interview details and interpretations

Role	How did the customer describe the problem?	Quotes	How painful is the problem?	How have they tried to solve the problem so far?
Homeowner	Pays high electricity bills but doesn't know which appliances consume the most power.	"I am fed up of high bills every month and they not sure how to reduce the bill"	High	Looked at energy-saving tips online but found them too generic.
Retired Homeowner	Struggles with understanding energy-efficient appliances.	"I am unable to manage high bills with my pension"	Medium	Relies on past experiences and tries to minimize unnecessary usage.
Tenant	Notices unexpected high bills and suspects certain devices but has no way to confirm.	"I feel there might be issues with the appliances given by owner, as I always get high bills despite of less consumption"	High	Turns off appliances randomly to test their impact but finds it unreliable.
Working Professional	Feels high carbon footprint and environmental degradation	"In the name of convenience, we are using too many appliances which is adversely effecting environment"	Medium	They are buying 5-star power saving guide appliance
Independent Homeowner	Wants to install solar panels but unsure about savings and efficiency.	"Thinking to install solar to reduce electricity charges and save environment by using renewable energy sources but they are also costly for one time installation.	High	Consulted an energy provider but found the investment too costly.

Homeowner	Family forgets to turn off appliances, causing high energy consumption.	"My children never turn off light or fan if they are leaving the room"	High	Uses smart plugs but finds them difficult to manage effectively.
Apartment	Notices high energy use in certain months but cannot pinpoint causes and lacks insights	"I am unable to track which appliance is resulting in hefty electricity bill every month"	High	Switched to energy-efficient appliances but still sees fluctuations.
Apartment Owner	Wants detailed appliance-wise breakdowns to understand energy consumption patterns.	"If I understand appliance wise breakdown and in detailed analysis, I think i can manage my household effectively"	High	Uses smart meter but finds the data hard to interpret.
IT engineer	Might forget to switch on or off appliances as they are in rush to work	"I wish i could see if I had left my fan on or off before leaving to work in hurry few mornings"	Medium	Tried to buy appliance that can be remotely controlled and observed
The Cost-Conscious Family Manager	During peak summer, I try to be more mindful about AC usage since that's when bills can double or even triple.	"If the app tells me that reducing AC usage by one hour every day would save ₹500 monthly, I would definitely make that change."	High	Checks monthly bill via email Has "rough idea" of average consumption Manually adjusts AC usage during summer months Set up auto-payment
Student living alone	Uses multiple modern kitchen devices to quickly finish house works, but has to pay high bills.	"I am unable to manage my house expenses from the pocket money I get from parents"	Low	Cooking more food at once in their induction cook top as they are not which device is consuming more electricity.
Fixed-income budget manager with limited technical skills	The price keeps increasing! What used to cost ₹800 is now ₹1,500 for the same usage. On my fixed pension, this is concerning.	"It would need to be very simple. I'm not very good with these gadgets. Perhaps something that tells me in plain language if my usage is higher than	High	Keeps paper records of bill receipts. Manually compares month to month.

		normal and exactly what to do."		Behavioral changes (LED bulbs, unplugging devices, full washing loads) Minimizes AC usage.
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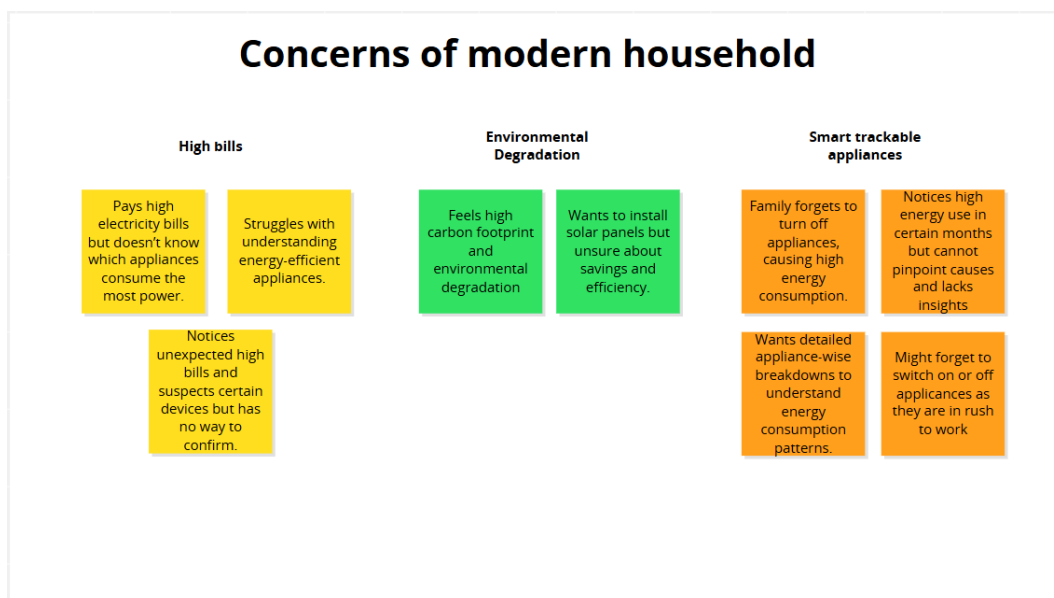
Insights, quotes, and key findings.

Interpretations

Case 1	Homeowners and tenants find it hard to track which appliances use the most electricity, leading to high bills. They need clear, personalized insights to manage energy better, save money, and choose efficient appliances.
Case 2	Homeowners and working professionals worry about high energy use and its impact on the environment but find it hard to take action due to high costs, unclear savings, and everyday habits.
Case 3	Apartment residents and owners have trouble tracking their energy use because they can't see how much each appliance consumes in real time. They need a simple system that shows clear insights, gives useful tips, and allows remote control to manage energy better. Visual representation adds more clarity.

PART 2: SYNTHESIS

Affinity Mapping



Themes Identified

Themes	Description
High Energy Bill Concern	Users like homeowners and renters, are frustrated by high utility costs and the lack of transparency in their energy usage. They want tools to track and optimize their consumption.
Environmental Concerns and Sustainability Goals	Eco-conscious users want to reduce their carbon footprint but don't know where to start. They need actionable insights on energy efficiency.
Lack of Awareness About Energy Consumption Patterns	Users are unsure about how and when they use the most energy. Without detailed insights, they can't adjust their habits effectively.

User Personas

Personas	Concern
Homeowners/ Renters	They want to reduce high energy bills with ways to control energy consumption
Eco-conscious people	Reducing carbon footprint by optimizing energy consumption
Tech savvy home owners	Want smart homes so that they can control the devices from anywhere

Problem Definition Document

Modern households face high energy costs, lack of visibility into consumption patterns, and the need for smart automation. Homeowners struggle to identify energy-intensive appliances, eco-conscious users lack actionable sustainability insights, and tech-savvy individuals want seamless smart home integration. Existing solutions are fragmented and complex, preventing efficient energy management. A real-time, AI-powered system is needed to provide cost-saving insights, sustainability optimizations, and smart automation for better energy efficiency.

Target Audience

Working Professionals
Budget friendly tenants and owners
Eco-conscious users
Tech Savy homeowners
IT Engineers
Retired Professionals

Design Goal

Develop a real-time, AI-powered energy management system that provides appliance-level insights, cost-saving recommendations, and smart automation. The solution should be user-friendly, eco-conscious, and seamlessly integrate with smart home devices to help users reduce energy costs, optimize consumption, and enhance convenience.

PART 3. IDEATION

User Stories

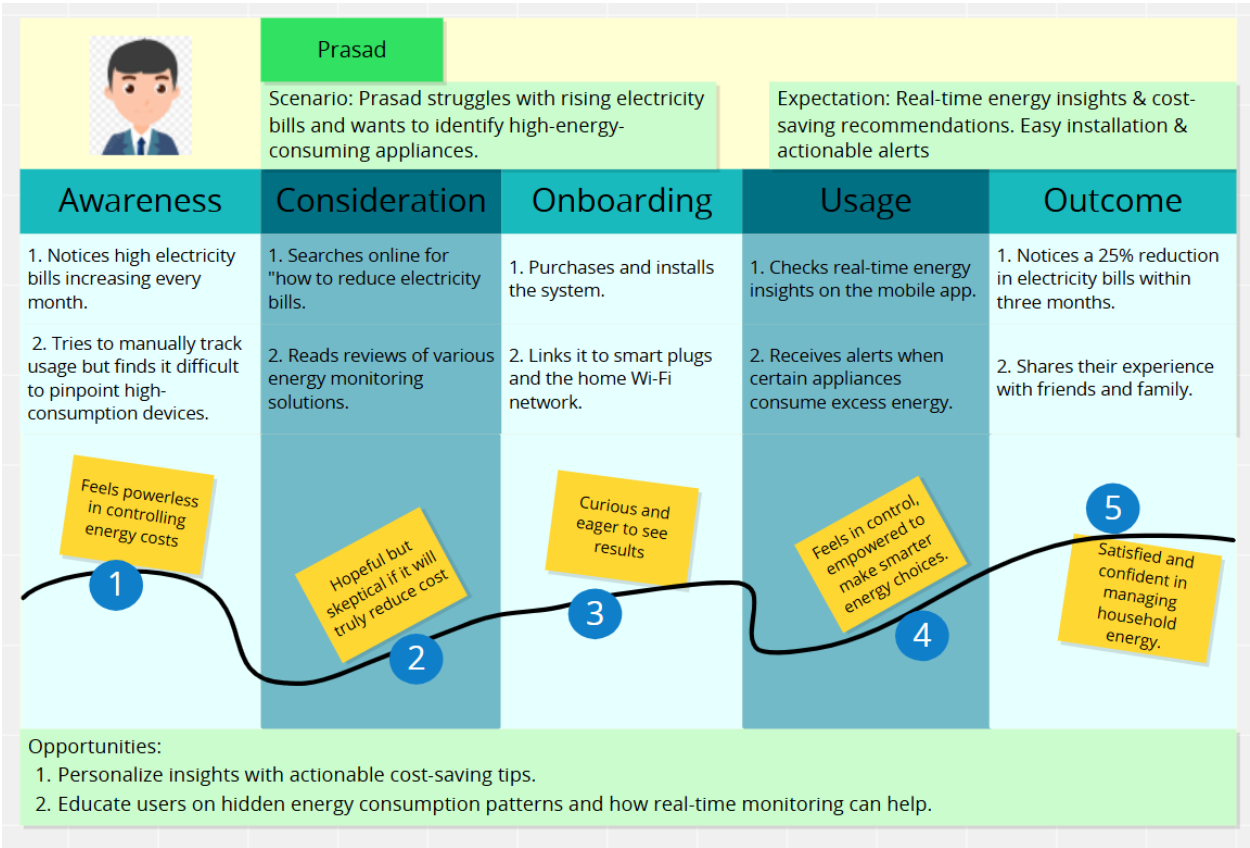
Homeowners/Renters – Reducing High Energy Bills	Monitor and Control Energy Consumption	As a homeowner/renter , I want to track and control my household's energy consumption in real-time, so that I can identify high-consuming appliances, reduce unnecessary energy usage, and lower my electricity bills.
Eco-Conscious People – Reducing Carbon Footprint	Optimize Energy for Sustainability	As an eco-conscious individual , I want to receive energy-saving recommendations and sustainability insights, so that I can minimize my carbon footprint and make environmentally responsible choices in my daily energy consumption.
Tech-Savvy People – Smart Home Automation	Remote Control, data analysis and Smart Automation	As a tech-savvy homeowner , I want a smart home system that allows me to monitor and control my appliances remotely, so that I can automate energy usage, enhance convenience, and optimize efficiency from anywhere.

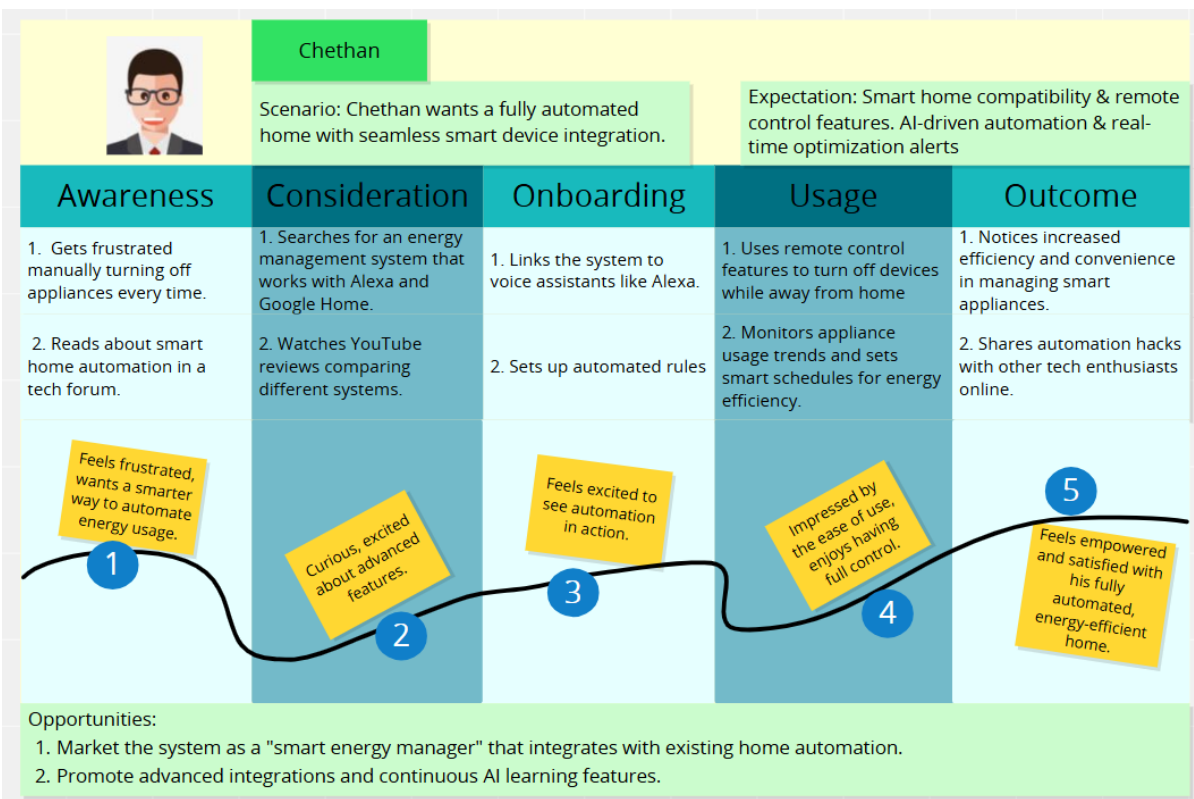
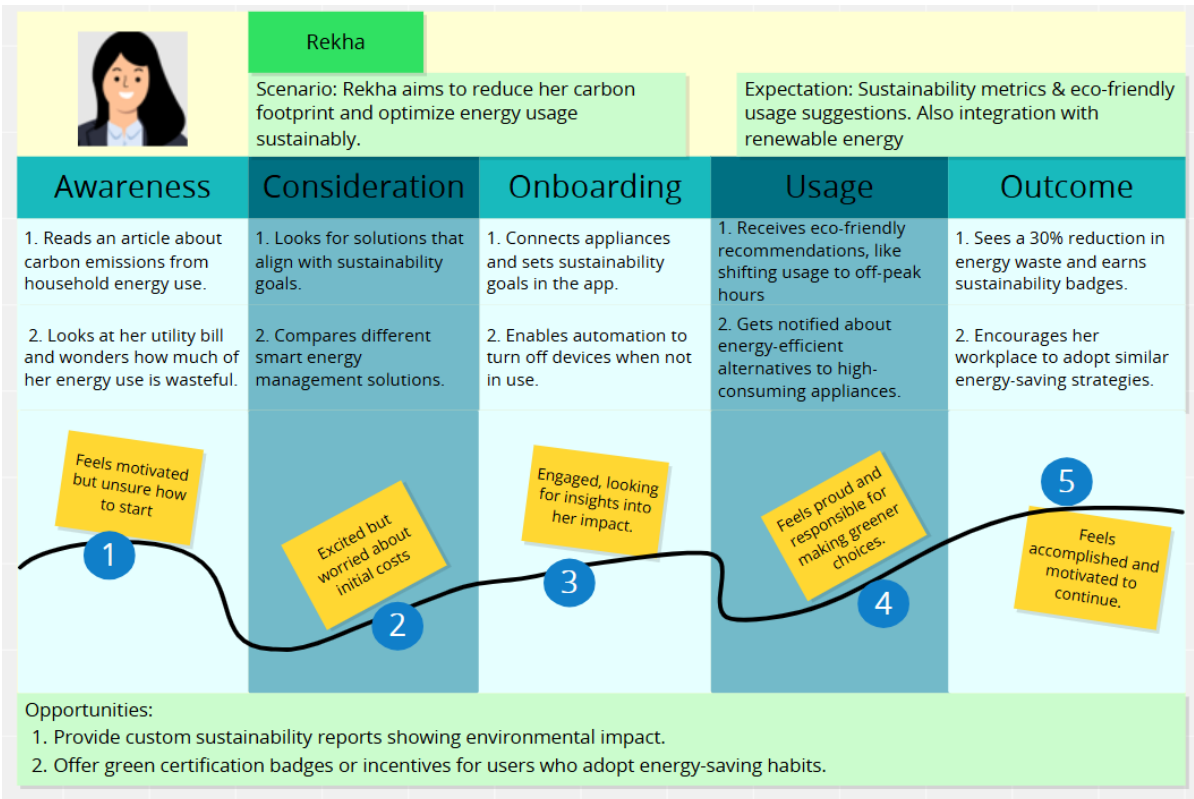
User Scenario

Scenario Type	Homeowners/Renters (Cost-Saving)	Eco-Conscious Users (Sustainability)	Tech-Savvy Users (Smart Homes)
Context Scenario (Before Design)	Struggles with high energy bills and doesn't know which appliances consume the most energy.	Wants to reduce their carbon footprint but lacks insights into how their energy use impacts the environment.	Uses multiple smart devices but finds it inconvenient to manage energy consumption across different apps.

Key Path Scenario (During Design Ideation)	Uses the new system to get real-time energy insights and personalized cost-saving recommendations.	Uses the system's eco-tracking feature to measure energy savings and optimize for sustainability.	Uses the platform to automate energy usage, control devices remotely, and set smart schedules.
Validation Scenario (After Design Implementation)	After a few months, notices a significant reduction in electricity bills and improved energy efficiency.	Sees a decrease in overall energy consumption and achieves their sustainability goals.	Finds that managing energy is effortless, making their home smarter and more efficient.

User Journey





Selected Idea with justification

Highest Priority (Selected persona)

- Homeowners/Renters – Cost Savings

Justification:

- Rising energy bills affect most households, making cost savings a universal and urgent need.
- Unlike sustainability or smart home automation, cost savings offer tangible financial benefits quickly, making adoption easier.
- Users don't need to be tech-savvy or eco-conscious to see value, ensuring broader market reach.
- Once users adopt energy tracking for savings, they can be encouraged to explore automation or sustainability features later

Medium Priority

- Eco-Conscious Users – Sustainability

Justification:

Growing awareness of environmental issues makes this a compelling use case. However, cost-saving concerns often take precedence over sustainability unless incentives (like tax benefits or rewards) are provided.

Medium Priority

- Tech-Savvy Users – Smart Home Automation

Justification:

While automation enhances convenience, it appeals to a niche market of tech enthusiasts. Adoption is limited by the need for higher upfront investment in smart home devices, making it less urgent than cost savings or sustainability.

Unique Value Proposition

The planned solution provides a personalized, data-driven approach to energy management, offering real-time insights, cost-saving recommendations, and automation to optimize consumption efficiently.

1. Cost Savings & Smart Recommendations (For Homeowners/Renters)

- Appliance-level monitoring to identify high-energy-consuming devices.
- AI-powered cost optimization with personalized savings recommendations.
- Automated alerts for unusual consumption patterns.

2. Sustainability Metrics & Green Optimization (For Eco-Conscious Users)

- Carbon footprint (energy consumption) tracking to show the environmental impact of energy use.

- AI-based eco-mode suggestions to promote sustainable consumption.

3. Seamless Smart Home Automation (For Tech-Savvy Users)

- Integration with Alexa, Google Home, and other smart devices.
- AI-driven automation that optimizes energy usage based on behavior patterns.
- Peak-hour load balancing to shift non-essential consumption and reduce strain on the grid.

What Makes This Solution Unique?

- Hybrid Approach – Combines cost efficiency, sustainability, and automation in a single platform.
- AI-Driven Personalization – Adapts recommendations to individual user habits and priorities.
- Real-Time, Actionable Insights – Goes beyond monitoring by actively optimizing energy consumption.

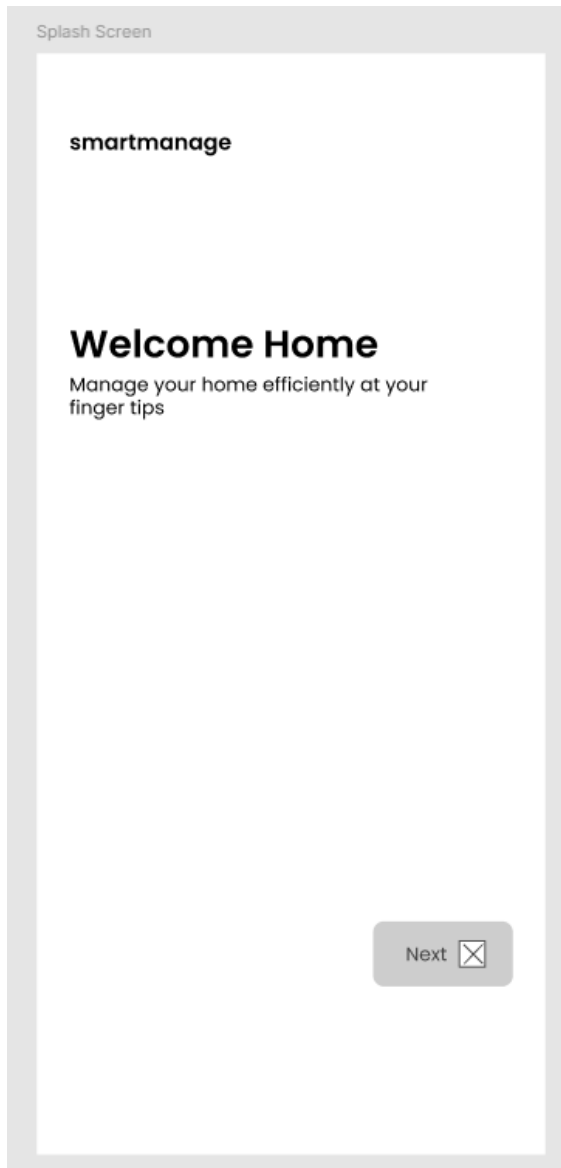
PART 4: PROTOTYPE

Wireframe

Link : <https://www.figma.com/design/irKsn4EMQcDdHqSwN0qx0f/Untitled?node-id=0-1&t=Y9lZR8YuL5VisHgf-1>

Splash screen	Welcome page
Home	From welcome page, on clicking next user navigates to the home screen. The current temperature, total energy consumption by the household, rooms in the house and active appliances are displayed
Smart mode (of a room)	List of all appliances in a selected room where it can be operated remotely
Usage	Whole weeks' usage in KWh. Individual device consumption can also be seen
Detail room	More detailed analysis like 18% of a light lamp of dining room was maximum out of all
Detail item	The smart lamp's usage analysis around the month
AI Insight	AI based suggestions after detailed analysis
See all detail	List of all the rooms
Device Active	List of all active appliances in a room

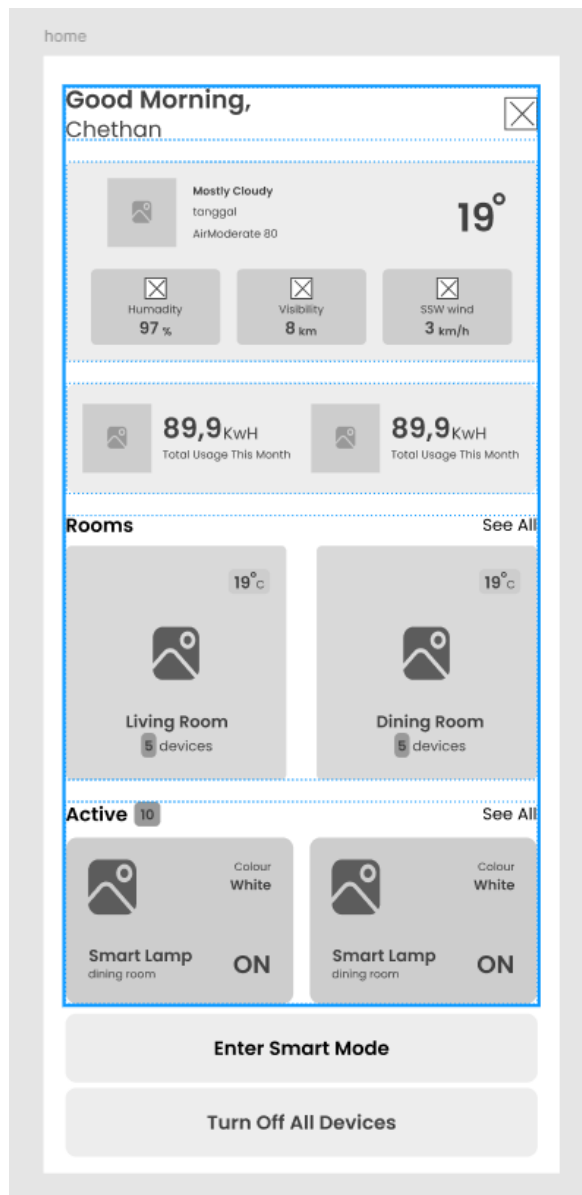
Snapshot of the Wireframes - Splash Screen



This wireframe represents a **Splash Screen** for the **smartmanage** app. It includes:

- **App Name** at the top for branding.
- **Welcome Message** ("Welcome Home") to greet users.
- **Description** explaining the app's purpose.
- **Next Button** at the bottom right to proceed.

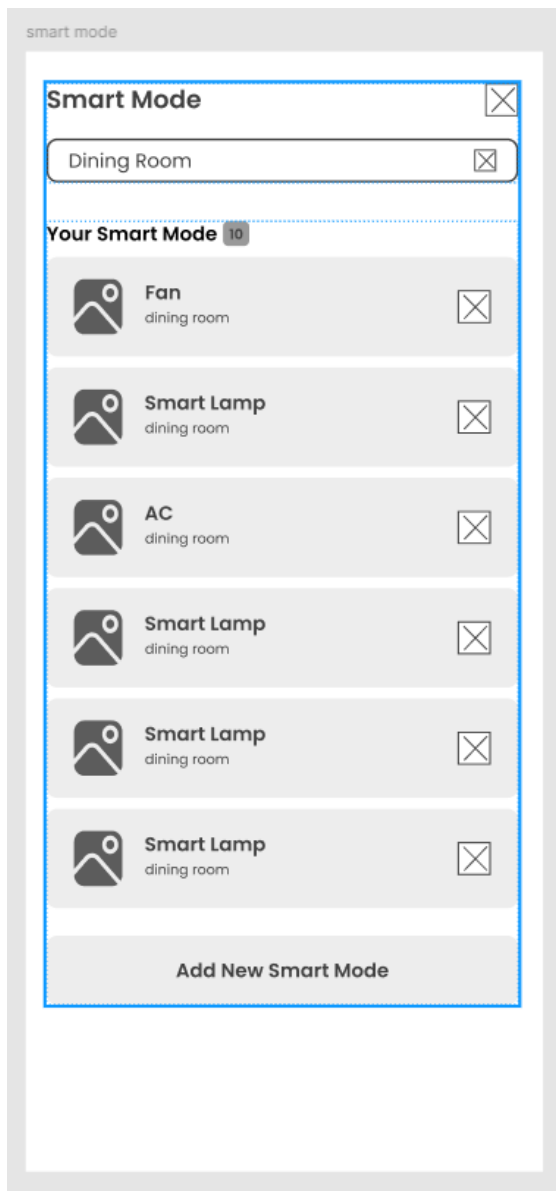
Snapshot of the Wireframes - Dashboard



This wireframe represents a smart home dashboard with:

1. **Greeting & User Info** – Displays the user's name.
2. **Weather Info** – Shows temperature, humidity, visibility, and wind speed.
3. **Energy Usage** – Displays monthly power consumption.
4. **Rooms Overview** – Lists rooms with device count and temperature.
5. **Active Devices** – Shows currently active devices and their status.

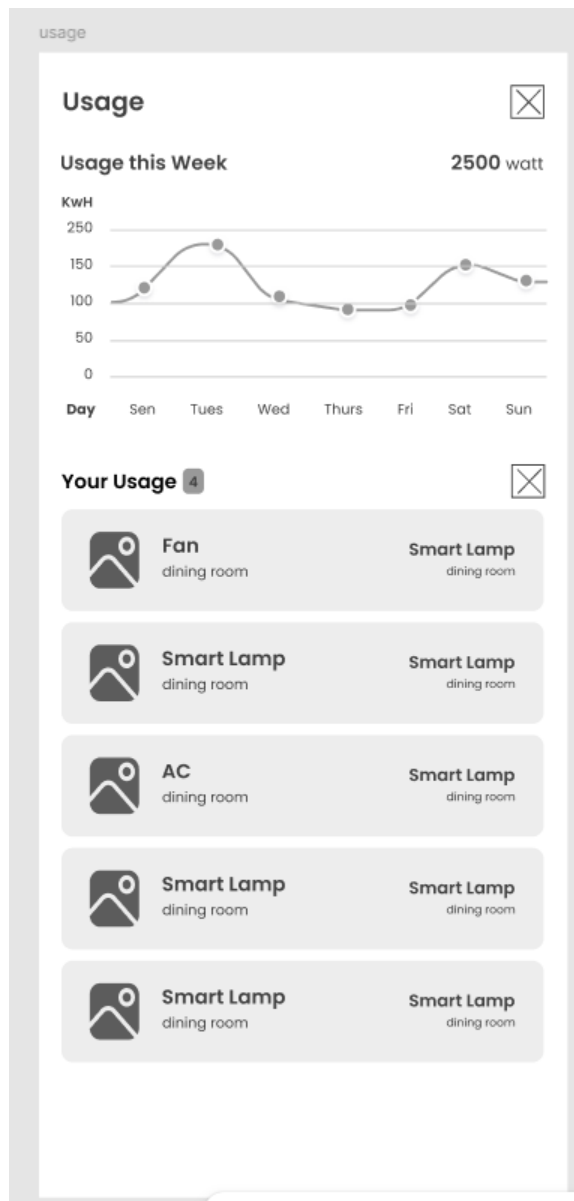
Snapshot of the Wireframes - Smart Mode settings



This wireframe represents the **Smart Mode** settings for a smart home system:

1. **Smart Mode Selection** – Dropdown to choose a room (e.g., "Dining Room").
2. **Your Smart Mode** – Lists active devices (Fan, AC, Smart Lamps) within the selected room.
3. **Remove Option** – Each device has a close button (X) for removal.
4. **Add New Smart Mode** – Button to configure additional smart modes.

Snapshot of the Wireframes - Smart home energy usage dashboard



This wireframe is a **smart home energy usage dashboard** showing:

1. **Weekly Usage Summary** – Displays total consumption (2500W) with a **line graph** tracking daily kWh usage.
2. **Device Usage List** – Lists power-consuming devices (Fan, AC, Smart Lamps) in the **dining room**, helping users monitor specific appliances.

Snapshot of the Wireframes - Dining room energy control panel



This wireframe is a **dining room energy control panel**, showing:

1. **Room Status** – AC (19°C), Light (18%), WiFi (102 Kb/s).
2. **Energy Usage** – 25W today, with a **weekly trend graph**.
3. **Device Control** – Lists **Fan (ON)**, **Smart Lamps (OFF)**, **AC (OFF)** with a **"Turn Off All Devices"** button.

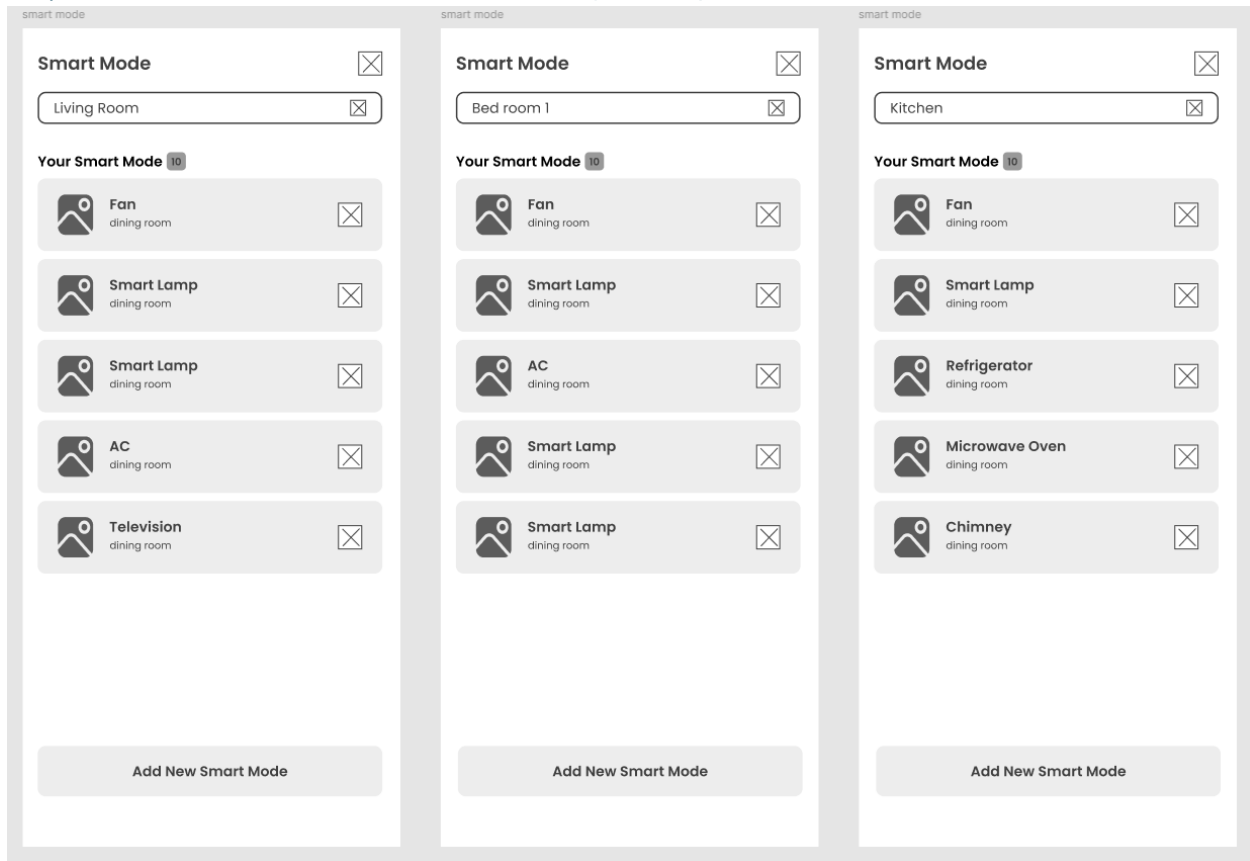
Snapshot of the Wireframes - Dining room energy control panel



This wireframe is a **dining room energy control panel**, showing:

1. **Room Status** – AC (19°C), Light (18%), WiFi (102 Kb/s).
2. **Energy Usage** – 25W today, with a **weekly trend graph**.
3. **Device Control** – Lists **Fan, Smart Lamps (2), and AC** – all **OFF** with a "Turn ON All Devices" button.

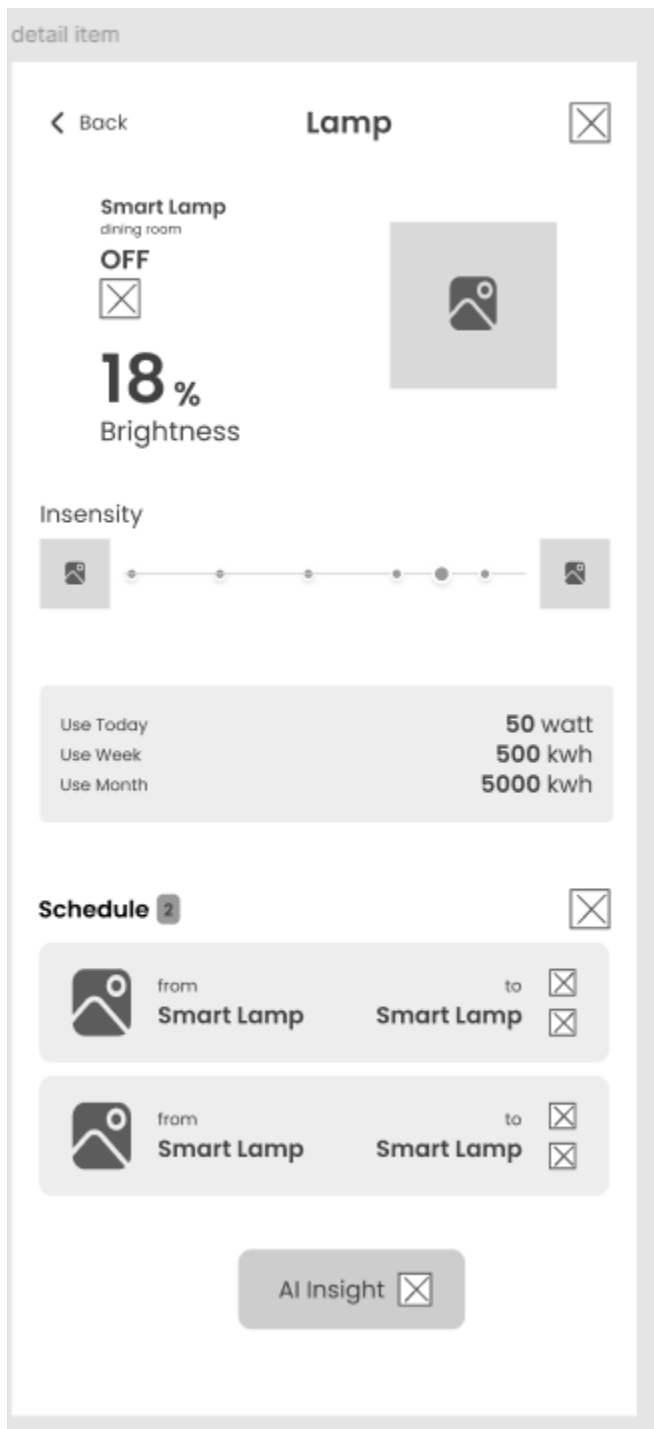
Snapshot of the Wireframes - Smart Mode configuration panel



This wireframe represents a **Smart Mode configuration panel**, showing:

1. **Room Selection** – Users can choose a **specific room** (Living Room, Bedroom 1, Kitchen).
2. **Device List** – Displays devices included in **Smart Mode** (Fan, Smart Lamp, AC, Refrigerator, Microwave, Chimney, Television).
3. **Remove Option** – Each device has a **delete (X) button** for removal.
4. **Add New Smart Mode Button** – Allows users to **create new automation settings**.

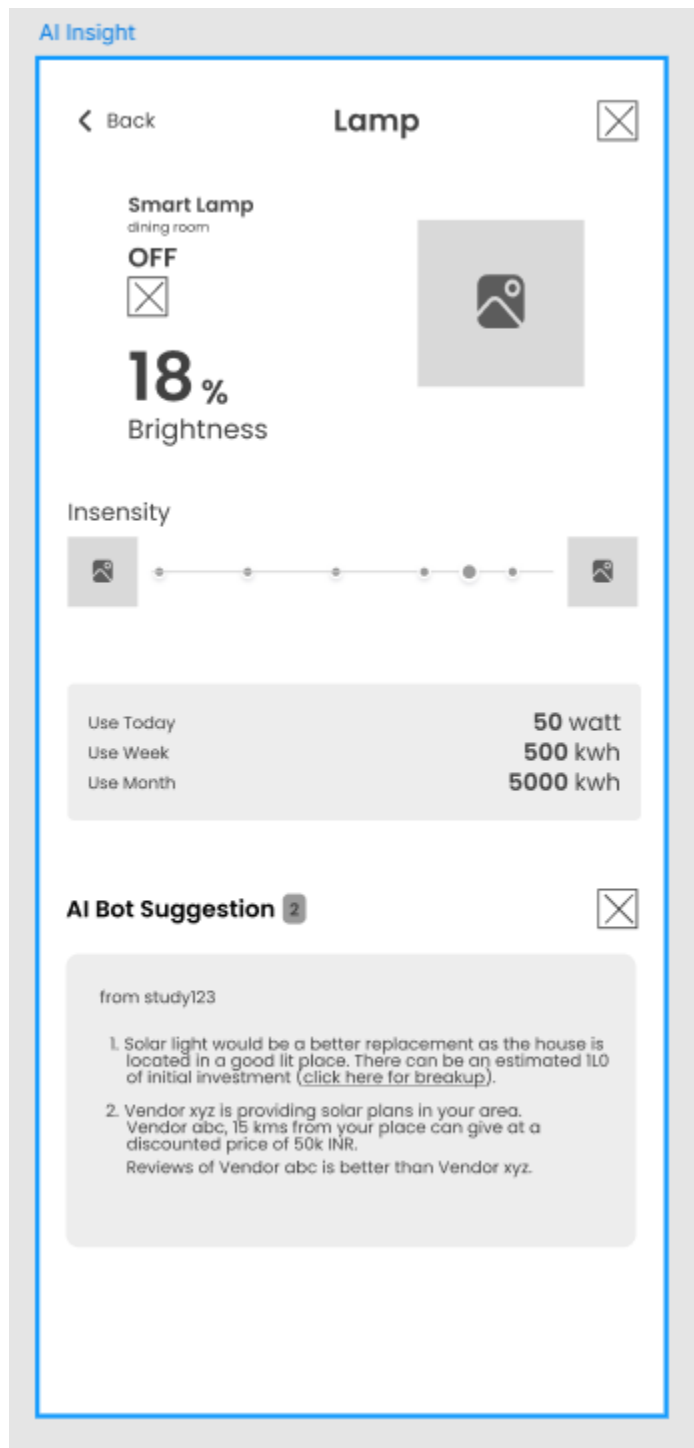
Snapshot of the Wireframes - Smart Lamp control panel



This wireframe is a **Smart Lamp control panel**, showing:

1. **Lamp Status** – Smart Lamp (OFF), **Brightness: 18%**.
2. **Intensity Control** – Adjustable **slider** for brightness.
3. **Energy Usage** – **50W today, 500 kWh this week, 5000 kWh this month.**
4. **Schedule Management** – Lists **2 scheduled operations** for the lamp.
5. **AI Insight Button** – Likely provides **energy-saving recommendations.**

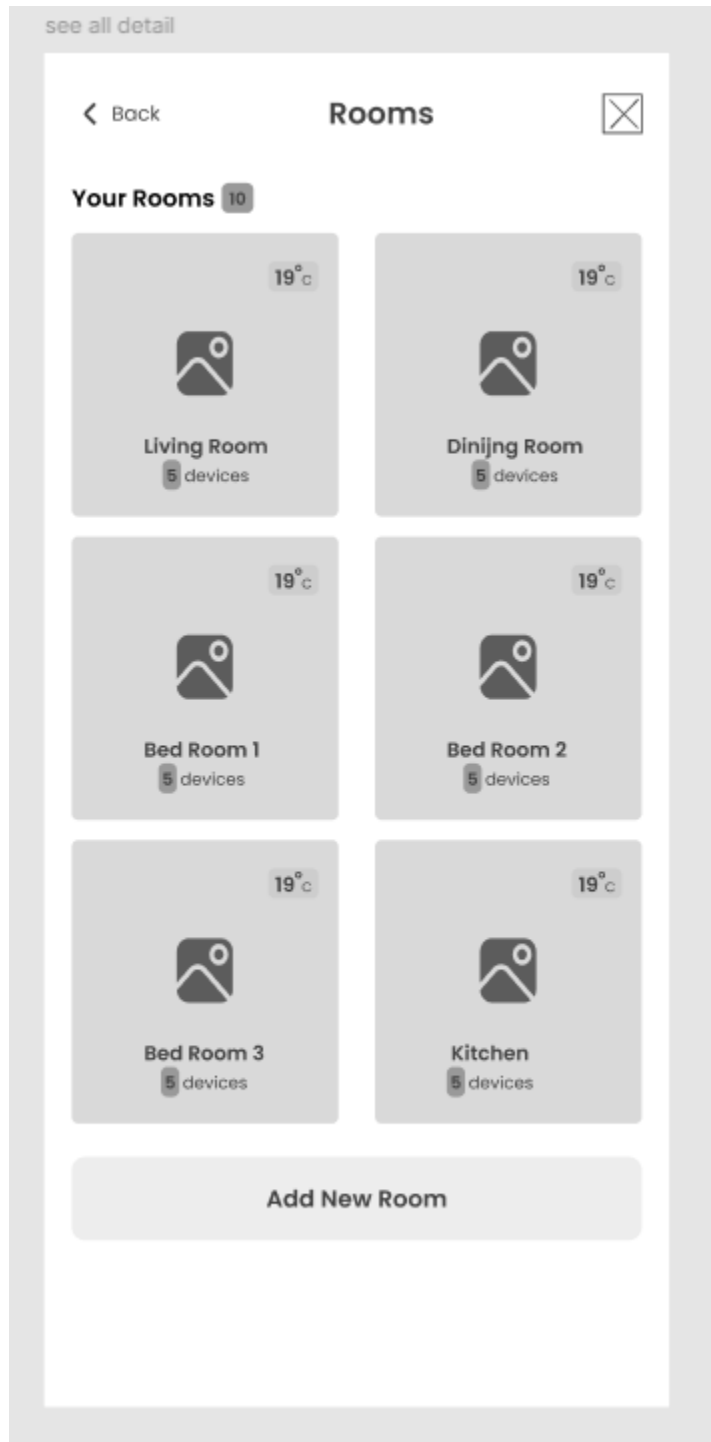
Snapshot of the Wireframes - Smart Lamp control panel with AI Insights



This wireframe is a **Smart Lamp control panel with AI Insights**, showing:

1. **Lamp Status** – Smart Lamp (OFF), **Brightness: 18%**.
2. **Intensity Control** – Adjustable brightness slider.
3. **Energy Usage** – 50W today, 500 kWh this week, 5000 kWh this month.
4. **AI Bot Suggestion** – Provides **energy-saving insights**, including:
 - **Solar light recommendation** with investment estimation.
 - **Vendor suggestions** for better pricing and efficiency.

Snapshot of the Wireframes - Room management dashboard



This wireframe is a **room management dashboard**, showing:

1. **Room List** – Displays **six rooms** (Living Room, Dining Room, Bedrooms, Kitchen).
2. **Device Count** – Each room has **six devices** connected.
3. **Temperature Display** – All rooms show **19°C**.
4. **Add New Room Button** – Allows adding more rooms.

Snapshot of the Wireframes - Device management panel



This wireframe is a **device management panel**, showing:

1. **Device List** – Displays **eight devices** (AC, Smart Lamps, Fan, Refrigerator, Oven, Grinder, Television).
2. **Device Status** – Some devices are **ON (Smart Lamp, Fan)**, others are **OFF**.
3. **Color Indicator** – All devices are marked as **White**.
4. **Turn Off All Devices Button** – Allows users to **power down everything** instantly

PART 5: TESTING

Usability Test Plan

Goal:

- Evaluate how effectively users can navigate the system and perform common tasks.
- Measure user satisfaction, task completion rate, and clarity of AI-generated insights.
- Identify pain points in terms of information visibility, control, and feature access.

Participants:

Participant	Persona	Profile Summary
P1	Eco Conscious Apartment Owner	Tech-aware user living in a flat, values smart features and eco-insights
P2	Working Professional (IT)	Busy user, wants control and flexibility in automation, prefers efficiency
P3	Retired Homeowner	Elderly user with limited tech experience, values clarity and simplicity
P4	Cost-Conscious Family Manager	Budget-focused user, looks for savings tips and easy device control

Test Scenarios:

- Navigating through the home dashboard to check real-time energy consumption.
- Viewing individual appliance consumption details.
- Setting up smart automation for energy optimization.
- Understanding AI-driven insights and recommendations.

Metrics for Evaluation:

- Task Completion Rate
- Error Rate
- Time Taken to Complete Tasks
- User Satisfaction Score (Scale of 1-5)

User Feedback

1. User Persona: Apartment Owner

Test 1

Testing Method: Heuristic Evaluation

Feature Tested: AI Insights panel and sustainability data

User Interaction:

I tested the app with an apartment owner who wanted to understand their energy impact. They found the savings helpful but didn't know how it affected the environment.

I suggested adding simple messages like "You saved 5 kg CO₂ this week" and giving badges for saving energy.

Changes Proposed: Show CO₂ savings clearly and add badges for motivation.

Test 2

Testing Method: Think-Aloud Protocol

Feature Tested: Device management panel

User Interaction:

The same user tried to turn off unused devices. They clicked on icons but weren't sure if they worked. There was no feedback or status change.

I recommended adding clear labels (e.g., ON/OFF) and color changes when a device is turned off.

Changes Proposed: Make device status more visible and add confirmation when a device is switched.

2. User Persona: Working Professional (IT)**Test 1**

Testing Method: Remote Usability Testing

Feature Tested: Smart Mode settings and automation schedule

User Interaction:

The user liked Smart Mode but wanted to schedule devices at different times. They asked for a drag-and-drop option or a time picker for each device.

Changes Proposed: Add a drag-and-drop interface and separate scheduling for each appliance.

Test 2

Testing Method: Think-Aloud Protocol

User Persona: Working Professional (IT)

Feature Tested: Weekly usage dashboard and appliance-level consumption

User Interaction:

I tested the weekly usage screen with a working professional. While using the app, the user spoke out loud and said things like "Where is the device-wise breakdown?" and "I thought clicking on the graph would give more info."

They didn't notice the list of devices below the graph and expected it to be more visible or directly connected to the chart.

Changes Proposed:

Make the graph bars clickable, add a scroll-down indicator, and show top power-using devices at the top.

3. User Persona: Retired Homeowner**Test 1**

Testing Method: Think-Aloud Protocol

Feature Tested: Smart Lamp energy usage panel

User Interaction:

The user had trouble understanding energy numbers like “2500 kWh.” They skipped the AI tips and didn’t know what to do.

I suggested using simpler phrases like “This lamp used the most energy today” and using color hints.

Changes Proposed: Add simple messages and visual cues for better understanding.

Test 2

Testing Method: Cognitive Walkthrough

Feature Tested: Onboarding process for new users

User Interaction:

The user was confused when they opened the app for the first time. They didn’t know what to click or where to start.

I recommended a short guided tour or tips pop-up when users first use the app.

Changes Proposed: Add a welcome tour or hints to help first-time users navigate the app.

4. User Persona: Cost-Conscious Family Manager**Test 1**

Testing Method: Cognitive Walkthrough

Feature Tested: Dashboard → Usage → Device Breakdown

User Interaction:

The user wanted to find out which device was using the most energy. They clicked on “Total Usage” but didn’t know they could click again to see more details. They only found the Smart Lamp usage after going back and trying different options.

Changes Proposed:

Add hover hints or clickable highlights to show users where they can find more details easily.

Test 2

Testing Method: Think-Aloud Protocol

Feature Tested: AI Suggestions and Cost Saving Tips

User Interaction:

The user read the AI tips but said things like, “What does this mean?” and “How does this save me money?” They didn’t feel confident about following the suggestions.

Changes Proposed:

Use simple language like “Turn off AC after 10 PM to save ₹200” and add a monthly savings tracker for better clarity.

Sample Figma Tests

We have uploaded sample Figma tests under the below link

<https://drive.google.com/drive/folders/1NT1aA0bx3CNMaSk-0aojgzf48CbS3E09?usp=sharing>

Identified issues and potential improvements

Issue	Impact	Suggested Improvement
Environmental impact not clearly shown	Medium – Reduces motivation to save	Show CO ₂ savings in simple text and use badges to reward energy-saving achievements
No feedback when switching devices ON/OFF	High – Confuses users	Add ON/OFF labels and use color changes or animations to show status change
Smart Mode lacks flexibility for per-device scheduling	High – Limits user control	Add drag-and-drop interface and allow individual time settings per appliance
Device-level data not easily discoverable from weekly usage graph	Medium – Causes user frustration	Make graph bars clickable and highlight top-consuming devices with scroll cues
Complex energy terms confuse elderly users	Medium – Affects understanding	Use simple phrases like “Most energy used today” and visual indicators like color hints
No guidance for first-time users	High – Affects onboarding experience	Add a guided tour or pop-up hints to help users navigate on first use
Device-level usage hidden under multiple clicks	Medium – Slows down task completion	Add hover tips and make device icons clearly clickable
AI tips are hard to understand and apply	Medium – Low trust and usability	Use clearer language and practical examples (e.g., “Use fan instead of AC to save ₹200”)

No summary or tracking of personal cost savings	Medium – Limits motivation	Add a monthly savings tracker and simple comparisons (e.g., “₹ saved vs. last month”)
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Conclusion

The usability testing provided valuable insights, confirming that the prototype is user-friendly but requires improvements in **navigation, AI explanations, smart automation, and integrations**. Addressing these issues will enhance overall user experience and adoption.

References

1. Figma for wireframe design.
2. Concept board affinity map design
3. Concept board for User Journey design