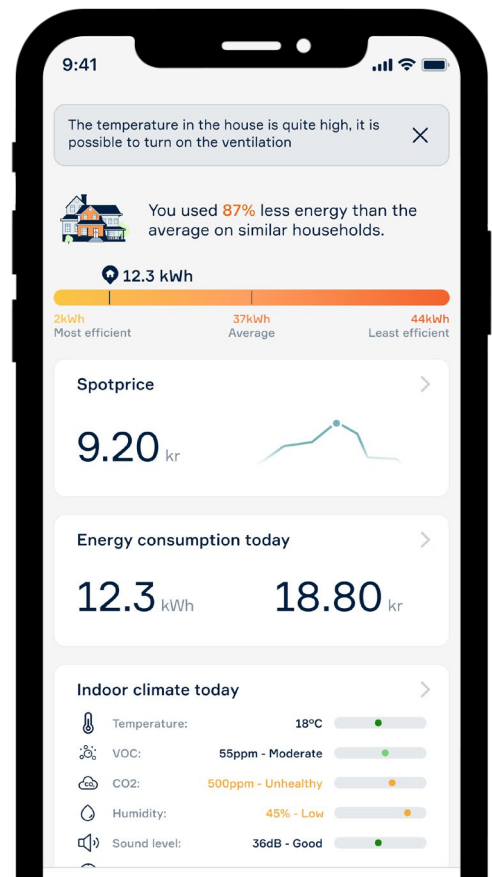


Electrical Demand Response Solutions for a Sustainable Future: Revolutionizing Grid Energy Management with an Intelligent Infrastructure Operating System for Homes and Buildings

Executive summary

Fell Tech's Abra Energy intelligent infrastructure platform system provides an all-encompassing solution for electric utility providers (EUPs) and customers to address the growing need for efficient energy management and demand response (DR) programs.

The system seamlessly integrates monitoring and control of energy consumption with a range of smart home features to promote sustainable energy usage and enhance living comfort. By tackling energy-related challenges such as grid stability, peak demand, and carbon emissions, Abra Energy creates a mutually beneficial ecosystem for EUPs and customers, paving the way for a more sustainable and efficient future.



Introduction

As the global population continues to grow and urbanize, energy consumption and the associated challenges for energy grids are becoming increasingly pressing issues. The widespread adoption of electric vehicles and the growing need for energy optimization solutions make it essential to explore innovative ways to manage and optimize home energy consumption. This whitepaper discusses the problem of increasing energy consumption, presents an effective solution, and introduces our state-of-the-art Smart Home System designed to revolutionize home energy management.

The Problem

The U.S. power grid is under growing strain due to increasing energy consumption and the rapid expansion of the electric vehicle (EV) market. Maintaining grid reliability and reducing peak demand are critical to avoid overloading the grid and integrating renewable energy sources. The escalating demand for energy optimization solutions presents a substantial market opportunity for companies that can address these challenges. Demand response programs offer a promising avenue for intelligently managing energy consumption, benefiting utility companies and end-users alike, and contributing to a more sustainable energy future.

2.1 Increasing Energy Consumption

The U.S. power grid is under growing strain due to rising energy consumption, which has been steadily increasing at an annual rate of 0.3% since 2010. By 2021, the total energy consumption reached approximately 4 trillion kWh, putting immense pressure on existing infrastructure and leading to higher energy costs for consumers and businesses alike. With an estimated \$4.5 trillion investment needed in U.S. energy infrastructure by 2025 to maintain grid stability and meet growing demands, there is a significant market for energy optimization solutions that can alleviate the strain on the grid and reduce costs for both end-users and utility companies.

2.2 Challenges in Grid Management Renewable Energy Integration

As energy demand grows, the grid faces numerous challenges, such as maintaining reliability, reducing peak demand, and integrating renewable energy sources that currently account for 21% of U.S. electricity generation. By 2025, renewables are expected to make up around 30% of global electricity generation. Addressing these challenges is essential for sustaining the energy grid and meeting market demands. Demand response programs and smart grid management solutions offer promising avenues for reducing peak demand, cutting costs, and creating a more sustainable energy future, while simultaneously minimizing carbon emissions and optimizing energy usage. Implementing smart grids can lead to a reduction of greenhouse gas emissions by 3.7 gigatons by 2050 and save up to \$157 billion in avoided grid infrastructure investments. (Rocky Mountain Institute, 2018)

2.3 Growing Adoption of Electric Vehicles

The electric vehicle (EV) market is experiencing rapid growth, with sales projected to grow at a compound annual growth rate (CAGR) of 29% from 2021 to 2030. By 2030, the number of EVs on the road is expected to reach 18.7 million, significantly impacting the energy grid as they collectively require an additional 50-90 GW of power during peak demand hours. This surge in EV adoption presents a substantial market opportunity for solutions that can optimize charging infrastructure and manage the added strain on the grid.

2.4 The Need for Energy Optimization

Optimizing energy usage is essential to address the challenges posed by increasing energy consumption, the growing adoption of electric vehicles, and the integration of renewable energy sources. Demand response programs, which intelligently manage energy consumption, can help utility companies and end-users alike navigate these challenges and capitalize on the growing market for grid optimization solutions. Demand response initiatives can reduce peak demand by 20% and help avoid or defer investments in grid infrastructure, saving U.S. consumers between \$3.3 billion and \$12.8 billion annually by 2025. (Brattle Group, 2016)

Peak shaving is a strategy used by utility companies and consumers to reduce energy consumption during periods of high demand, also known as peak hours. The main objective of peak shaving is to balance the electrical grid by minimizing stress on the system and preventing potential blackouts or power outages. This is typically achieved through demand response programs, which incentivize consumers to shift their energy-intensive activities to off-peak hours, or by implementing energy storage systems that store excess energy during low-demand periods for later use. By effectively managing peak demand, utility companies can improve the reliability and stability of the grid, reduce the need for costly infrastructure upgrades, and promote more efficient energy usage.

2.5 Impact of Peak Load Due to EV Charging in 2030

Based on the Edison Electric Institute's projections, there will be around 18.7 million electric vehicles in the US by 2030, with each vehicle consuming an average of 4,050 kWh annually. This results in an estimated total annual electricity consumption of 75.7 TWh for EV charging.

Peak Demand Periods and Load Control Requirements

During peak demand periods, typically late afternoons and early evenings, approximately 40% of total EV charging demand occurs. In 2030, this would equate to 30.3 TWh of electricity consumption for EV charging during peak hours. Assuming 5 peak hours per day and 365 days per year, the average power demand for EV charging during these peak periods would be around 16.5 GW.

Avoided Infrastructure Investments

Implementing Electrical Demand Response Solutions can help defer or avoid costly infrastructure upgrades at a local level, such as reinforcing distribution networks, upgrading transformers, and expanding substation capacities. The U.S. energy infrastructure requires an estimated \$4.5 trillion investment by 2025 to maintain grid stability and meet growing demands (ASCE, 2021). Smart grid management and demand response initiatives can save U.S. consumers between \$3.3 billion and \$12.8 billion annually by 2025 (Brattle Group, 2016), by reducing peak demand and thus avoiding or deferring some of these investments.

Considering the 16.5 GW of power demand reduction from electric car charging during peak hours, the potential cost savings in avoided power plant construction could be \$16.5 billion. Assuming a 30-year lifespan for power plants and a 5% discount rate, the annualized cost savings would be approximately \$1.1 billion. Implementing demand response solutions like those offered by Fell Tech can bring significant benefits to local communities and utility companies alike.

By effectively managing the growing demand for electricity due to electric vehicle adoption, utility companies can reduce the strain on the grid during peak hours and avoid costly local infrastructure investments. This approach helps to ensure grid stability and sustainability in the face of rapid growth in energy consumption and EV adoption.

Figure 1

Discover the benefits of our innovative solution that revolutionizes smart EV charging and peak shaving. Our state-of-the-art system intelligently manages your EV charging needs, reducing strain on the grid during peak demand hours, and ultimately saving you money. Embrace the future of sustainable living and contribute to a greener, more efficient energy landscape with our cutting-edge smart home solution.



The Solution

Demand response (DR) solutions address the challenges faced by the U.S. power grid by intelligently managing energy consumption during peak demand periods. Optimizing domestic water heater boilers and implementing smart electric car chargers through DR programs can help balance supply and demand, reduce energy costs, and improve grid stability. By shifting energy usage to off-peak hours and promoting renewable energy adoption, DR solutions contribute to a more sustainable and efficient energy future.

3.1 Electrical Demand Response Solutions

To address the challenges faced by the U.S. power grid, demand response (DR) solutions play a crucial role in intelligently managing energy consumption. DR programs incentivize customers to shift, reduce or curtail their energy usage during peak demand periods, effectively alleviating stress on the grid. By enabling utility companies to balance supply and demand, DR programs reduce the need for additional generation capacity and help integrate renewable energy sources.

3.2 Optimizing Domestic Water Heater Boilers

Domestic water heater boilers can be optimized through DR programs to improve energy efficiency and reduce peak demand. By remotely controlling the water heater boilers, utility companies can adjust their operation to off-peak hours or when renewable energy sources are abundant. This smart management approach results in reduced energy costs for customers, decreased carbon emissions, and a more stable grid.

3.3 Smart Electric Car Chargers

With the growing adoption of EVs, smart charging solutions are essential for managing the increased energy demand. By implementing DR programs for EV chargers, utility companies can encourage users to charge their vehicles during off-peak hours or when renewable energy generation is high. This not only helps manage the load on the grid but also reduces the overall cost of charging for EV owners. In the long run, smart EV chargers contribute to grid stability, energy savings, and the widespread adoption of renewable energy sources.

Innovative and new technologies such as V2G and V2X capable charging solutions also open up new markets, with the global V2G market expected to reach \$17.43 billion by 2027, growing at a CAGR of 48%. (Allied Market Research, 2020)

Figure 2

The US power grid faces increasing challenges, with the number of electric vehicles (EVs) predicted to reach 18.7 million by 2030, resulting in an additional peak load of 16.5 GW. Aging infrastructure, with 70% of transformers being 25 years or older, and extreme weather events contribute to the annual cost of power outages, estimated at \$25-\$70 billion. Innovative solutions like demand response programs and smart home technologies can help address these challenges.



Our Product

Intelligent Infrastructure Operating System for Homes and Buildings powers a seamless and user-friendly energy optimization and smart home management experience. It comprises the Linkbox+ IoT Hub, AbraLife App, and a smart switch for water heaters, which together enable efficient control of various energy-consuming devices and smart home features. The system is designed for scalability and future-proofing, with a modular architecture that accommodates the evolving energy landscape and the growth of smart home technologies. In addition, our solution offers an array of value-added features such as leakage and frost protection, humidity monitoring, fire and intrusion alarms, and customizable energy-saving settings, enhancing user experience and improving home safety, security, and comfort for end users.

4.1 Intelligent Infrastructure Operating System for Homes and Buildings

Home System powers our Electrical Demand Response Solution, enabling seamless integration and management of various energy-consuming devices.

4.2 Practical Components of Our Solution

Our solution is designed to offer a seamless and user-friendly experience in managing any home's energy consumption and smart home features. It comprises of three main components that work together to provide the user with an efficient and practical system:

a) Introducing the Abra Ecosystem:

A comprehensive and innovative solution designed to address the challenges of the evolving energy landscape. Our ecosystem seamlessly integrates smart home devices, electric vehicle (EV) chargers, and an advanced energy management platform to optimize energy consumption, reduce peak demand, and contribute to a sustainable energy future. At its core, the ecosystem comprises the Linkbox+ IoT Hub, AbraLife App, Abra OS, the Abra Energy Management Portal for Utility Companies, Smart Switch for water heaters, and our cutting-edge EV charger operating on OCPP with V2G technology.

b) Abra OS

Our innovative operating system that binds the Abra Ecosystem together, creating a seamless and unified experience for both end-users and utility companies.

As the central nervous system of the ecosystem, Abra OS connects and synchronizes all components, including the Linkbox+ IoT Hub, AbraLife App, Smart Switch for water heaters, and the advanced EV charger, ensuring smooth and efficient operation. Abra OS uses advanced algorithms and machine learning to analyze energy consumption patterns, optimize device performance, and intelligently manage energy distribution throughout the smart home system. By integrating with the Abra Energy Management Portal, the OS enables utility companies to monitor, control, and optimize energy usage across their customer base in real-time.

Designed with a focus on security, Abra OS employs robust encryption and data protection measures, ensuring that user data and privacy are safeguarded. The operating system's modular and scalable architecture allows for easy integration of new devices, features, and updates, making it a future-proof solution that can adapt to the ever-changing energy landscape and smart home technologies.

In essence, the Abra OS is the cohesive force that brings the Abra Ecosystem to life, delivering an unparalleled smart home experience that simplifies energy management and enhances the overall quality of life for homeowners, while empowering utility companies to embrace modern energy strategies.

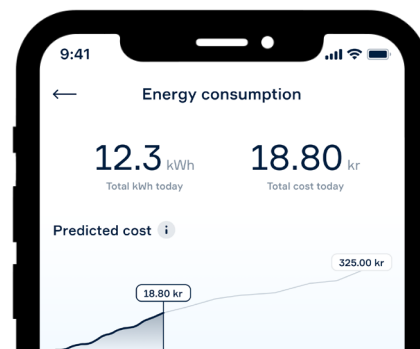
Utility companies benefit from the Abra Energy Management Portal, a powerful tool that allows real-time monitoring, control, and optimization of energy usage across their customer base. The ecosystem's modular architecture ensures scalability, compatibility, and future-proofing, making it an ideal solution for both end-users and utility companies. By combining state-of-the-art technology with user-friendly design, the Abra Ecosystem delivers an unparalleled smart home experience that enhances energy management, safety, security, and comfort for homeowners while empowering utility companies to modernize their energy strategies.

Figure 3

Always in control:

With the AbraLife App the user is ensured to enjoy all benefits of our cutting-edge smart home ecosystem.

Unlock a sustainable, smart, and efficient future with cutting-edge energy management solutions.



The Abra Energy Management Portal is a web-based platform designed for utility companies to monitor, control, and optimize energy usage across their customer base. It provides real-time data and analytics, empowering utilities to implement demand response strategies and prevent blackouts. The portal's dashboard displays energy consumption patterns, EV charging schedules, and smart home device usage, while also offering individual customer insights for personalized solutions. This innovative tool helps utilities optimize resources, enhance customer satisfaction, and contribute to a sustainable energy future.

Our intelligent EV charging management system operates on the Open Charge Point Protocol (OCPP), ensuring compatibility with various chargers and networks. The system manages EV charging during off-peak hours, reducing grid strain and saving costs for homeowners. Additionally, our solution supports Vehicle-to-Grid (V2G) technology, enabling bidirectional energy flow between EVs and the grid, contributing to grid stability and potential financial benefits for homeowners. Overall, our smart EV charging system offers an efficient, eco-friendly, and cost-effective experience.

c) Linkbox+ IoT Hub:

The Linkbox+ is the heart of our solution. This smart IoT hub monitors energy consumption, controls various smart home devices, including EV charger, and connects to cloud-based services. The Linkbox+ ensures that the entire system operates harmoniously and efficiently.

d) Abralife App:

The Abra life App is the personal gateway to interact with the Linkbox+ and manage all aspects of the user's home. With this intuitive and easy-to-use platform, the user will have complete control over all the information and functions of your home. The app is available on both Android and iOS devices, ensuring compatibility with whichever preferred device.

e) Abra Energy Management Portal for Utility Companies:

The Abra Energy Management Portal is a powerful and user-friendly web-based platform designed specifically for utility companies to effectively monitor, control, and optimize energy usage across their customer base. The portal provides real-time data and analytics, enabling utilities to make informed decisions and implement demand response strategies to balance grid load and prevent blackouts during peak demand periods.

The portal's intuitive dashboard displays an overview of energy consumption patterns, EV charging schedules, and smart home device usage across the entire network. Utility companies can also access individual customer profiles to gain deeper insights and tailor personalized energy management solutions. The Abra Energy Management Portal supports seamless integration with utility companies' existing systems and infrastructure, ensuring a smooth transition and minimal disruption to operations.

With the ability to manage large-scale demand response events, monitor grid stability, and access valuable data, the Abra Energy Management Portal empowers utility companies to optimize their resources, enhance customer satisfaction, and contribute to a more sustainable energy future. This innovative tool positions our solution as a valuable asset for utility companies seeking to modernize their energy management strategies and adapt to the evolving energy landscape.

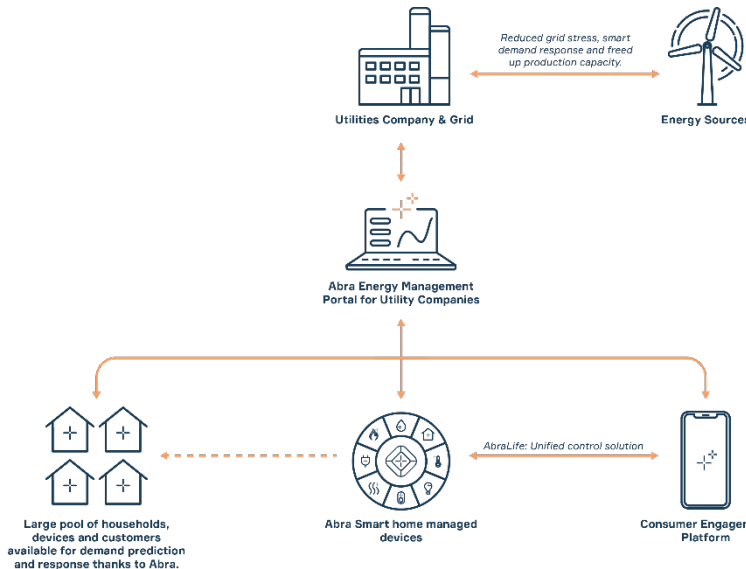


Figure 4
Abra Energy Management Portal and ecosystem connected to Abra home platforms for portfolio management of grid demand.

f) Smart Load Switch for Water Heaters:

Our solution includes a smart switch that connects to and controls to the water heater. This device empowers households to optimize the domestic water heater boiler's energy consumption, ultimately saving money on utility bills and contributing to a more sustainable energy consumption pattern.

Unlock a sustainable, smart, and efficient future with cutting-edge energy management solutions.

Our product's success and widespread adoption are bolstered by strategic partnerships with utility companies, renewable energy providers, and smart home technology manufacturers. These collaborations ensure alignment with existing infrastructure, regulatory requirements, integration of clean energy sources, and compatibility with various devices and platforms.

For distribution and customer acquisition, we offer three pricing models: Pure Energy Optimization Approach, Freemium Model, and Incentivized Upgrade Model. In the Pure Energy Optimization Approach, partners receive a 20% discount on the B2B Price, while the Freemium Model offers a 50% discount, enabling users to access basic Smart Home features for free. The Incentivized Upgrade Model eliminates the B2B Price, motivating partners to promote premium subscriptions. These pricing structures allow partners to choose the most suitable model for their businesses, ensuring efficient implementation and marketing of our state-of-the-art smart home solution.

g) Smart EV Charging with OCPP and V2G Support:

Our solution incorporates an intelligent EV charging management system that operates on the Open Charge Point Protocol (OCPP). OCPP is a universally accepted communication standard between EV charging stations and central management systems, ensuring compatibility with various chargers and networks. This allows our system to efficiently manage your EV charging process during off-peak hours, reducing strain on the grid and ensuring cost savings for homeowners. Additionally, our EV charging solution supports Vehicle-to-Grid (V2G) technology, enabling bidirectional energy flow between your electric vehicle and the grid. This means that, when necessary, the energy stored in your EV's battery can be sent back to the grid to help balance supply and demand during peak load periods. Conversely, your EV can charge during off-peak hours when electricity demand and prices are lower. This innovative V2G technology not only contributes to a more stable and reliable energy grid but also presents potential financial benefits for homeowners participating in demand response programs or leveraging time-of-use pricing. Overall, our smart EV charging system ensures an efficient, eco-friendly, and cost-effective charging experience for you and your electric vehicle.

4.3 Scalability and Futureproofing

Our product is designed to accommodate the evolving energy landscape and the growth of smart home technologies. Its modular architecture enables seamless integration of new hardware and software features as they become available. The scalability of our solution ensures utility companies can manage increasing energy demands and adapt to changes in consumer behavior. The system's cloud-based infrastructure ensures that updates can be delivered remotely, keeping the product up-to-date and future-proof.

4.4 Value-Added Features

Our smart home system offers an array of value-added features, enhancing the user experience and increasing the overall utility of the product. These features include leakage and frost protection, humidity monitoring, fire and intrusion alarms, and customizable energy-saving settings. By incorporating these features, we create a comprehensive smart home system that not only addresses energy management but also improves home safety, security, and comfort for end users.

4.5 Strategic Partnerships

To ensure the success and widespread adoption of our product, we forge strategic partnerships with utility companies, renewable energy providers, and property management companies needing EV charging management systems. Collaborating with utility companies allows us to align our solution with their existing infrastructure and regulatory requirements. Partnerships with renewable energy providers enable the integration of clean energy sources into our solution, further promoting sustainability. By working with smart home technology manufacturers, we ensure seamless compatibility with a wide range of devices and platforms, offering a truly integrated and versatile solution for end users.

4.6 Distribution and Customer Acquisition

4.6.1 Pure Energy Optimization Approach

In this model, utility companies install our product in users' homes at their own expense, focusing only on energy optimization without necessarily informing about or "up-selling" any of the Smart Home features to their end-users. This solution comes at no cost and minimum benefits to the end-users and households. With this model, the partners receive a 20% discount on the B2B Price, should the end-user household by chance choose to upgrade on a subscription on Smart Home features. The net discount for the utility company is generated based on the number of units with end-user subscription, multiplied by 20% discount on the utility company cost for the solution. This model primarily benefits our partners.

We offer two main delivery and financing models for our partners: Comprehensive Delivery Model, which includes licensed software, hardware, and installation costs in one monthly price; and Flexible Delivery Model, where partners manage and finance the installation process. Catering to diverse partner needs, we ensure efficient implementation of our smart home solution. Our solution's low monthly subscription fee ensures affordability and value for end customers.

4.6.2 Freemium Model

Utility companies install our product in user homes at their own expense, and users get access to basic Smart Home features for free. Users have the ability to upgrade to a full Smart Home experience with a monthly subscription. For the Freemium Model, partners benefit from a 50% discount on the B2B Price. This attractive pricing option allows partners to encourage end-users to try the basic smart home features for free. The net discount for the utility company is generated based on the number of units with end-user subscription, multiplied by 50% discount on the utility company cost for the solution.

4.6.3 Incentivized Upgrade Model

Our product is installed in users' homes either at the utility companies' or shared expenses, by upgrading end-users to a premium subscription, where this is heavily advertised and incentivized. The Incentivized Upgrade Model entirely discounts the B2B Price for our partners, motivating them to promote the upgrade to a premium subscription for end-users. Net discount is again generated based on the number of end-user subscription, multiplied by 100% discount on the utility company cost for the solution.

These pricing structures allow our partners to select the most appropriate model for their business, ensuring that they can efficiently implement and market our state-of-the-art smart home solution to their customers.

4.7 Our Delivery Model to Partners

We understand the importance of flexibility and adaptability in delivering our solution to partners. To address their varying needs, we offer two main delivery and financing models that accommodate different preferences and requirements:

- Comprehensive Delivery Model:

This model includes our licensed application and software, along with hardware and installation costs, all combined into a single monthly price. With this approach, the partner can either manage the installation process themselves, or we (Fell Tech) can manage it as a collaboration or on behalf of the partner. This option provides a complete package for our partners, ensuring a smooth implementation of our solution.

- Flexible Delivery Model:

In this model, our partners receive our licensed application and software, as well as the hardware, both rolled into one monthly price. The partner is responsible for managing and financing the installation process. This option provides our partners with greater flexibility in handling the implementation of our solution while still benefiting from the core components of our system.

By offering these two distinct delivery models, we cater to the diverse needs of our partners, ensuring that they can efficiently and effectively implement our state-of-the-art smart home solution into their customers' homes.

In Conclusion

Fell Tech has developed a cutting-edge ecosystem Abra for homes, buildings and energy systems to address the US energy grid's challenges, including rising energy consumption, electric vehicle adoption, and energy optimization. Our comprehensive, user-friendly solution combines electrical demand response, optimized water heater boilers, and smart electric car chargers, benefiting end-users and utility companies alike.

Our product's modular architecture ensures scalability, future-proofing, and seamless integration with various devices and platforms. We provide strategic partnerships, diverse distribution, and customer acquisition models for efficient implementation and marketing. Our flexible delivery and financing models cater to partners' preferences and requirements, ensuring effective implementation in customers' homes.

With substantial growth potential, Fell Tech offers stakeholders a promising value proposition in the growing smart home and energy optimization markets. By addressing energy management needs and enhancing home safety, security, and comfort, Fell Tech's smart ecosystem Abra for homes, buildings and energy systems presents a timely solution to the challenges faced by the US energy grid and homeowners.

Resources

Fell Tech is a green-tech company. We are passionately committed to enhancing lives, protecting assets, and promoting sustainability through innovative products and services delivered through exceptional customer experiences. Our cutting-edge products and services, including Home & Building, Marine, and Energy solutions, are designed to elevate daily living, ensure safety, and reduce energy consumption.

Fell Tech was founded in 2013, driven by a mission to revolutionize the future of IoT safety and security products across various industries. With a commitment to enhancing safety, freedom, and convenience, our innovative solutions captivate our customers.

Initially focused on the marine market, Fell Tech has expanded into other sectors, including home and building management, while maintaining our core principle: prioritizing our customers' needs and well-being as the guiding force behind all our products.

For more information, visit www.felltech.io

Additional resources:

- Abra Smart Home System: www.abralife.no
- Fell Tech Energy Business Area: www.felltech.io/energy