GENIUS Q

CLIENT CASE STUDY

Ensuring Safety and Efficiency with GENIUS

Revolutionizing Home Energy Management with GENIUSQ AI Infrastructure Technology

The emergence of the prosumer movement and the evolution of the grid edge are reshaping the traditional utility-consumer relationship, transforming consumers from passive recipients to active participants in the energy transition. This shift is driven by the proliferation of rooftop solar, home energy storage, and distributed energy resources (DERs), highlighting the importance of grid-edge innovations and community energy initiatives.

Consumers are no longer merely consumers; they are prosumers actively shaping the energy landscape. At the grid edge, where consumers interact directly with energy systems, better data quality, validity, and granularity are achieved, leading to low latency, high reliability, and scalability. This proximity to data sources enables predictive infrastructure and empowers citizens to be part of the solution.

Overview:

GENIUS, a groundbreaking innovation in autonomous home energy management, is transforming how homeowners interact with their electrical systems. This case study explores a real-world implementation of GENIUS in a residential home facing increasing energy demands, highlighting the measurable benefits and impact of its intelligent, solid-state technology and providing real world responsiveness with embedded safety algorithms for whole home protection.

GENIUS is an infrastructure technology for energy consumers and providers. It was developed over 18 years of R&D and real-life pilots since 2009. It's intended objective was to align the needs of consumers with that of energy providers and simplifying the energy lifestyle of each unique homeowner through autonomous operation while providing a grid edge technology that instantly readies each installation for networked connectively to power providers.

Objective accomplished.

Background:

Jigar Shah, Former Director, DOE Loan Programs Office, Advisory Services-Multiplier,

- **Location:** Maryland, United States - foothill region within the Appalachian Mountains
- **Home Specifications:**
  - 2,000 square feet
  - 400-amp service
  - GENIUS @ 2
  - 54 circuits
  - 6.4kw Solar
  - Tesla Powerwall/ Gateway
  - Energy demands: EV chargers, heat pump & heat pump water tank, induction range, and home office equipment

The homeowner faced a task of identifying the best solution possible for integrating renewable energy assets while electrifying his new home. As a professional with a very busy lifestyle, simplicity was first and foremost. As equally important, a resilient system that is dependable and serves as a holistic energy management system offering autonomous operation and safety algorithms to protect appliances and their investment for years to come.

Challenges:

Current smart panels often rely on third-party devices like smart plugs, switches, and sensors to achieve limited energy management and automation. While these solutions have helped improve energy efficiency for essential loads, they come with significant drawbacks compared to the integrated, autonomous design of GENIUS. Below is a detailed comparison:

Current Smart Panels: Reliance on Third-Party Components

1. **Dependence on Smart Plugs and Switches**
   - **Drawback**: These panels require external hardware (smart plugs, switches, or relays) to monitor and control individual circuits or devices.
   - **Challenge**: Each component must be purchased, installed, and maintained separately, increasing cost and complexity.
   - **Limitation**: External devices often lack seamless integration, leading to inefficiencies in communication and control.
2. **Manual Configuration and Monitoring**
   - **Drawback**: Homeowners need to set up rules, schedules, and automations manually through apps or third-party platforms.
   - **Challenge**: Limited adaptability to changing energy needs or unexpected usage patterns without manual adjustments.
3. **Vulnerability to Compatibility Issues**
   - **Drawback**: These systems depend on compatibility with specific devices or ecosystems, limiting flexibility when adding new devices or technologies.

- **Challenge**: Firmware updates or discontinuation of third-party components can disrupt the system's functionality.

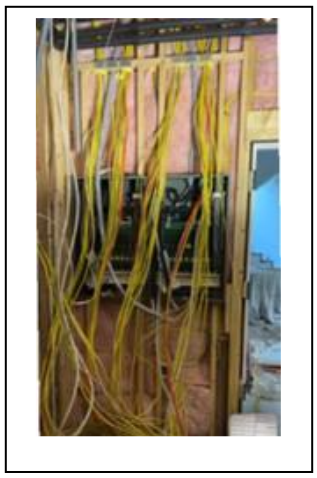
4. **Dependence on Active Internet connection**
   - **Drawback**: Current smart panels and add on equipment depend on an active internet connection for manual intervention by homeowner for energy management.
   - **Challenge**: This approach leads to suboptimal energy management and higher utility costs.

Results:

1. **Increased Energy Demand:** The addition of an EV charger, new appliances, and home office equipment added additional load that could not be reduced.
2. **Energy Management Inefficiencies:** Traditional load management devices could not provide real-time optimization for the entire home.

Installation:

Rough-in



Connection

Testing & Initialization

After consultation with all parties the process began for rough-in, connection and initialization of the entire system. Testing was performed to ensure all connections and integrated assets functioned in accordance with all manufacturer's specifications.

Programming and Prioritization:

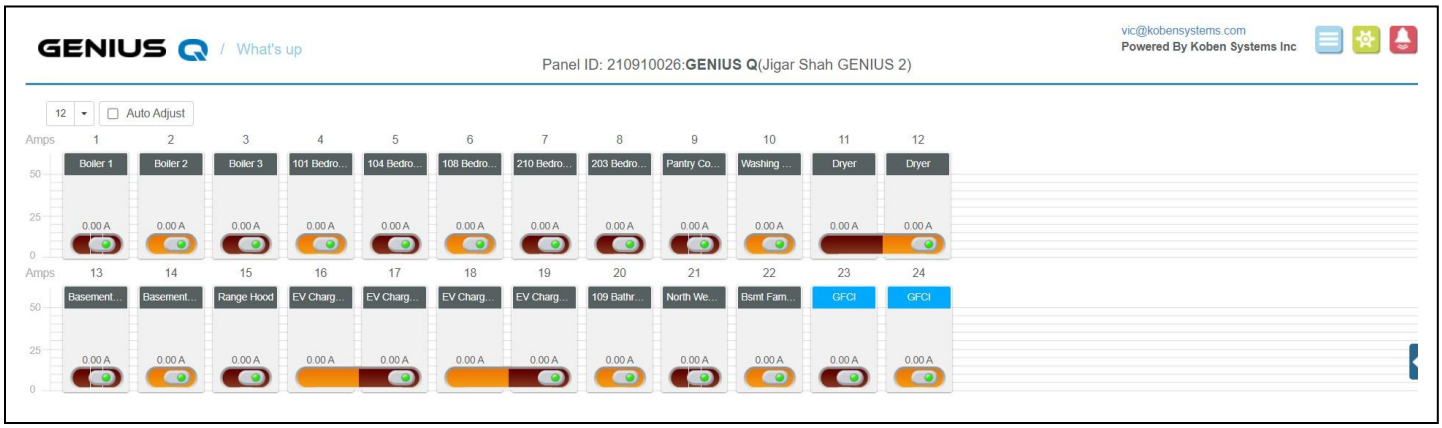
After careful consideration for the homeowner's energy lifestyle, a circuit map was created to identify which circuits required certain levels of priority. GENIUS has levels 1-5, 1 being the highest level of importance.

One of the benefits of AI in GENIUS is the virtual breakers. This allows us to match the physical breakers for amperage, overload threshold and time delay for each breaker to deal with inrush currents for specific equipment such as an air conditioner upon startup.

Internal options for each circuit are available to identify sensitive loads that require additional protection beyond typical mechanical breaker protective characteristics.

GENIUS 1

GENIUS 2



Key Features Implemented:

1. **Dynamic Load Management:**
   - GENIUS was programmed to match the home's existing 400-amp service.
   - Embedded AI redistributed energy across circuits in real time to prevent overloads.
2. **Whole-Home Circuit Management:**
   - Every circuit in the home is monitored and managed autonomously, prioritizing critical systems like HVAC and refrigeration during peak demand.
3. **Real-Time Optimization:**
   - The panel's solid-state technology dynamically balanced loads across phases, eliminating nuisance trips and maximizing efficiency.

4. **Phase Balancing:**
    - Each GENIUS system has embedded phase balancing for even distribution across all phases. This is especially important for longevity of appliances and sensitive equipment.
5. **Scalable Design:**
    - The system was configured to accommodate additions such as solar panels, home batteries, and additional EV chargers.
6. **Built in Protection:**
    - Real time alerts and protection for overload, short circuit, arc / sparks, and voltage surge / lightning protection

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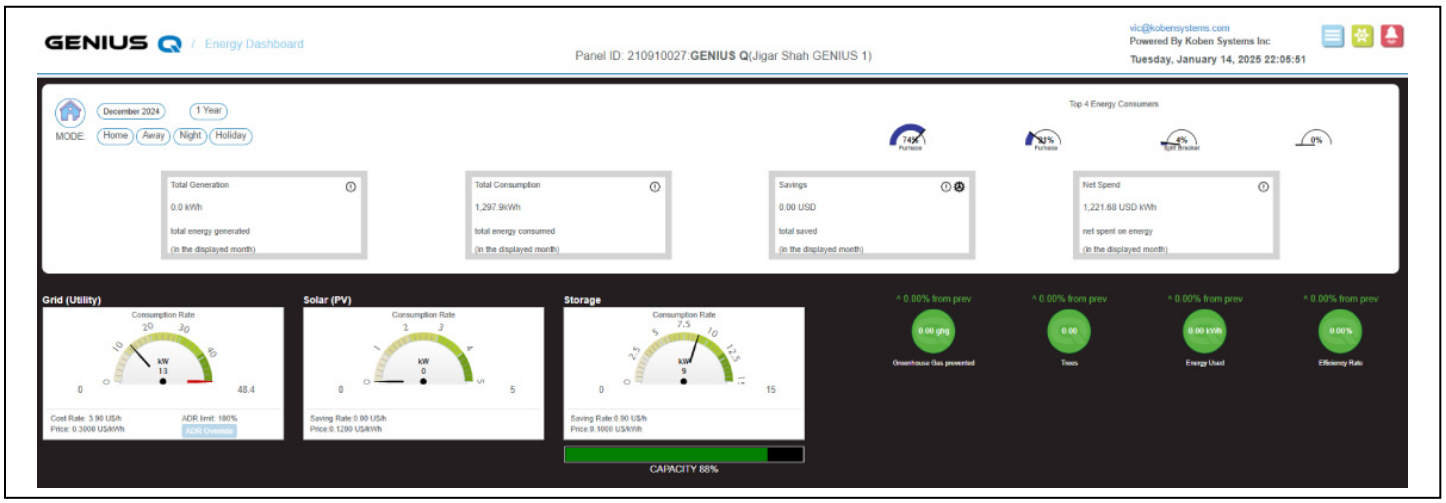
GENIUSQ Energy Dashboard



The GENIUSQ dashboard provides a one-stop summary of activity in real-time of the home's energy activity. GENIUS operates autonomously after all preset parameters are programmed in accordance with the homeowner's energy lifestyle providing a "set it and forget it" experience.

Multiple apps are not required as GENIUS operates from a capacity perspective ensuring energy is distributed evenly across al phases. Communication is via the internet however does not impede performance in the event the internet signal is lost. GENIUS will continue to operate autonomously until communication is restored. All data is collected on prem and then pushed to the server for retention and data analytics.

Post Installation Issues:

This installation went live in August 2023 and handed off to the homeowner.

How GENIUS Prevented a Potential Electrical Fire Through Advanced Diagnostics and Real-Time Monitoring

Problem Identified: Lack of Phase – Street side main
Equipment: Meter Base – 400Amp – two bolt-on 200A main breakers
Utility: SMECO - Southern Maryland Electric Cooperative

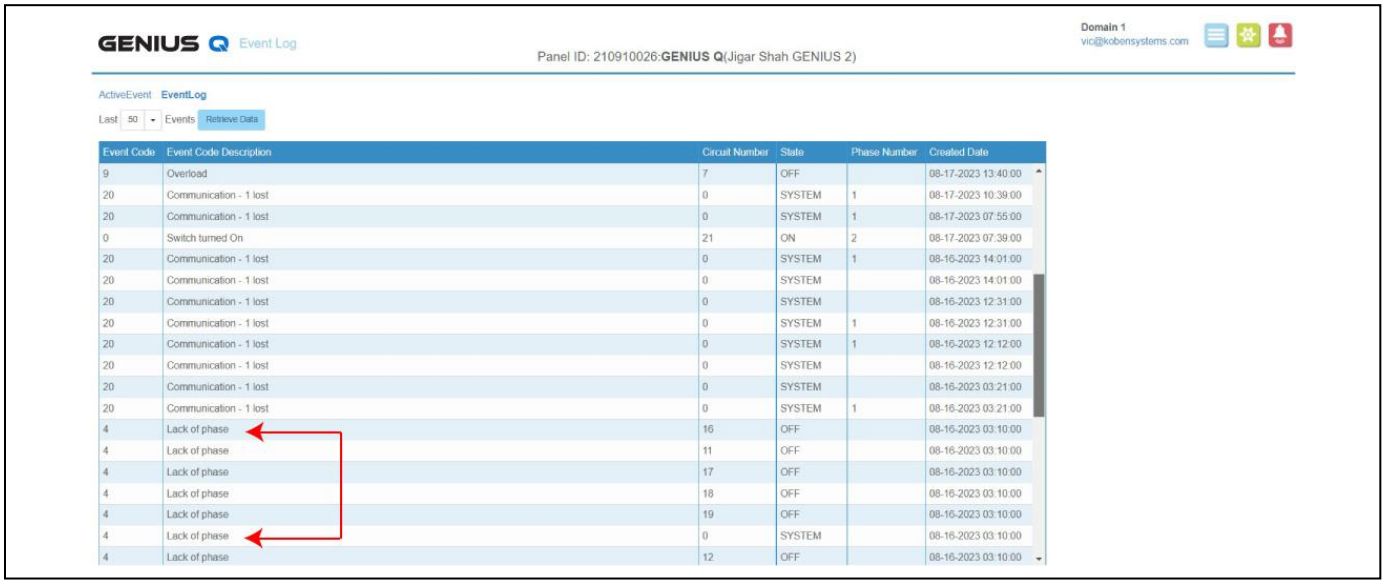
Identifying the Problem

During a routine remote diagnostic session, an intermittent phase loss was detected in the electrical system of a newly built home. Phase 1 (L1) exhibited voltage drops and rises, causing an increase in conductor temperature. The home was unoccupied at the time, increasing the risk of undetected electrical issues escalating into serious hazards.

How GENIUS Diagnosed the Issue

GENIUS, a solid-state electrical panel with embedded AI and real-time monitoring and alert capabilities, continuously measures all system parameters, including voltage, current, and connections across the grid, distributed energy resources (DERs), and loads. It also monitors voltage drops at critical connection points, including neutral and mains.

Using its protective algorithms and multiple monitoring points, GENIUS quickly identified the intermittent loss of Phase 1 (L1). The system isolated the issue and guided the troubleshooting process, beginning with the street-side service and moving inward.



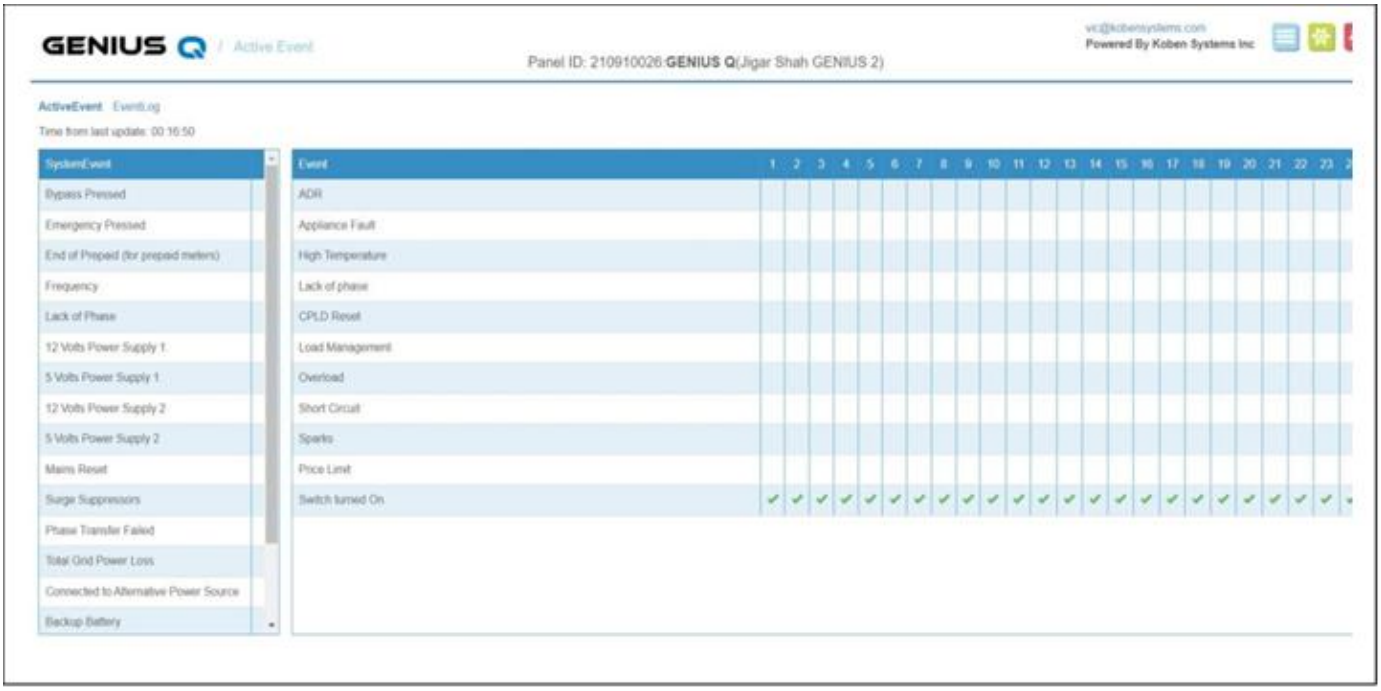
Event Code	Event Code Description	Circuit Number	State	Phase Number	Created Date
9	Overload	7	OFF		08-17-2023 13:40:00
20	Communication - 1 lost	0	SYSTEM	1	08-17-2023 10:39:00
20	Communication - 1 lost	0	SYSTEM	1	08-17-2023 07:55:00
0	Switch turned On	21	ON	2	08-17-2023 07:39:00
20	Communication - 1 lost	0	SYSTEM	1	08-16-2023 14:01:00
20	Communication - 1 lost	0	SYSTEM		08-16-2023 14:01:00
20	Communication - 1 lost	0	SYSTEM		08-16-2023 12:31:00
20	Communication - 1 lost	0	SYSTEM	1	08-16-2023 12:31:00
20	Communication - 1 lost	0	SYSTEM	1	08-16-2023 12:12:00
20	Communication - 1 lost	0	SYSTEM		08-16-2023 12:12:00
20	Communication - 1 lost	0	SYSTEM		08-16-2023 03:21:00
20	Communication - 1 lost	0	SYSTEM	1	08-16-2023 03:21:00
4	Lack of phase	16	OFF		08-16-2023 03:10:00
4	Lack of phase	11	OFF		08-16-2023 03:10:00
4	Lack of phase	17	OFF		08-16-2023 03:10:00
4	Lack of phase	18	OFF		08-16-2023 03:10:00
4	Lack of phase	19	OFF		08-16-2023 03:10:00
4	Lack of phase	0	SYSTEM		08-16-2023 03:10:00
4	Lack of phase	12	OFF		08-16-2023 03:10:00

Pinpointing the Fault

The diagnostics revealed that the 200A main breaker connected to GENIUS 2 on the L1 phase inside the meter base was improperly torqued. This led to intermittent power loss, which cascaded to several two-pole loads in the system.

Resolving the Issue

The breaker was re-torqued to the proper specifications, and the system was reinitialized. GENIUS autonomously performed a sequential reset of each load, ensuring the entire panel was safely re-energized. The events log was reviewed remotely to confirm the issue was resolved. Further integrity tests on each load verified that all phases were functioning correctly, and an "all clear" condition was established.



Averted Risks and Potential Incidents

Had this fault gone undetected, it could have resulted in severe consequences. The improperly torqued breaker in the meter base, which carries significant power into the home, posed a high risk of electrical arcing. Left unresolved, this could have caused an electrical fire either inside or around the home.

Since the property was a new build and unoccupied during the evening, the risk of delayed detection made the situation even more critical. GENIUS not only detected the issue but also mitigated the risk before it could escalate into a catastrophic event.

Key Takeaway

The Importance of GENIUS in Modern Electrical Systems

Traditional electrical systems often lack the capability to detect potential faults before they become serious issues. GENIUS, with its advanced diagnostics, real-time monitoring, and protective algorithms, bridges this gap. By identifying faults at both the service and load levels, GENIUS provides homeowners with unmatched safety and peace of mind.

Outcome

Thanks to GENIUS, the issue was resolved quickly, and the electrical system was restored to full functionality. This incident underscores the importance of advanced solid-state technology in safeguarding homes from potential electrical failures.

Conclusion

GENIUS not only detected and resolved the fault but also demonstrated its ability to prevent worst-case scenarios through its intelligent design and advanced capabilities. For the homeowners, GENIUS proved to be an essential tool in ensuring the safety and reliability of their new property.

Thank you, GENIUS, for making homes smarter and safer!

How GENIUS eliminated nuisance tripping for a GFCI circuit outlet in the kitchen Through Advanced Diagnostics and Real-Time Alerts.

The Importance of AI Virtual Breakers.

Identifying the Problem

A homeowner reported frequent nuisance tripping of the GFCI circuit outlet in their kitchen, disrupting the operation of small appliances and creating frustration during daily activities. GENIUS detected the overload to the GFCI circuit and immediately turned off this circuit and issued an alert indicating an overload has occurred.

How GENIUS Diagnosed the Issue

GENIUS, the solid-state electrical panel equipped with embedded AI and real-time monitoring capabilities, quickly identified the root cause of the issue. By continuously analyzing electrical

parameters across the entire system, GENIUS detected subtle irregularities in the GFCI circuit's performance and disabled it for protection.

Specifically, GENIUS measured voltage fluctuations and current imbalances on the circuit, which are common causes of nuisance tripping. It also monitored ground fault activity to assess whether the GFCI was responding to actual safety hazards or misinterpreting harmless fluctuations as faults.

Pinpointing the Fault

Using GENIUS advanced protective algorithms and diagnostic tools, GENIUS identified abnormal current behaviour and that the GFCI outlet was overly sensitive to transient voltage spikes caused by other appliances sharing the circuit. Additionally, the system detected a minor connection issue at the breaker terminal for the GFCI circuit, which contributed to inconsistent performance.

Resolving the Issue

Once the problem was diagnosed, GENIUS guided the troubleshooting process:

1. The loose terminal connection on the GFCI breaker was tightened to proper torque specifications.
2. GENIUS recalibrated the circuit's sensitivity levels to filter out harmless voltage spikes while maintaining strict safety standards.
3. The system performed real-time tests to ensure the GFCI outlet operated as intended without tripping unnecessarily.
4. All GFCI circuits were programmed for increased sensitivity and indicated in Blue to advise the homeowner.

Averted Risks and Improved Functionality

Without GENIUS, the homeowner might have continued experiencing nuisance tripping, leading to frustration and potential misuse of the GFCI outlet. Left unresolved, frequent tripping can also mask actual ground fault risks, compromising safety in critical areas like the kitchen.

GENIUS not only resolved the immediate issue but also provided real-time alerts and event logs to give the homeowner confidence that their system was functioning optimally.

The Importance of GENIUS in Modern Electrical Systems

Traditional panels and troubleshooting methods often rely on manual inspections and trial-and-error approaches, making it challenging to pinpoint subtle issues like nuisance tripping. GENIUS eliminates this guesswork with its real-time diagnostics, embedded AI, and automated calibration features.

By identifying and addressing faults at both the circuit and system levels, GENIUS ensures that critical safety devices like GFCI outlets function reliably without causing unnecessary disruptions.

Outcome

Thanks to GENIUS, the homeowner's GFCI outlet in the kitchen now operates flawlessly, eliminating nuisance tripping while maintaining the highest safety standards. This improvement restored convenience to daily kitchen use and reinforced the value of advanced electrical management technology.

Conclusion

GENIUS transformed a frustrating and persistent issue into a seamless solution through its intelligent design and real-time monitoring. For homeowners seeking reliability, safety, and peace of mind, GENIUS is an indispensable tool in modern energy management.

Conclusion:

The GENIUS Smart Panel offers a practical and innovative solution for homeowners facing the challenges of modern energy demands. By integrating solid-state technology and AI, it eliminates the need for costly upgrades, improves energy efficiency, and provides a scalable platform for future energy innovations.

Takeaway: GENIUS as the Future of Grid-Edge Energy Management

GENIUS isn't just an advanced solid-state electrical panel for individual homes—it's a groundbreaking solution designed to network every residential installation, creating a grid-edge-ready ecosystem in collaboration with energy providers.

How GENIUS Integrates Homes with the Grid

1. **Seamless Communication with Utilities**
   Each GENIUS installation is equipped with IoT connectivity and advanced communication protocols, enabling real-time data exchange between homes and energy providers. This ensures utilities have a granular understanding of energy demand and consumption at the edge of the grid.
2. **Demand Response and Load Optimization**
   GENIUS's embedded AI actively participates in utility-driven demand response programs by autonomously managing loads at the residential level. During peak demand periods, GENIUS can dynamically adjust non-essential energy usage without impacting the homeowner's comfort or critical systems.
3. **Scalable for Renewable Integration**
   By networking residential GENIUS panels, energy providers gain unprecedented visibility and control over distributed energy resources (DERs), such as solar panels and battery storage systems. GENIUS optimizes how DERs interact with the grid, ensuring efficient energy flow and grid stability.
4. **Grid Resilience and Stability**
   GENIUS enables faster identification of outages, voltage imbalances, and other grid-edge issues. By aggregating data from networked installations, utilities can respond proactively to maintain grid reliability, improving service quality for all customers.
5. **Proactive Maintenance and Fault Detection**
   GENIUS provides utilities with predictive analytics, allowing them to identify and address potential issues before they escalate. This reduces maintenance costs, minimizes downtime, and enhances the homeowner's experience.

Key Benefits of Networking GENIUS Installations

- **Grid-Edge Ready**: Creates a unified networked platform for managing distributed energy and demand response.
- **Enhanced Grid Reliability**: Reduces strain on the grid through autonomous, intelligent load balancing.
- **Empowering Utilities**: Provides utilities with real-time insights for better grid management.
- **Homeowner Savings**: Optimized energy use translates to lower energy bills and increased system efficiency.
- **Sustainability Goals**: Accelerates renewable energy adoption by seamlessly integrating solar, wind, and battery systems into the grid.

A Vision for the Future

By networking every GENIUS installation, homeowners and energy providers can collaborate to transform how energy is consumed, managed, and distributed. This smart, grid-edge-ready solution not only enhances individual energy management but also builds a more resilient, efficient, and sustainable energy infrastructure for the future.

With GENIUS, the power of innovation doesn't just reside in one home, it connects entire communities, making the grid smarter, cleaner, and more reliable for everyone.

Real-Time Power Control at the Grid Edge

GENIUSQ's grid-edge Ai intelligence centers on real-time, autonomous control at the interface between homes and the utility grid. Devices like the GENIUS Panel and GENIUS Edge Ai control and manage the electrical load of high-demand appliances (EV chargers, heat pumps, batteries) at the circuit level, and any integrated energy resource, atomically adjusting power distribution to maximize efficiency and minimize strain on the grid.

Automatic Demand Response

GENIUS Edge Ai enables utilities to set a virtual limit on a home's total electricity use. This allows utilities to manage groups of homes during peak demand, balancing system loads or preventing transformer overloads without requiring costly infrastructure upgrades. Homeowners can still add new electric loads without increasing their utility service, and appliances may be paused to stay within the set limits.

Adaptive Mains:

GENIUS features a programmable main breaker built into its core architecture, allowing installers or utilities to remotely or locally adjust the service capacity. This flexibility enables the system to align with existing electrical service—eliminating the need for costly utility upgrades—while supporting expansion up to 500 amps. As a result, homeowners can significantly increase electrical capacity without replacing the entire panel.

Load Shaping and Orchestration

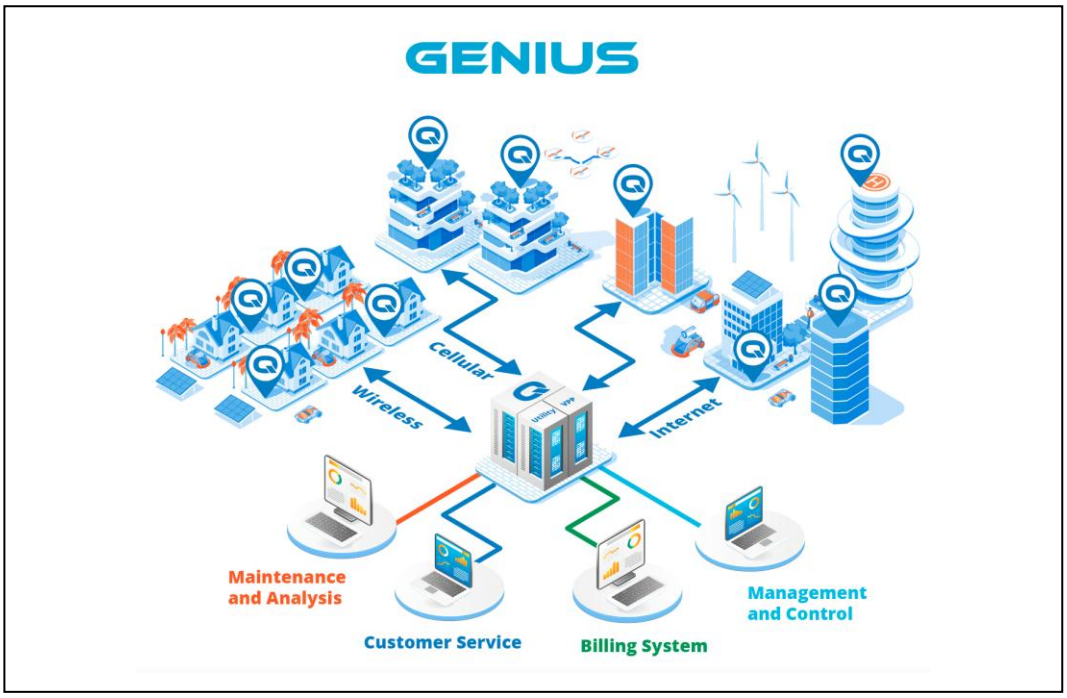
GENIUSQ's system provides device-level, high-resolution control, management, and monitoring, autonomously orchestrating home loads based on real-time usage and the occupant's unique energy lifestyle preferences. This helps utilities defer or avoid grid upgrades, improve infrastructure utilization, and unlock new flexibility for demand response and virtual power plant programs.

Simplified Consumer Experience

All of this happens behind the scenes, with GENIUSQ's technology adjusting autonomously while homeowners retain comfort, control, and visibility through the GENIUSQ app.

Networked Energy Enterprise System

GENIUSQ's Ai platform enables grid-wide or localized deployment across a utility's service territory, including high-load pockets. Through intelligent filtering by unique identifiers, substations, or transformers, GENIUSQ provides precise, real-time load control delivering an immediate and verifiable response to evolving grid conditions and peak demand stress.



Learn More: Visit www.geniusq.io for more information about the GENIUS Smart Panel and how it can revolutionize energy management in your home.

Simply GENIUS