An interactive

Self-Troubleshooting Augmented Reality Guide

for homeowners

Honourable mention, Ennovate'24

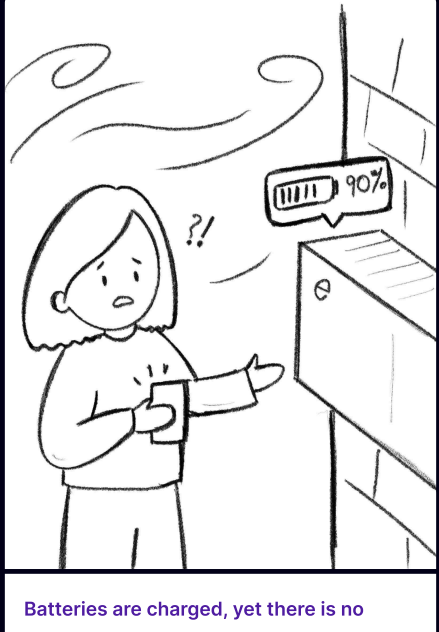
Thesis, M.Des 2021-2023

Case study by
Somya Burman

UX Designer, Experience Design Team
Enphase Energy, Bangalore

Let's

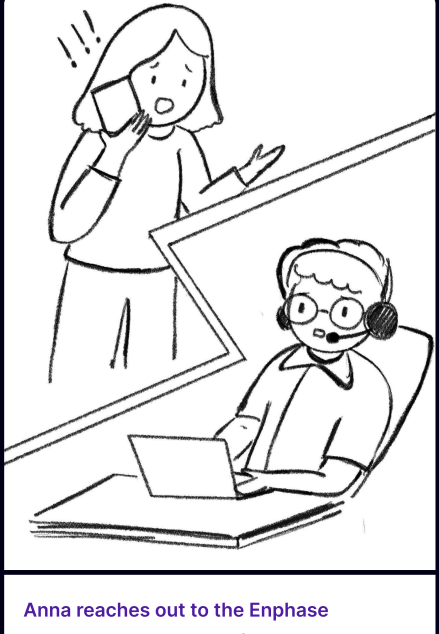
Consider



Batteries are charged, yet there is no power in Anna's home!

An entire geographical area has been *hit by a hurricane*.

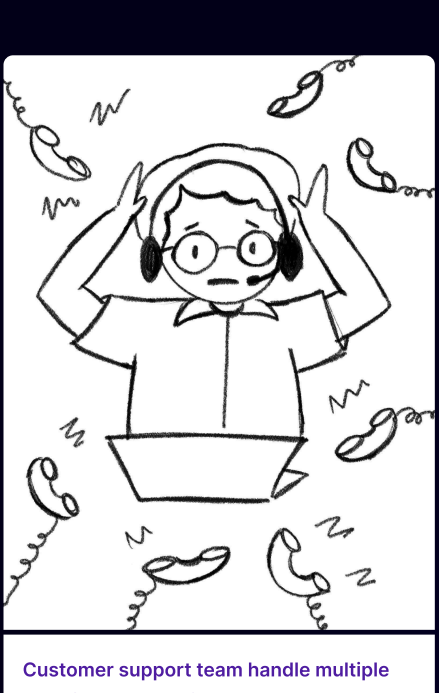
Even though Anna had their storm guard turned on and have power in the batteries, when the grid got disconnected, *batteries could not kick-in.*



Anna reaches out to the Enphase customer support team!

Anna and *many other homeowners in the neighbourhood* faced this issue for which they reached out to Enphase customer support.

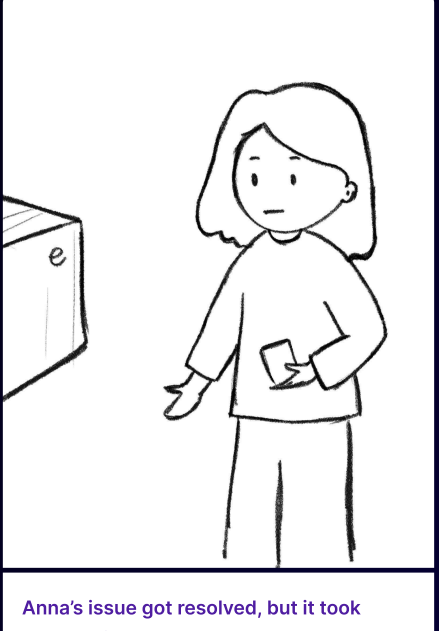
On-call assistance provided since nobody could reach in that hurricane affected area.



Customer support team handle multiple calls for the same issue!

Since the *call volume is huge* for the same issue, it gets overwhelming for the CS team to handle.

Each issue takes on an average *25 minutes for on-call guidance.*



Anna's issue got resolved, but it took 30-40 minutes!

It took a total of 40 minutes including the *call wait time*, and *25 minutes of on call support.*

Had it been a medical dependency on power supply 40 mins was a big chunk of time to get it fixed.

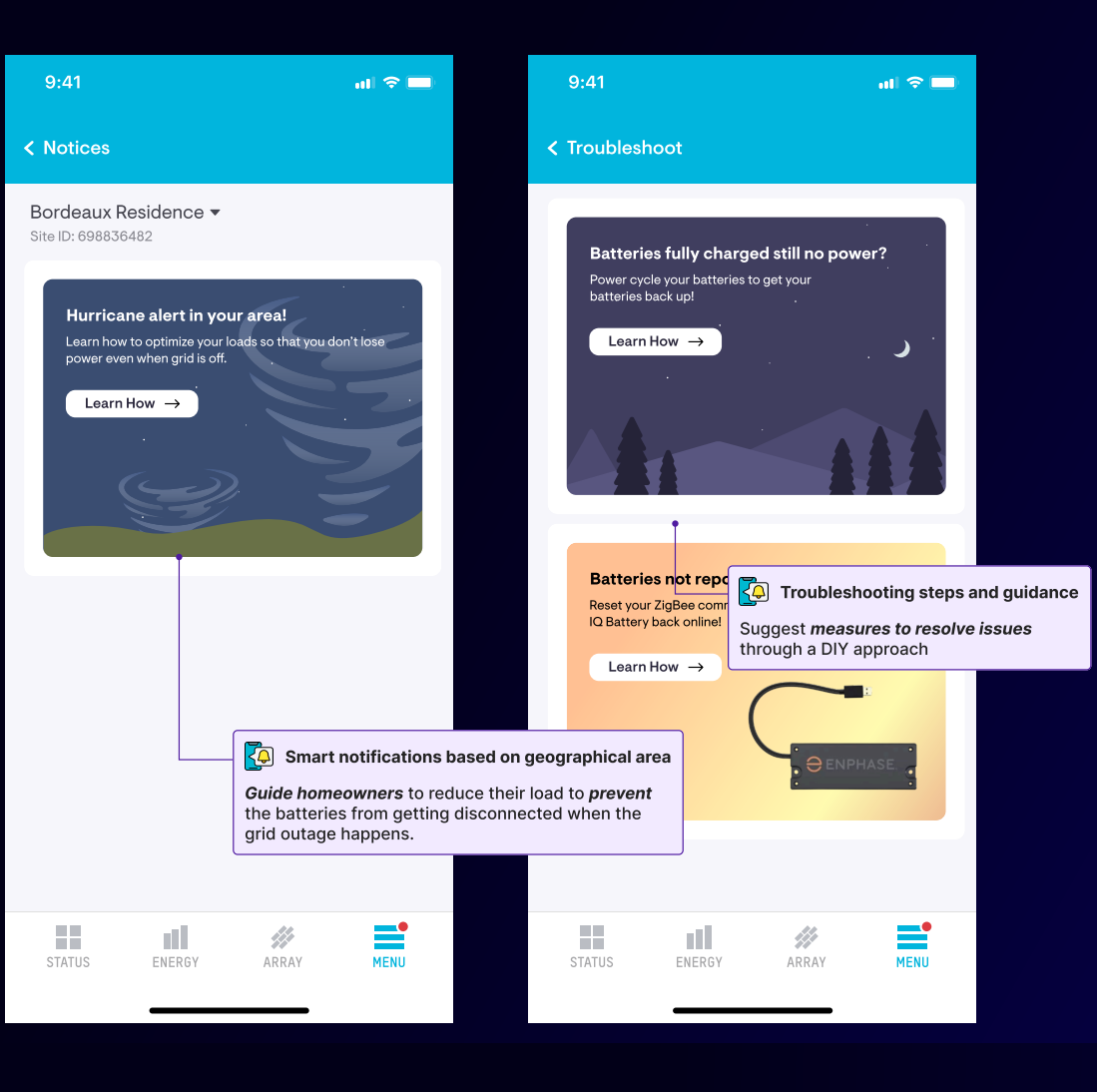
What if

The issue resolution is just one click away!

Introducing an innovative solution for Enphase homeowners – a comprehensive AR based *self-troubleshooting guide* designed to empower users to *independently resolve issues* during catastrophic and time-sensitive situations, which in turn *reduces the call volume* to the customer support team.

Prevent
outages from happening by sending smart notifications.

Resolve
issues efficiently within the app.

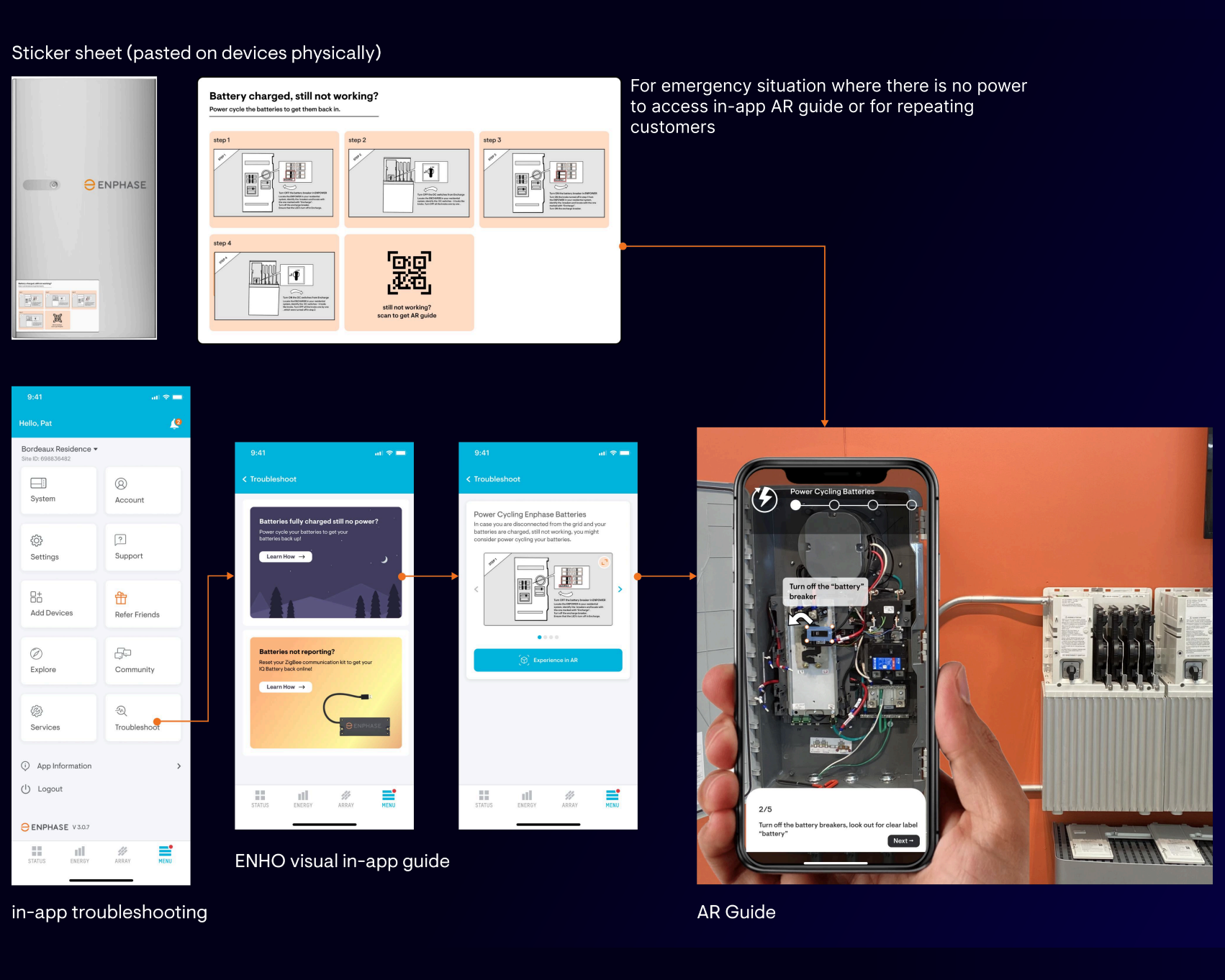

9:41
Notices
Bordeaux Residence
Hurricane alert in your area!
Learn how to optimize your loads so that you don't lose power even when grid is off.
Learn How
9:41
Troubleshoot
Batteries fully charged still no power?
Power cycle your batteries to get your batteries back up!
Learn How
Batteries not reporting?
Learn How
STATUS
ENERGY
ARRAY
MENU

Smart notifications based on geographical area
Guide homeowners to reduce their load to *prevent* the batteries from getting disconnected when the grid outage happens.

Troubleshooting steps and guidance
Suggest *measures to resolve issues* through a DIY approach

Let's see

How it works...


ENPHASE
Battery charged, still not working?
step 1
step 2
step 3
step 4
still not working? scan to get AR guide
Power Cycling Batteries
Turn off the "battery" breaker

Sticker sheet (pasted on devices physically)

For emergency situation where there is no power to access in-app AR guide or for repeating customers

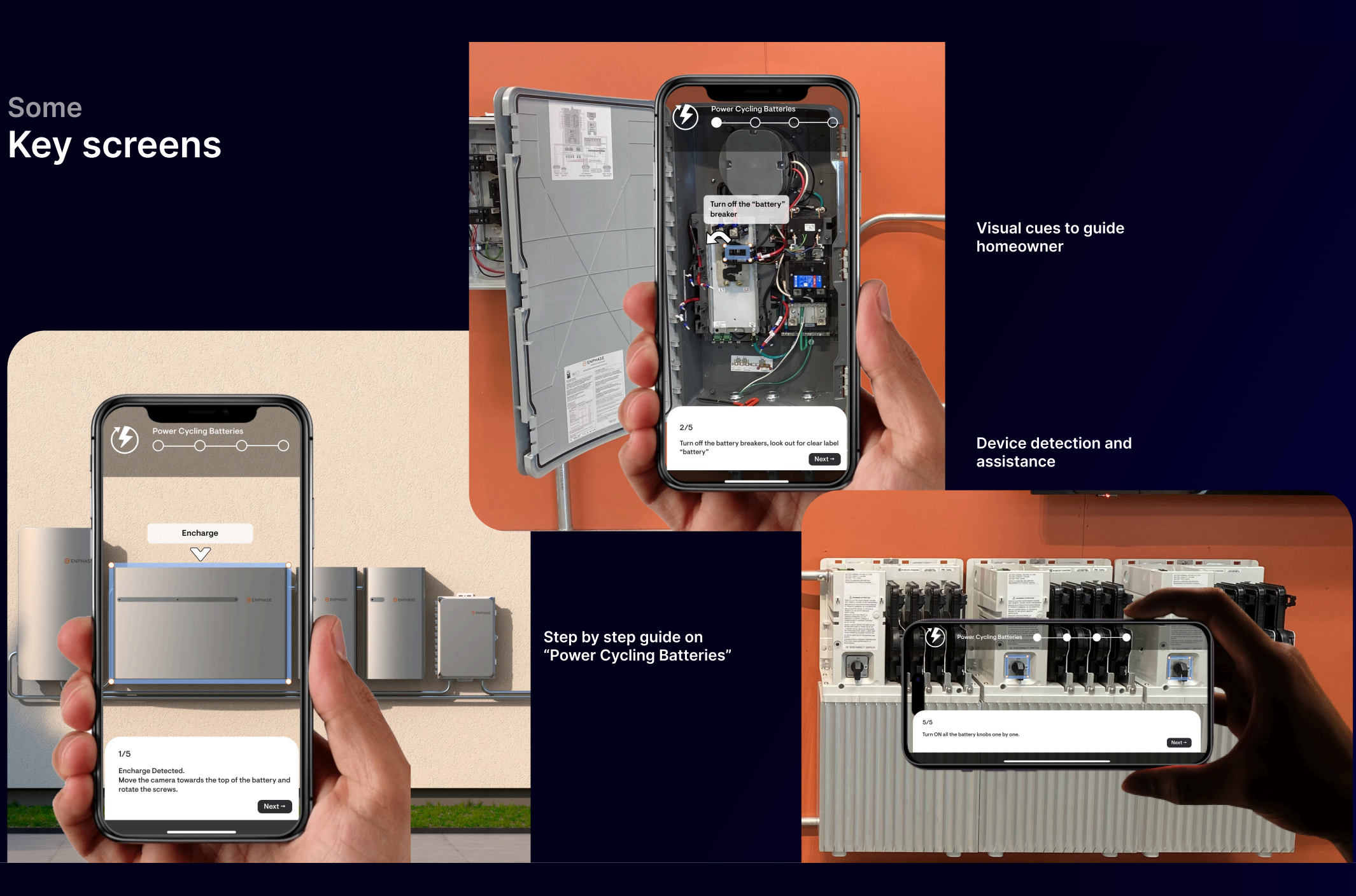
in-app troubleshooting

ENHO visual in-app guide

AR Guide

Some

Key screens


Power Cycling Batteries
Turn off the "battery" breaker
Encharge
Encharge Detected.

Visual cues to guide homeowner

Device detection and assistance

Step by step guide on "Power Cycling Batteries"

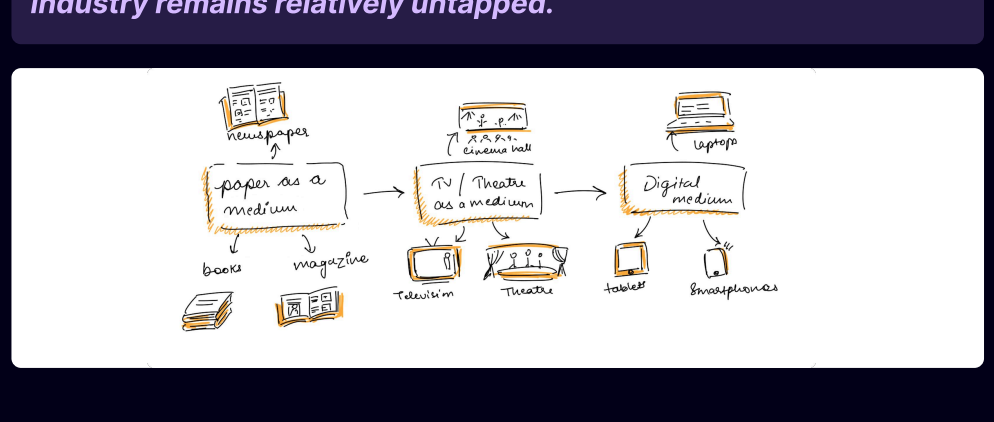
A brief over the

Background

New media design is an interactive, digital evolution of traditional formats, incorporating elements like graphics, multimedia, and 3D design.

It leverages advanced technologies such as AR, VR, IoT, and voice recognition to transform data into meaningful, futuristic interactions.

New media is widely used in industries like entertainment, healthcare, education, and training, its *application in the solar industry remains relatively untapped.*


paper as a medium
TV / Theatre as a medium
Digital medium

Adoption rates
45% of businesses globally are actively using AR/VR for training, maintenance, or customer engagement.

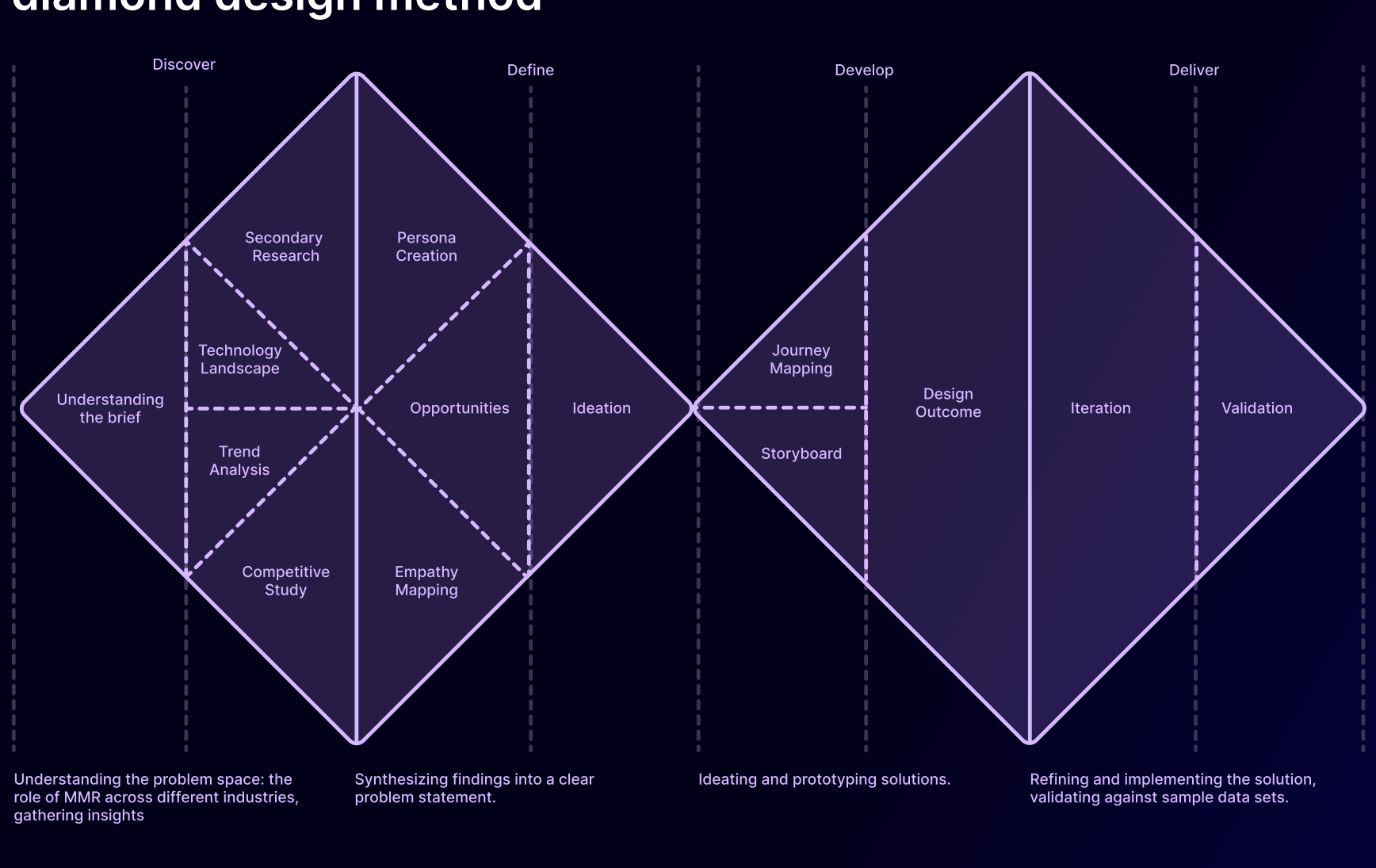
Industry adoption
Manufacturing: AR is used for real-time equipment repair, reducing downtime by up to 50%.

Healthcare: Surgeons use AR for precision-based surgery, improving accuracy by over 20%.

Retail: AR has improved customer engagement rates by 30%, particularly through virtual try-ons.

Following the

Double diamond design method


Discover
Define
Develop
Deliver
Secondary Research
Persona Creation
Technology Landscape
Understanding the brief
Opportunities
Ideation
Trend Analysis
Competitive Study
Empathy Mapping
Journey Mapping
Storyboard
Design Outcome
Iteration
Validation
Understanding the problem space: the role of MMR across different industries, gathering insights
Synthesizing findings into a clear problem statement.
Ideating and prototyping solutions.
Refining and implementing the solution, validating against sample data sets.

How is the industry shaping with

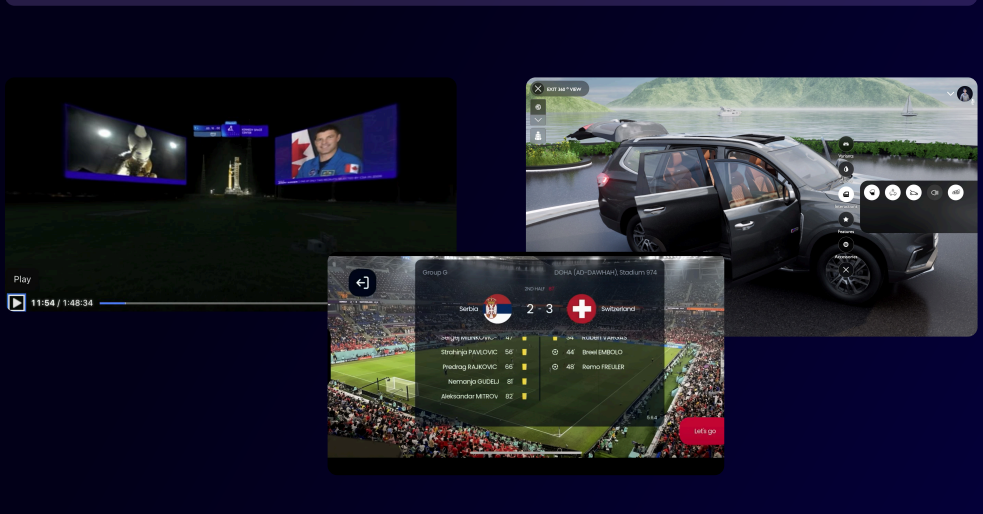
Mixed media reality

Healthcare
- AR-assisted surgeries for precision. VR-based therapy for mental health and rehabilitation.
- IR based vein visualization technology, eg. AccuVein

Automobile
- MMR based learning and user engagement, example MGverse offering virtual car showrooms, AR test drives. Audi Activesphere allowing drivers to view navigation, controls, and environmental data through AR glasses.

Entertainment and Media
- Enhanced game experiences with AR/VR, eg. FIFA World Cup, Qatar
- Virtual concerts and immersive storytelling, eg. Fortnite concerts by Ariana Grande, Travis Scott, etc. and narrative-driven story experiences by Baobab Studios.

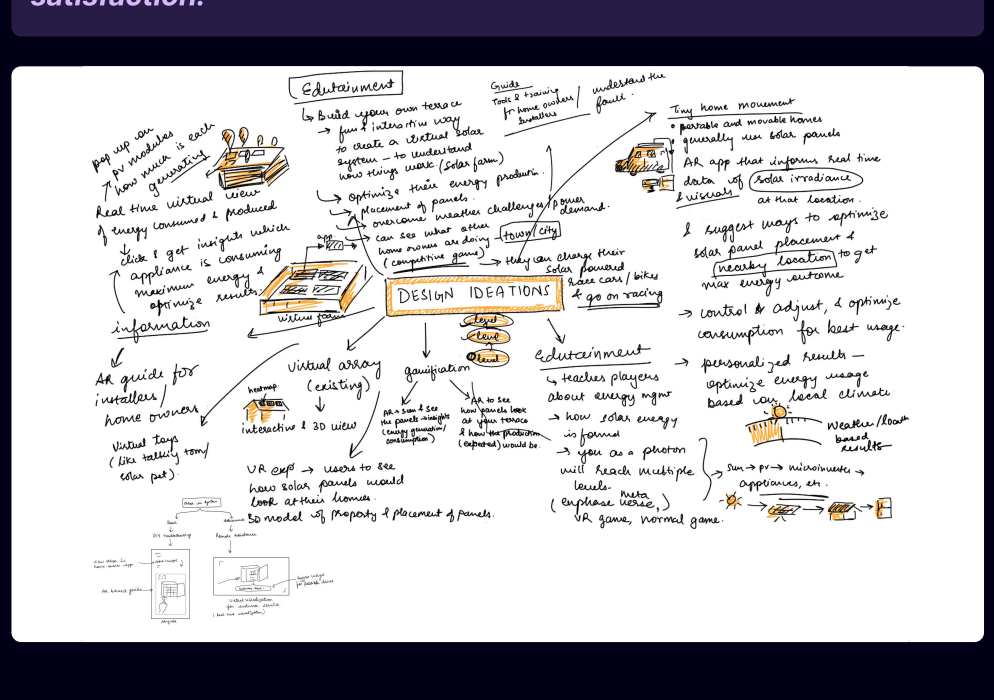
Various other industries use MMR to enhance their customer engagement, example,
- IKEA's AR app lets users virtually place furniture in their rooms to see how it fits and matches.
- Boeing implemented AR glasses for technicians to visualize wiring diagrams in 3D during assembly.
- Enel Green Power used AR-powered apps to provide technicians with real-time, interactive guidance on maintenance tasks.



Finding the

Solution space : Troubleshooting guide

When exploring various potential solutions for integrating Mixed Media Reality (MMR) into the solar industry, several ideas emerged, ranging from gamified educational experiences to real-time energy monitoring and optimization tools. After evaluating these concepts, it became evident that a troubleshooting-focused AR solution offers the most significant impact for both *business growth* and *customer satisfaction.*


DESIGN IDEATION

Immediate Problem Resolution
Systems can face issues such as Microinverters not reporting, Gateway connectivity issues, etc. An AR-based troubleshooting guide helps homeowners resolve these issues in real-time without waiting for service personnel, minimizing downtime.

Enhanced Customer Experience
By empowering homeowners to identify and address problems themselves, the solution builds trust and loyalty, ensuring a better customer experience.

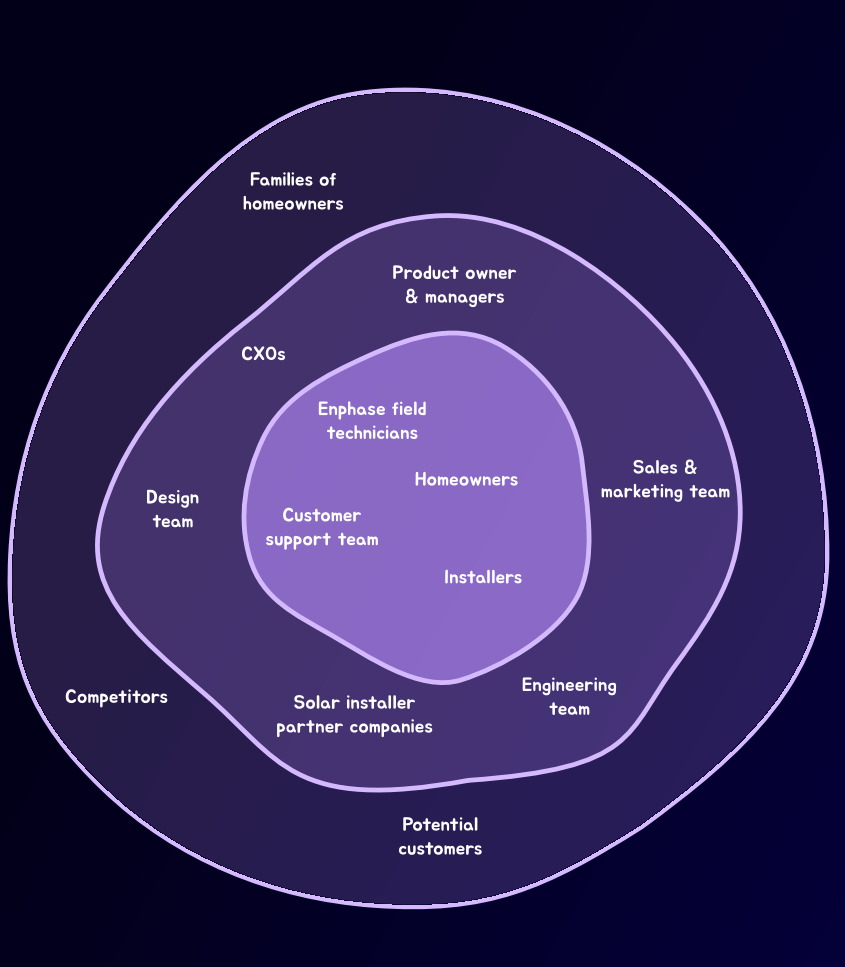
Operational Cost Savings
Reducing the dependency on customer support teams or service visits translates into lower costs for businesses while providing a scalable support solution.

Understanding the

Stakeholders

For this project, the stakeholders can be categorized into primary, secondary and tertiary groups based on their involvement and influence

Collaboration across all these stakeholders ensures the project is customer-centric, technically feasible, and business-viable.


Families of homeowners
Product owner & managers
CXOs
Enphase field technicians
Homeowners
Design team
Customer support team
Installers
Sales & marketing team
Competitors
Solar installer partner companies
Engineering team
Potential customers

Insights from the

Interview - Homeowners

Primary Points of Contact for Issue Resolution
Homeowners typically rely on two key resources when facing issues with their solar systems: their *installer* and the *Enphase customer support team.*

Time Taken for Issue Resolution
The resolution time varies significantly depending on the nature of the issue. While some problems are addressed quickly, others require prolonged interactions.

Challenges with Customer Support
Many homeowners reported spending hours or even days in *back-and-forth communication* with Enphase customer service. This delay is often due to the *limited accessibility of on-site support*, making remote troubleshooting the only viable option.

Quick Resolutions for Simple Issues
On the other hand, certain issues—such as guidance on using the system or app—are resolved efficiently in a single call when the support team provides clear instructions.

Gaps in General Information
Homeowners frequently encounter challenges with basic questions about their devices, often struggling to find straightforward answers. This lack of readily available information leaves them *feeling unsupported and frustrated.*

Insights from the

Interview - Customer support team

Range of Issues
Homeowners contact support for app-related problems, system malfunctions, or general information.

Primary Contact Points
Most homeowners reach out to the customer support team first, followed by installers for on-site resolutions.

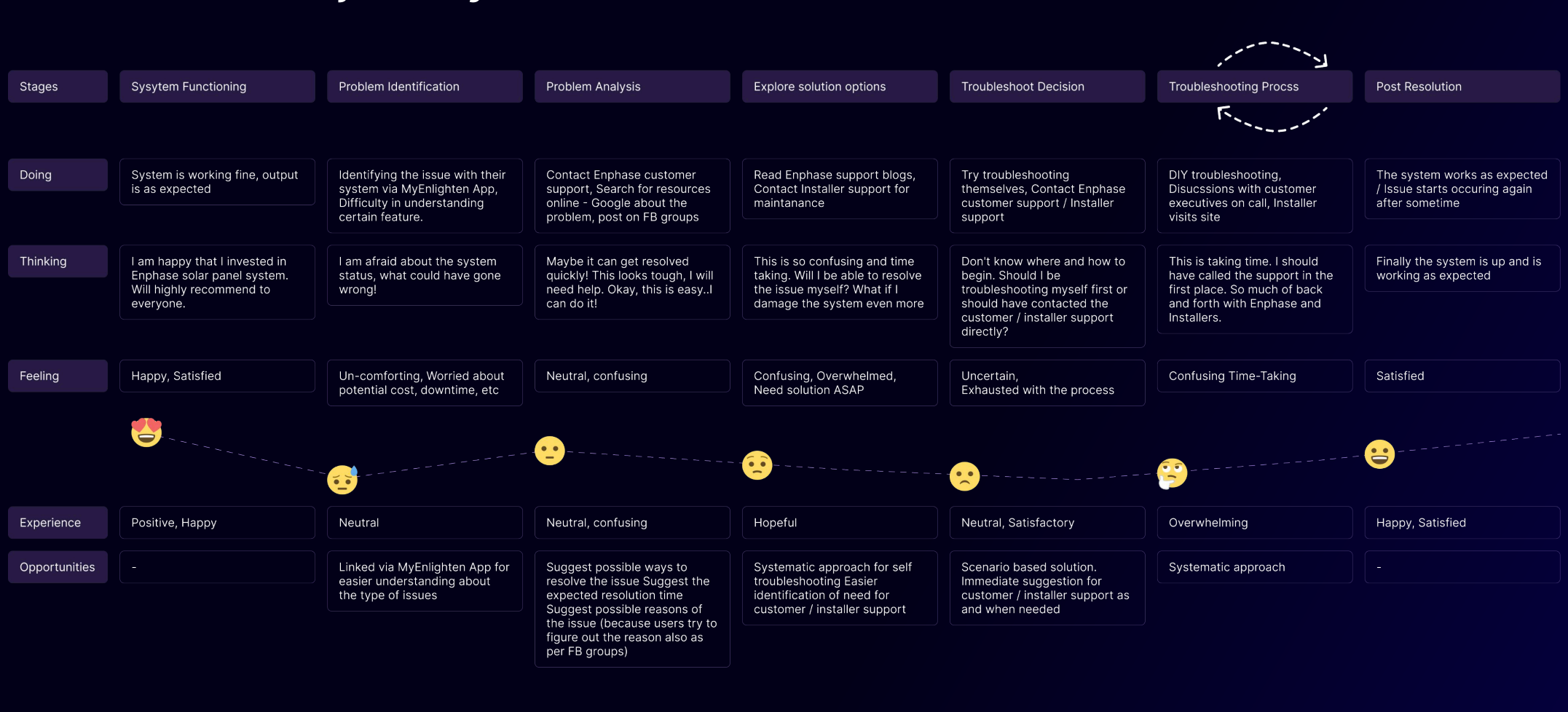
Self-Resolution Behavior
- 20% of homeowners attempt to resolve issues on their own before seeking assistance.
- Only a small segment of users utilize online self-help articles, indicating the need for more accessible and effective self-guided solutions.

Issue Breakdown
- 30% of issues are fully resolvable by homeowners.
- Another 30% may require an on-site visit, depending on the situation.
- The remaining 40% necessitate a technician's visit for resolution.

Common Support Queries
- Envoy connectivity issues contribute to a significant portion of call volumes.
- Battery-related problems during natural calamities in the U.S., such as hurricanes, are frequently reported.

How does the homeowner feel in the

Issue resolution journey

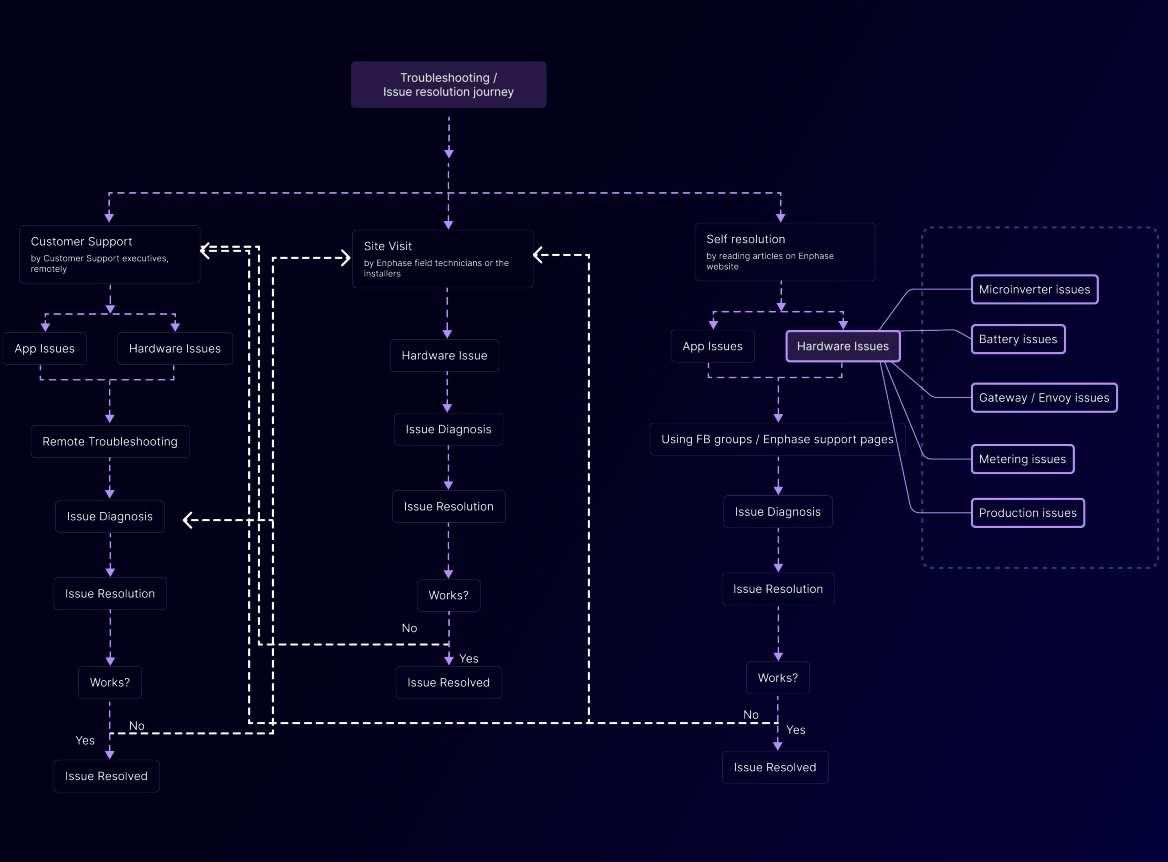


Stages	Sysytem Functioning	Problem Identification	Problem Analysis	Explore solution options	Troubleshoot Decision	Troubleshooting Procss	Post Resolution
Doing	System is working fine, output is as expected	Identifying the issue with their system via MyEnlighten App, Difficulty in understanding certain feature.	Contact Enphase customer support, Search for resources online - Google about the problem, post on FB groups	Read Enphase support blogs, Contact Installer support for maintanance	Try troubleshooting themselves, Contact Enphase customer support / Installer support	DIY troubleshooting, Disucssions with customer executives on call, Installer visits site	The system works as expected / Issue starts occuring again after sometime
Thinking	I am happy that I invested in Enphase solar panel system. Will highly recommend to everyone.	I am afraid about the system status, what could have gone wrong!	Maybe it can get resolved quickly! This looks tough, I will need help. Okay, this is easy..I can do it!	This is so confusing and time taking. Will I be able to resolve the issue myself? What if I damage the system even more	Don't know where and how to begin. Should I be troubleshooting myself first or should have contacted the customer / installer support directly?	This is taking time. I should have called the support in the first place. So much of back and forth with Enphase and Installers.	Finally the system is up and is working as expected
Feeling	Happy, Satisfied	Un-comforting, Worried about potential cost, downtime, etc	Neutral, confusing	Confusing, Overwhelmed, Need solution ASAP	Uncertain, Exhausted with the process	Confusing Time-Taking	Satisfied
Experience	Positive, Happy	Neutral	Neutral, confusing	Hopeful	Neutral, Satisfactory	Overwhelming	Happy, Satisfied
Opportunities	-	Linked via MyEnlighten App for easier understanding about the type of issues	Suggest possible ways to resolve the issue Suggest the expected resolution time Suggest possible reasons of the issue (because users try to figure out the reason also as per FB groups)	Systematic approach for self troubleshooting Easier identification of need for customer / installer support	Scenario based solution. Immediate suggestion for customer / installer support as and when needed	Systematic approach	-

Scope for the

Design intervention

The intervention specifically focuses on hardware-related issues that homeowners often face. These are issues that typically require professional intervention, but many of them can be *resolved by homeowners with proper guidance.*


Troubleshooting / Issue resolution journey
Customer Support
by Customer Support executives, remotely
Site Visit
by Enphase field technicians or the installers
Self resolution
by reading articles on Enphase website
App Issues
Hardware Issues
Remote Troubleshooting
Issue Diagnosis
Issue Resolution
Works?
No
Yes
Issue Resolved
Hardware Issue
Using FB groups / Enphase support pages
Microinverter issues
Battery issues
Gateway / Envoy issues
Metering issues
Production issues

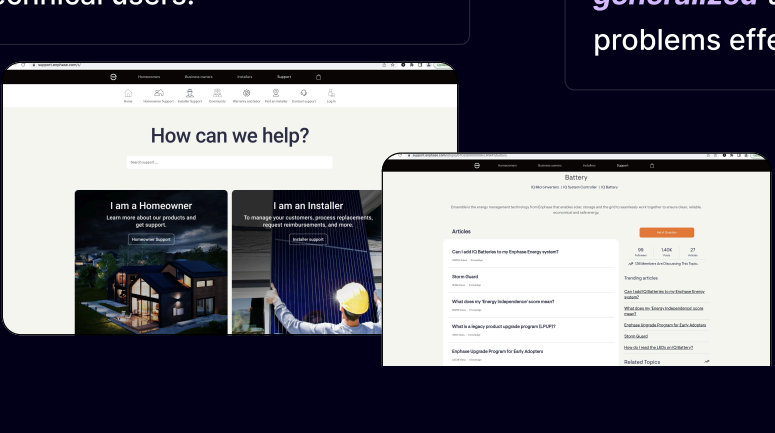
Existing channels for

First contact resolution

For homeowners, achieving FCR often depends on their ability to independently resolve issues using existing resources before reaching out to customer support.

Blogs and Articles
A repository of how-to guides and troubleshooting articles on company websites providing instructions for resolving common issues.

Drawbacks:
These resources, however, are often *static, text-heavy, and lack interactivity*, which can make them difficult to follow for non-technical users.

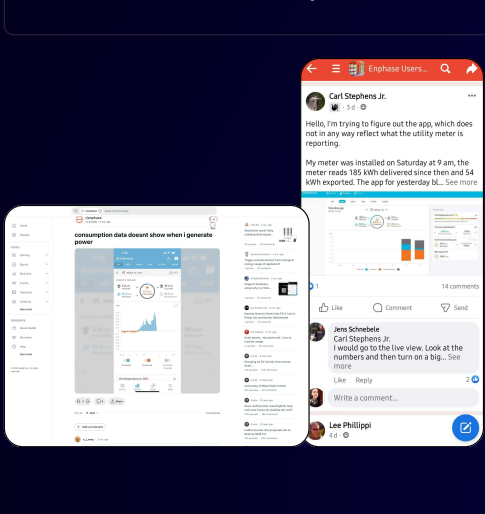

How can we help?
I am a Homeowner
I am an Installer
Battery

Online Communities
Facebook groups, Reddit forums, and other community platforms serve as spaces where users share experiences and solutions.

Drawbacks:
While these communities are valuable for peer-to-peer support, the advice is often *inconsistent, unverified, or too generalized* to address specific hardware problems effectively.

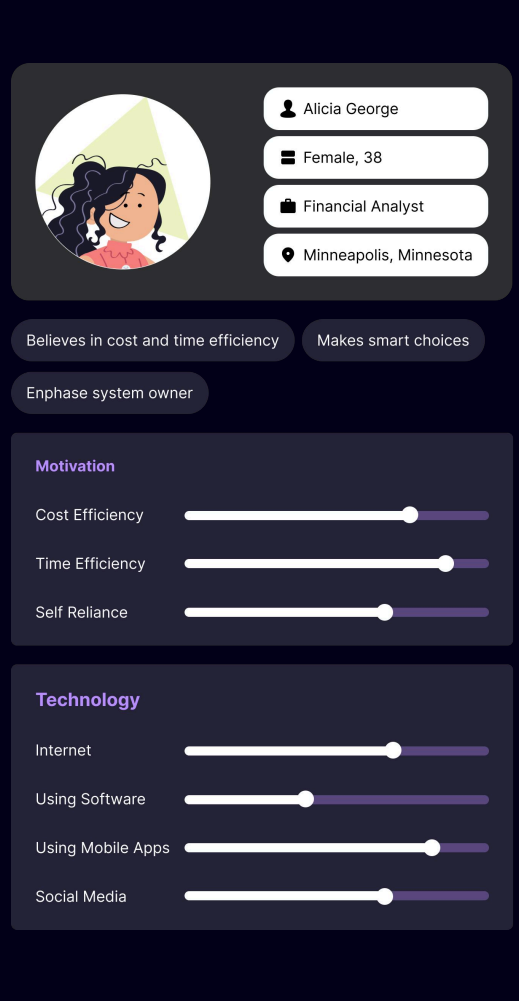
Product Manuals and Documentation
Traditional product manuals and PDFs are still available as a resource for troubleshooting

Drawbacks:
They often use *technical jargon*, making them *less user-friendly* for homeowners without technical expertise.



From the

Homeowner perspective



Alicia George
Female, 38
Financial Analyst
Minneapolis, Minnesota

Believes in cost and time efficiency
Makes smart choices
Enphase system owner

Motivation
Cost Efficiency
Time Efficiency
Self Reliance

Technology
Internet
Using Software
Using Mobile Apps
Social Media

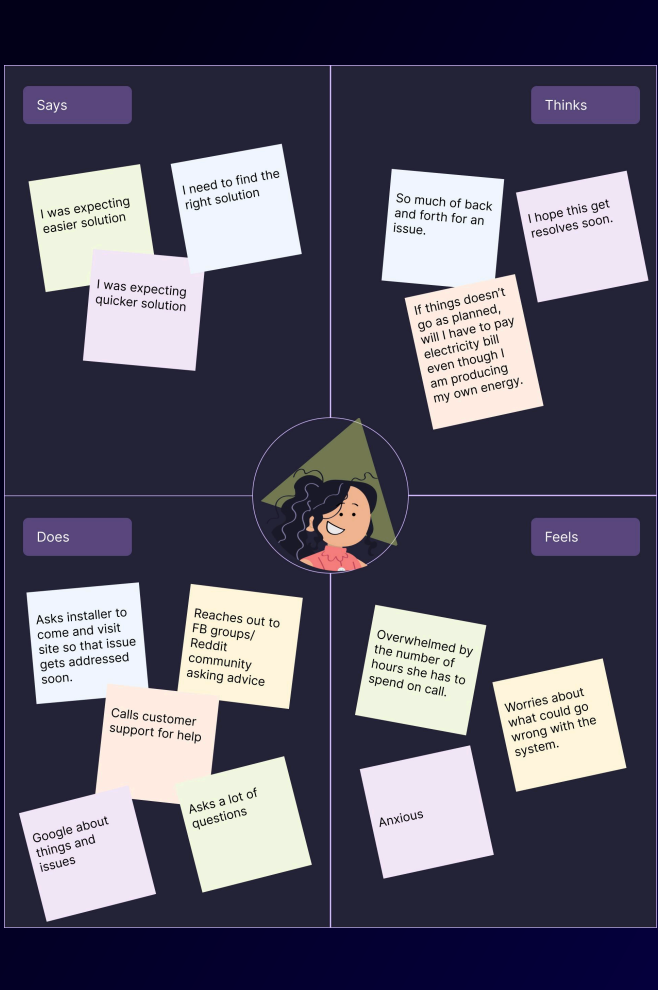
Bio

Alicia is a Financial Analyst living in Minneapolis. She is known for always making smart choices that reflects her financially smart decision making skills. She lives in her house with 2 kids and her husband. Their primary reason for settling down in Minneapolis is because the place offers a balanced solution between a city life and country-side. Before getting the Enphase System installed, she did her own research online and discussing with friends and colleagues and realized that this is the best way to get end to end solution for her needs. She wishes to gain energy independence in case of outages and wants to have best returns for the investment done in Enphase system.
She wishes to reduce her system downtime when any part of the system goes down and until she finds a way back to make the system up and running.

Goals
- Manage and work on finances very well which aligns with her husband and children's needs and lifestyle.
- Being able to sell additional energy produced by the system.
- Make smart investments and choices, such as reduction in electricity bills.
- To understand her daily energy needs and consumption.
- Being able to take smart financial decisions.
- Being grid independent in case of power failures.
- Get the understanding of her energy independence.
- Being proactive in tackling issues and troubleshooting them as early as possible.

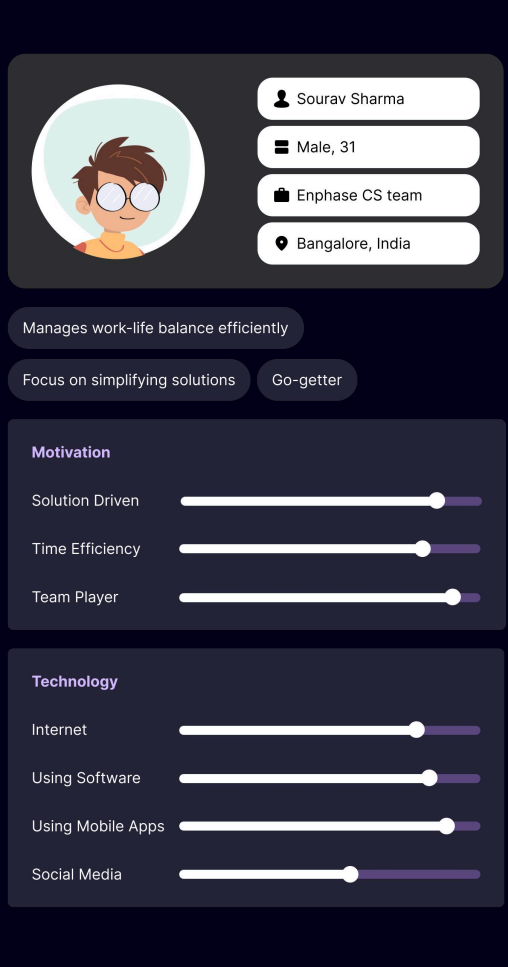
Frustration
- Unable to keep a track of the energy produced.
- Not knowing if the investment done in installing Enphase System was paying off.
- Unable to know how much energy is being imported from grid and how much was self generated.
- Not being able to see quantifiable results.

Needs
- To identify the right way of troubleshooting issues with the system.
- To find ways to reduce system downtime.


Says
I was expecting easier solution
I need to find the right solution
I was expecting quicker solution
Thinks
So much of back and forth for an issue.
I hope this get resolves soon.
If things doesn't go as planned, will I have to pay electricity bill even though I am producing my own energy.
Does
Asks installer to come and visit site so that issue gets addressed soon.
Reaches out to FB groups/ Reddit community asking advice
Calls customer support for help
Google about things and issues
Asks a lot of questions
Feels
Overwhelmed by the number of hours she has to spend on call.
Worries about what could go wrong with the system.
Anxious

From the

CS agent perspective



Sourav Sharma
Male, 31
Enphase CS team
Bangalore, India

Manages work-life balance efficiently
Focus on simplifying solutions
Go-getter

Motivation
Solution Driven
Time Efficiency
Team Player

Technology
Internet
Using Software
Using Mobile Apps
Social Media

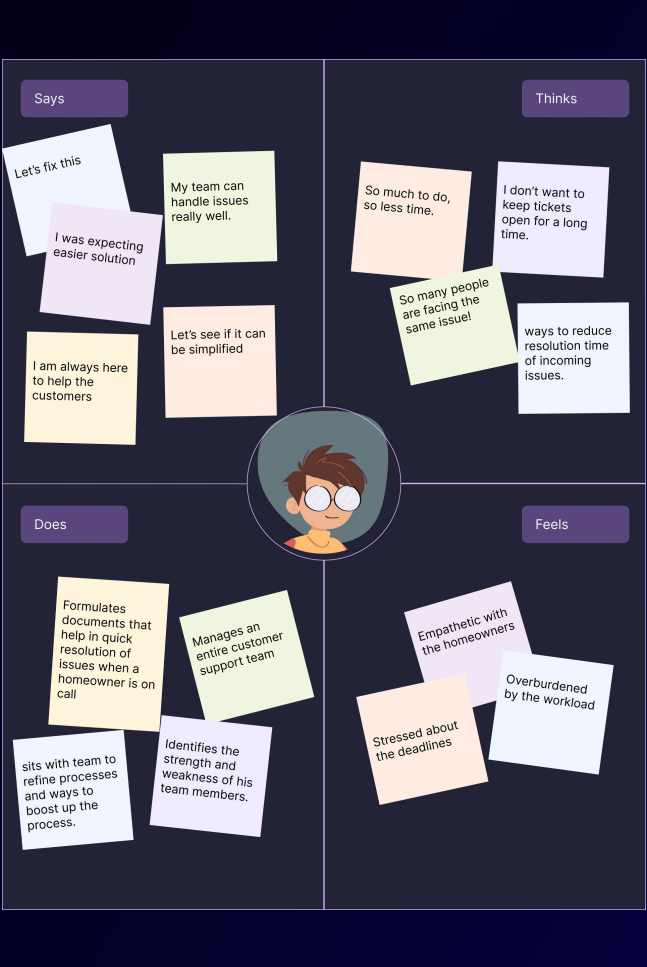
Bio

Sourav is a customer support lead working in Enphase office, Bangalore. He joined the team one and half year back and is a diligent employee. Within an year he has taken ownership of various tasks within the team which has helped him to move to the position of team lead. He understands the customer needs and acknowledges the tickets very well. The team receives various kinds of issues from the homeowners, such as micro-inverter, storage, envoy related and his expertise is in the battery related issues that homeowners face. He often gets overwhelmed by the number of calls people do in a day which are mostly for redundant issues such as Envoy not able to connect or batteries not reporting. These issues can be resolved very easily via right guidance to the users remotely.
He wishes to have a lesser number of calls from the homeowners especially for the redundant and recurring issues which can be resolved easily by the homeowners themselves.

Goals
- Manage work life balance in a more efficient manner.
- Get a bit more time for himself outside of work and related issues.
- Make his and the Enphase customer's life easier.
- Being able to take more informed and impactful decisions.
- Providing ways to identify and simplify the processes.
- To create an internal database that helps in quick resolution for the customers when they reach out to CS.

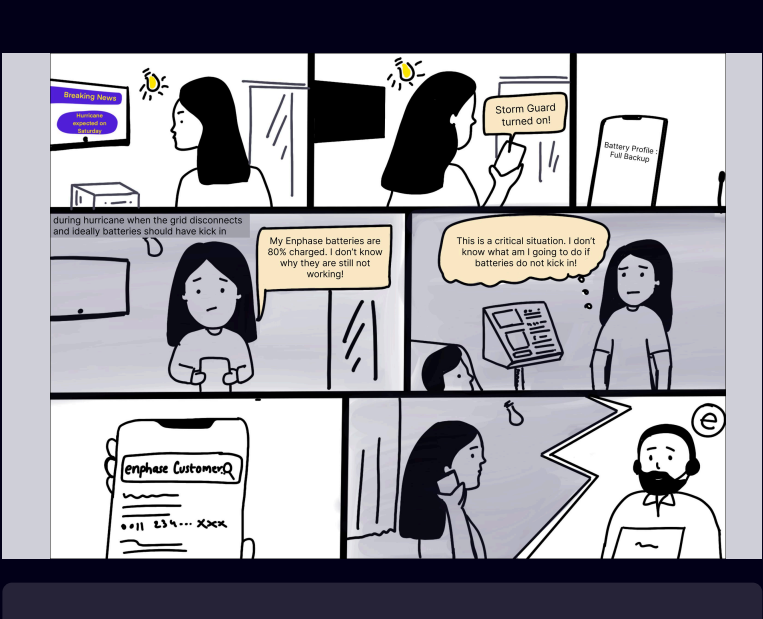
Frustration
- Redundant calls and requests for the problems homeowners face.
- Explaining customers each and every step to troubleshoot remotely.
- Unable to guide users using pre-defined templates.
- Unable to explain solution remotely to the customers.

Needs
- To guide users with the right and easy way of troubleshooting issues with their system.
- To find ways to reduce system downtime of homeowners.
- To have simple and effective solutions

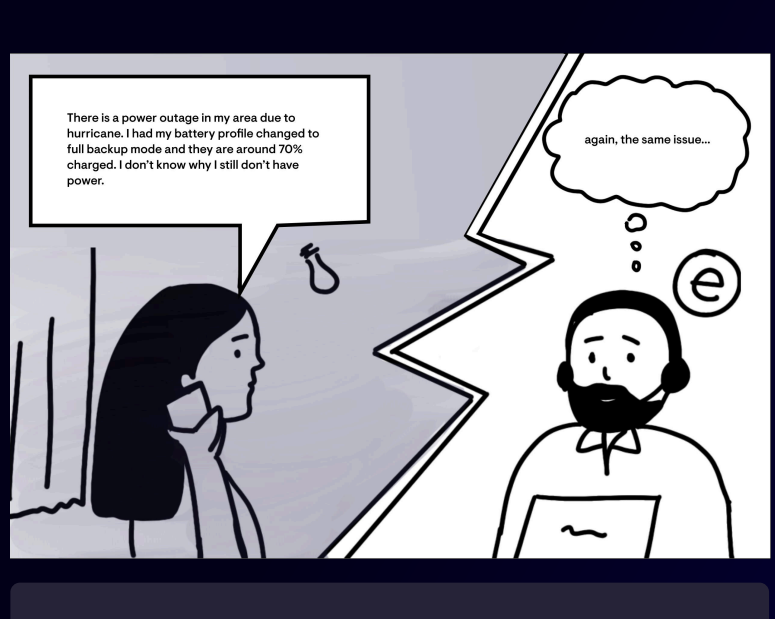

Says
Let's fix this
My team can handle issues really well.
I was expecting easier solution
Let's see if it can be simplified
I am always here to help the customers
Thinks
So much to do, so less time.
I don't want to keep tickets open for a long time.
So many people are facing the same issue!
ways to reduce resolution time of incoming issues.
Does
Formulates documents that help in quick resolution of issues when a homeowner is on call
Manages an entire customer support team
sits with team to refine processes and ways to boost up the process.
Identifies the strength and weakness of his team members.
Feels
Empathetic with the homeowners
Overburdened by the workload
Stressed about the deadlines

The contrasting

Scenario


Breaking News
Storm Guard turned on!
Battery profile Full Backup
during hurricane when the grid disconnects and ideally batteries should have kick in
My Enphase batteries are 80% charged. I don't know why they are still not working!
This is a critical situation. I don't know what am I going to do if batteries do not kick in!
enphase Customer

Alicia's side of the story
Alicia received a storm alert and charged her Enphase system batteries in preparation for a hurricane. When the grid went down, her batteries failed to activate. Trapped by the storm, she couldn't contact her installers. Her storage level was above 80%, but her critical medical equipment relied on power. Panicked, she called Enphase support. With remote guidance, the issue was resolved. Alicia sought a simpler solution to prevent future panics and ensure her family could easily access support during emergencies.


There is a power outage in my area due to hurricane. I had my battery profile changed to full backup mode and they are around 70% charged. I don't know why I still don't have power.
again, the same issue...

Sourav's side of the story
During storms, Sourav's team experiences a surge in calls from homeowners whose batteries fail to activate. He advises using generators or daytime battery power cycles for uncharged batteries. For charged batteries, homeowners require a complex procedure to *power cycle* them due to limited site access. Sourav seeks a simpler solution to improve homeowner experience and reduce call volume for his team.

Such issues are prominent in islands like Puerto Rico where hurricane season runs from June to September and for months there is no power from the grid. Only way to survive in such situations is through solar energy and therefore over the years more than 50k solar panel systems have been installed and by 2050 they are planning to get fully dependent on solar energy.

The guided

Solution

During situations like avalanche, hurricanes, heavy snowfall, and many other situations, the grid supply goes off.

Ideally in such scenarios the battery should kick in and power the devices at home.

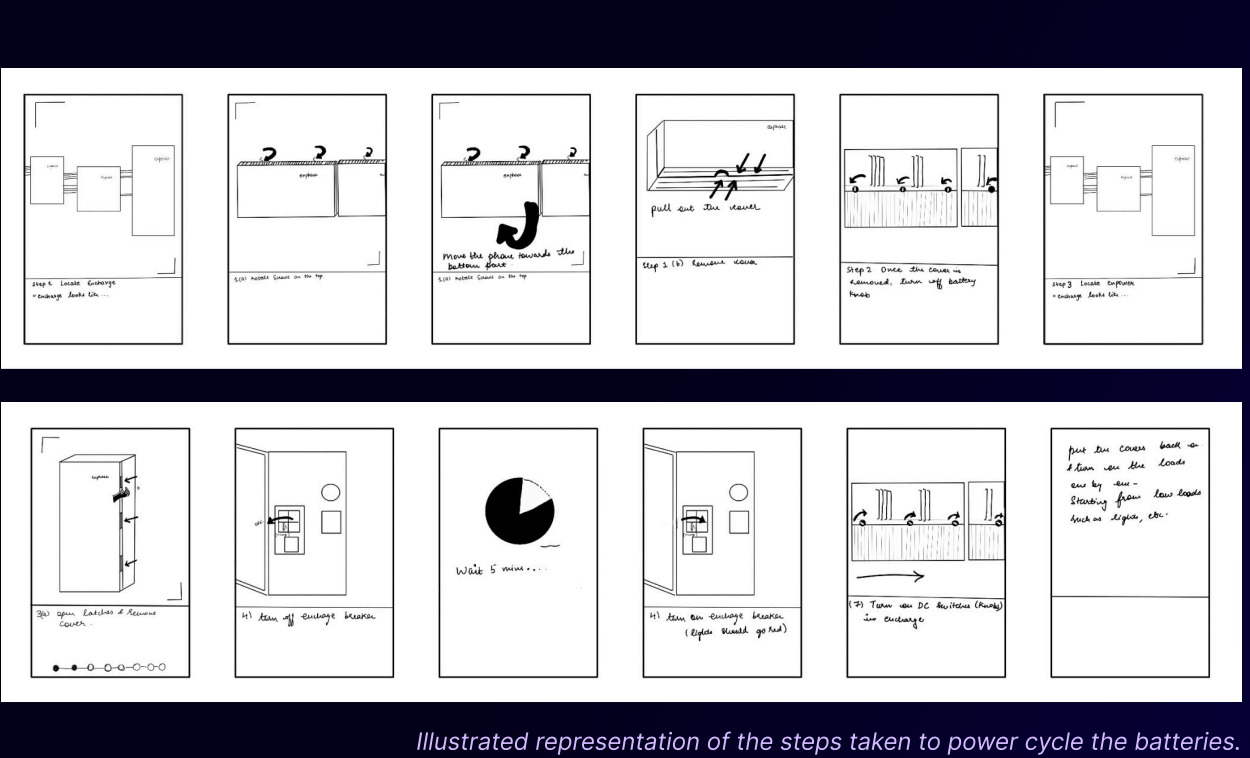
But in ~50% of the cases, the batteries are not kicking in and their is no power in the home

Due to heavy load, the stored power in the battery is not accessible to power all the home devices, and the only solution is to power cycle the batteries, the homeowners perform at their end since *no external help* is reachable.

It takes a *minimum of 25 minutes to guide the homeowner for this issue.*

Power cycling Enphase batteries involves a process of turning the power supply to the batteries off and then back on again, consisting of 5 major steps:

- Turn off the DC switches from Encharge
- Turn off the battery breaker in Enpower
- Wait 5 minutes
- Turn on the battery breaker in Enpower
- Turn on the DC switches from Encharge



Illustrated representation of the steps taken to power cycle the batteries.

What's the

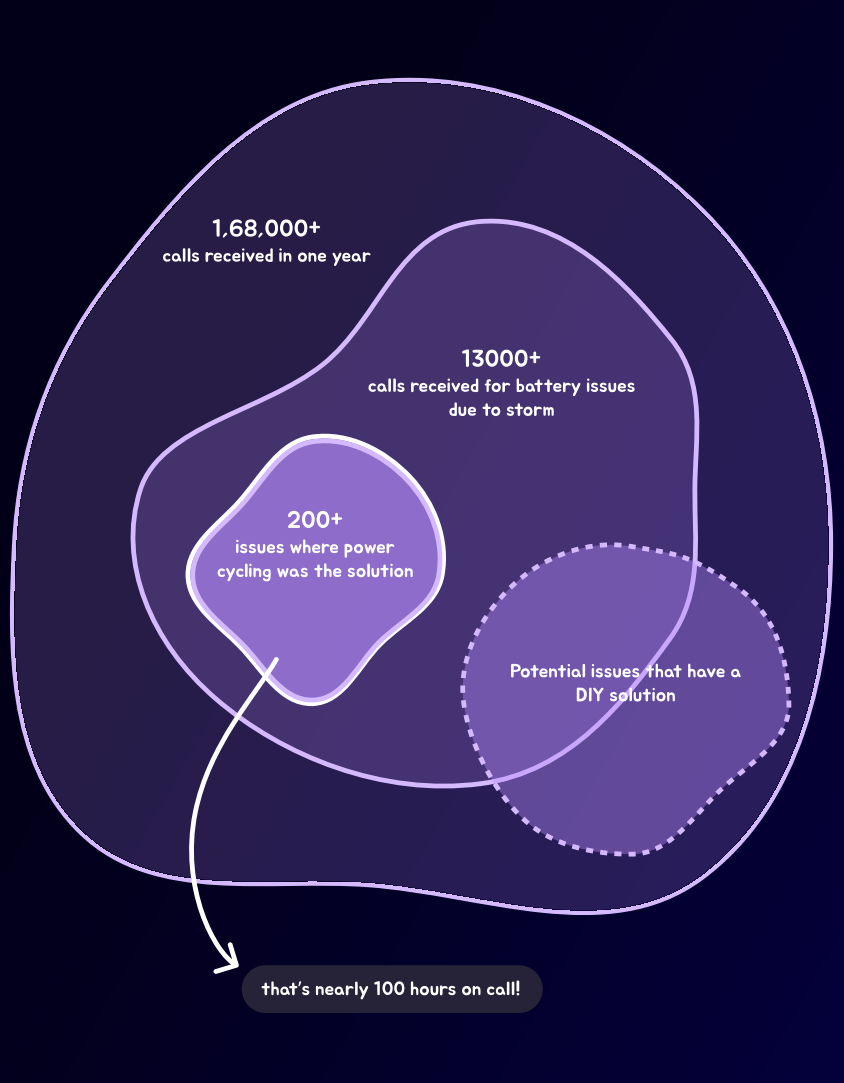
Big picture?

Autonomy Empowerment Faster Resolution

50,400+ calls
reduced for the CS team to handle in 365 days!

25,200+ hours
worth of efforts by CS team saved!

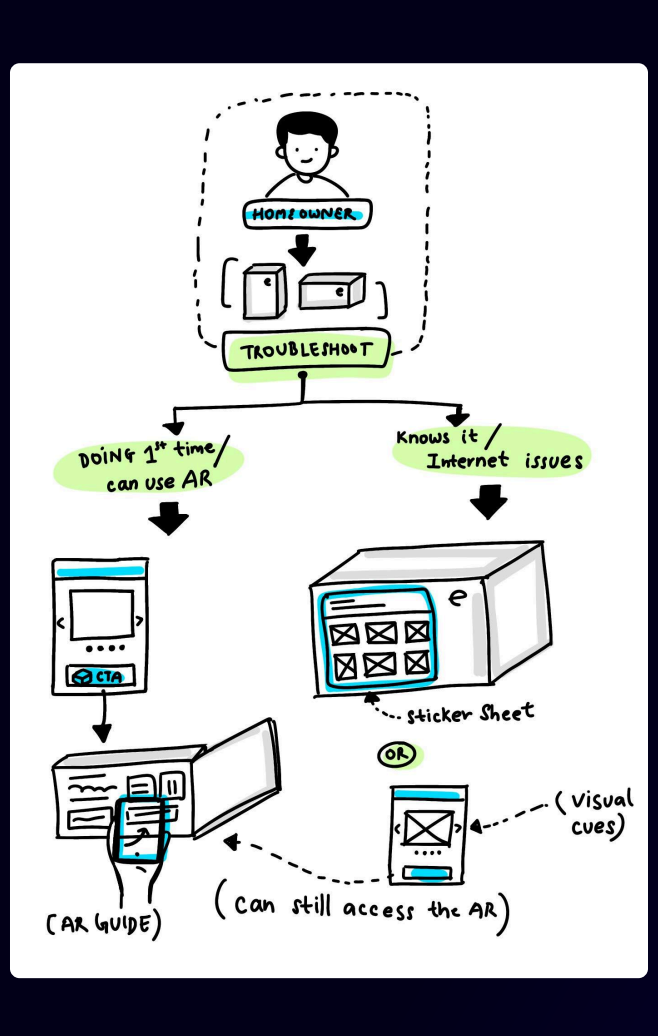
15,120+ homeowners
could feel empowered by gaining the autonomy and self-sufficiency to resolve issues on their own.


1.68.000+
calls received in one year
13000+
calls received for battery issues due to storm
200+
issues where power cycling was the solution
Potential issues that have a DIY solution
that's nearly 100 hours on call!

Numbers are guesstimates based on a sample yearly data / 2022.

A happy

Customer story


HOMEOWNER
TROUBLESHOOT
Doing 1st time/ can use AR
Knows it / Internet issues
Sticker Sheet
OR
(visual cues)
(AR GUIDE)
(can still access the AR)

The solution can be extended for similar use cases such as Gateway not connecting, Microinverters not reporting, etc. which can be solved using AR troubleshooting guide.

__30%__ of the issues for which the homeowners reach out to customer team can be resolved with this approach.

thank you!