

IoT Home Safety: Fire Prevention Solutions

A Parks Associates Whitepaper Developed for Whisker Labs



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IoT Home Safety: Fire Prevention Solutions

Home safety is the leading value proposition for the connected home, and consumers are willing to purchase and install smart solutions that offer protection, including solutions that can detect and prevent fires.

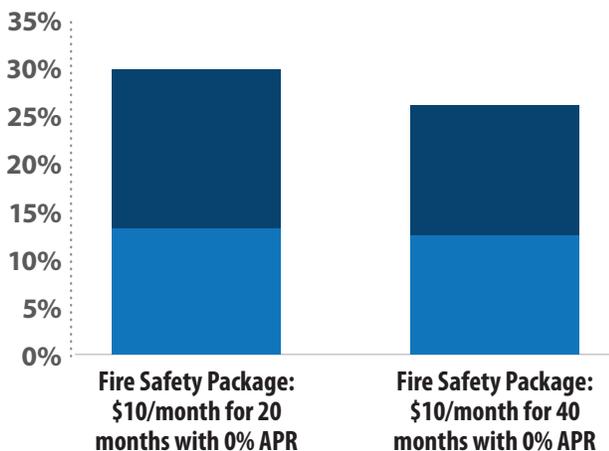
Fires can be devastating—electrical fires cause over 1,300 injuries and 420 deaths in the U.S. per year, with \$1.4 billion in associated residential property damage.¹ Advances in electromagnetic sensing technology can detect micro-arcs and sparks, the precursors to arc faults and electrical fires. New technology solutions can detect and prevent fires before they start, save lives and property, and reduce or eliminate false alerts.

This whitepaper examines the issues surrounding electrical fires in U.S. homes, the main causes of arc faults in electrical wiring, and advances in smart plugs and related smart home products designed to reduce and eliminate the incidence of electrical fires. It also examines consumer demand for fire prevention products and services and potential partnerships in related industries, including insurance, energy, security, or smart home.

Likelihood of Purchasing Fire Safety Packages

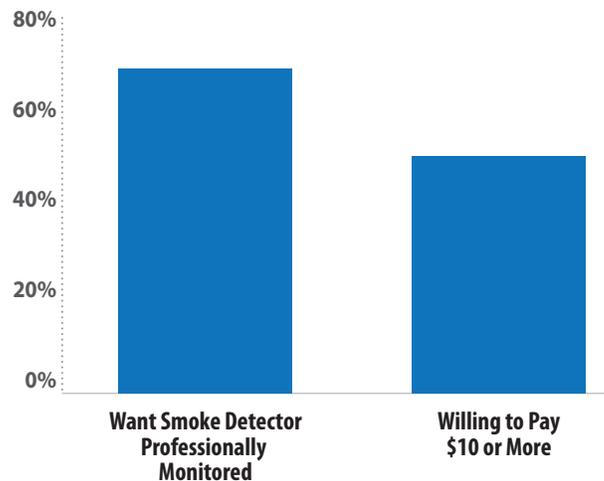
U.S. Broadband Households with Homeowners or Renters Insurance

■ Very likely (Rating 6-7) ■ Likely (Rating 5)



Interest in Professional Monitoring for Smart Smoke/CO Detectors

U.S. Broadband Households with a Smart Smoke/CO Detector



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Parks Associates research finds nearly half of U.S broadband households find a connected device that alerts them to smoke and fire highly appealing.

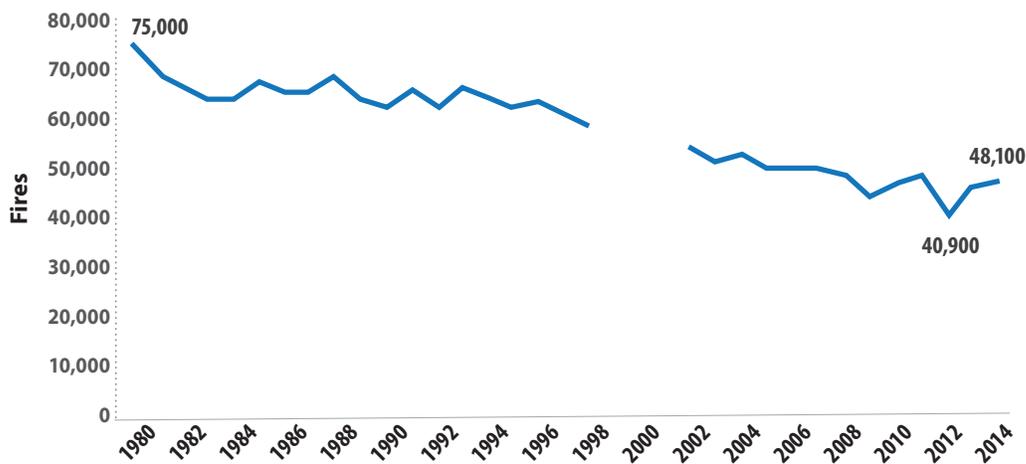
¹ <https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/Fire-causes/Electrical-and-consumer-electronics/Electrical>

Home Safety and Electrical Fires

Home safety is the leading value proposition for the connected home, but while consumers generally associate home security solutions with the protection of loved ones and property, there are many perils that can impact the home and family. Smart home solutions that detect, prevent, and protect against these fires are an increasingly important and valuable part of the connected home landscape.

Electrical fires are particularly devastating, causing over **1,300** injuries, **420** deaths, and **\$1.4 billion** in residential property damage each year.²

Number of Electrical Fires in the United States by Year³



Source: <https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics/Major-Causes/osHomeElectricalFires.pdf>

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Electrical fires occur in over 40,000 homes annually. Electrical fires can occur in any products that are powered by electricity, in electrical cords, or in electrical wiring.

The risk from electrical fires is a function of the severity, the occurrence, and the ability to detect these fires.

Occurrence is relatively low—1 in 2,000 homes experience an electrical fire each year; however, damages from faulty electrical wiring can be severe because wiring is often behind walls, where arcing goes undetected. The fire has more opportunity to spread before a smoke detector is triggered, and occupants have less time to evacuate compared to other fire types.

Anything that delays an occupant's response to the smoke alarm can have a dramatic impact on their survival—while only 24% all electrical fires occur between midnight and 8 a.m., fires in this time period cause 57% of fire-related deaths. According to NFPA statistics, wiring and related equipment account for 69% of fires and 66% of property damage, 56% of deaths, and 53% of injuries resulting from fires.⁴

² <https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/Fire-causes/Electrical-and-consumer-electronics/Electrical>

³ <https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics/Major-Causes/osHomeElectricalFires.pdf>

⁴ <https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics/Fact-sheets/ElectricalFactSheet.pdf>

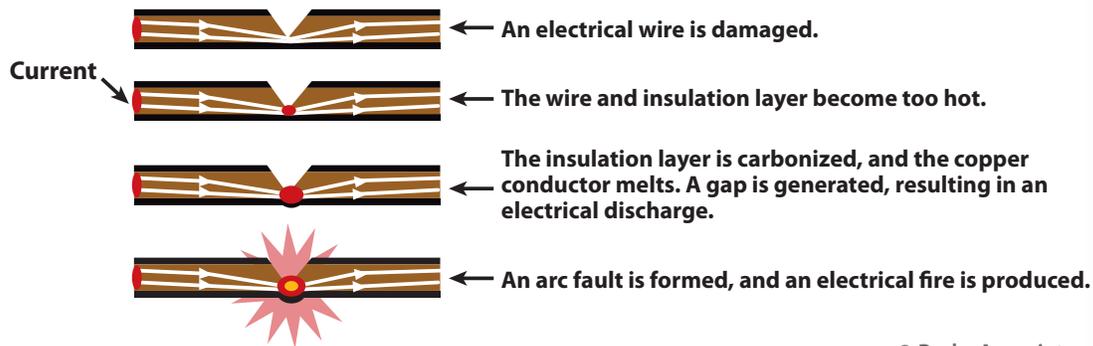
Electrical Fires: Causes and AFCI Protections

82% of electrical fires are caused by arc faults.⁵

Many different factors can cause arc faults, including deterioration of insulation, wires rubbing together, stress on the wires from bending or heat, or poor or loose connections.

The short circuit due to insulation damage often begins as a small arc. As the insulation deteriorates, sporadic small arcs carbonize the insulation, causing further damage. Over time the arcs increase in severity until eventually they produce an electrical fire.⁶

Progression from an Arc Fault to an Electrical Fire



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The National Electric Code first required arc-fault current interrupters (AFCI) protection in all bedroom circuits in 2002, and the standard has been updated and expanded in later years to include coverage of family rooms and dining rooms. In 2014, the code was expanded again to include all branch circuits supplying outlets or devices installed in kitchens and laundry areas. AFCI protection is designed to detect severe arcs, which will cause a fire immediately. Smaller arcs, which will lead to a fire over time, are not detected by AFCI.

Approximately 80% of U.S. housing stock is 20 or more years old, and retrofitting a home to include AFCI protection requires replacing old breakers with new AFCI breakers, which can cost between \$20 and \$50 per breaker depending on the manufacturer. The cost to protect 30-40 circuit breakers in the home would be between \$1,000 and \$2,000, which is unaffordable for most households.

There is an opportunity for a more affordable product that can detect smaller arcs to provide dramatically better and more accessible electrical fire protection.

Homes built since 2002 have protection in a few circuits and only those homes built since 2014 have greater protection, but 85% of electrical fires occur in homes that are at least 20 years old.⁷

⁵ https://w3.usa.siemens.com/us/internet-dms/btlv/residential/residential/docs_AFIC%20Circuit%20Protection/SIE_WP_AFCL_History.pdf
National Association of State Fire Marshals, Consumer Product Safety Task Force report

⁶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4851014/>

⁷ Arc-Fault Circuit Interrupters: National Electrical Code Inclusion Was Based on Faulty Reasoning, Dec 2017, What Causes Wiring Fires in Residences, <http://www.illinoisfire.com/wp-content/uploads/2017/01/wiringfires.pdf>

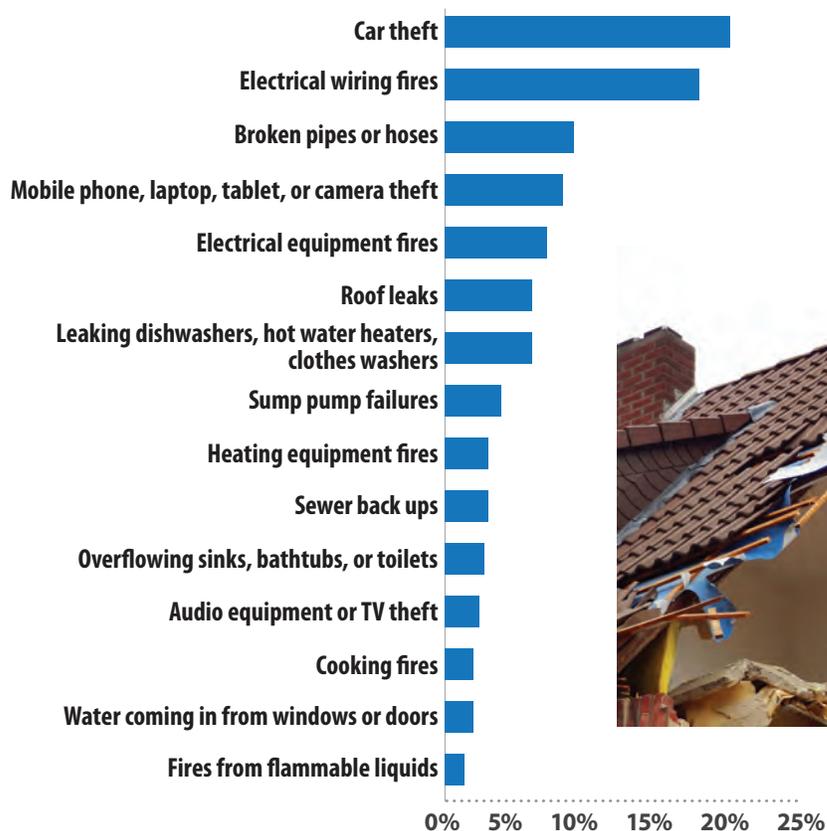


Consumer Demand for Electrical Fire Detection

Parks Associates has evaluated consumer demand for a wide variety of value propositions within the smart home. In a recent study on the intersection of smart home and insurance, Parks Associates evaluated consumer demand for solutions that can detect, prevent, or mitigate the severity of different perils impacting the home. Detection of electrical fires was ranked second among a long list of perils.

Most Valuable Insurance Use Cases for Smart Home

U.S. Broadband Households that have Homeowners or Renters Insurance



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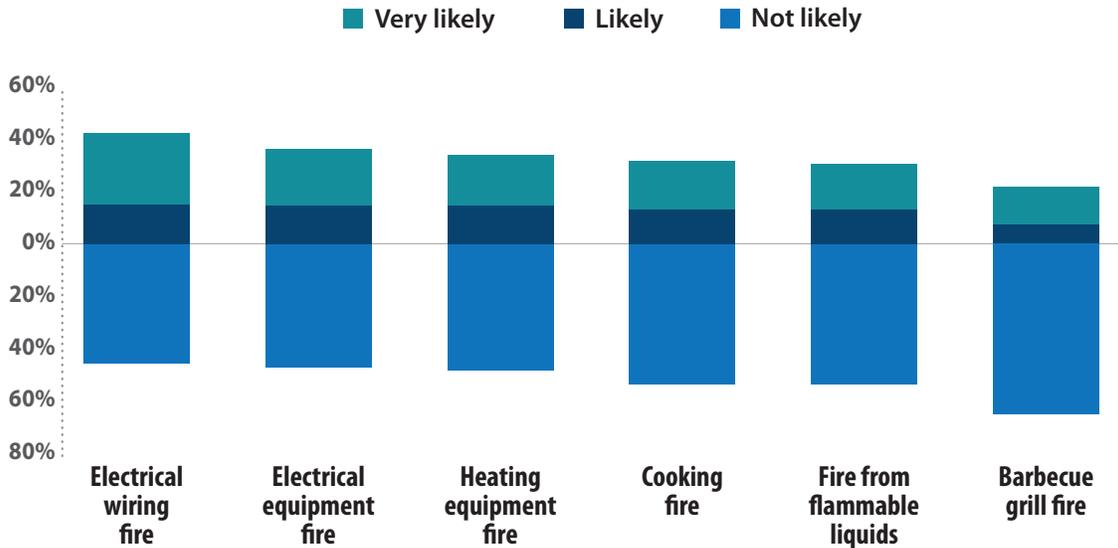
18% of U.S. Broadband households with insurance consider solutions that can detect, prevent, or mitigate electrical wiring fires to be the most valuable use case for smart home.

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Consumers are also aware of the unique and potent risk of electrical fires—they showed the most interest in purchasing products that can detect fires in electrical wiring or electrical equipment, as opposed to fire-detection solutions for heating equipment, cooking, and flammable liquids.

Likelihood of Buying a Smart Home Fire Notification Product

U.S. Broadband Households with Homeowners or Renters Insurance



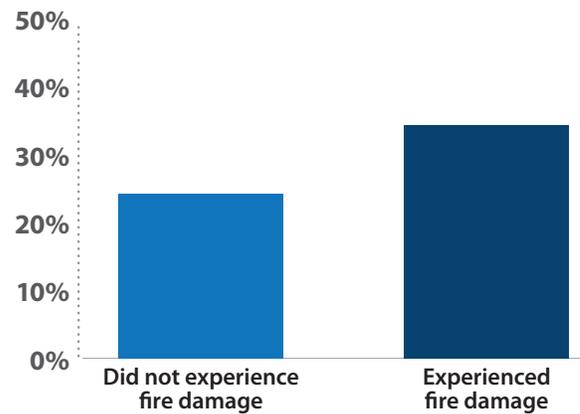
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Roughly **40%** of consumers are likely to purchase smart products that can detect electrical fires.

- **Younger consumers** are more likely to be interested in smart fire detection products than older consumers.
- **Consumers living in larger homes** (in terms of square footage) are also more likely to purchase these devices.
- In every category of fire hazard, **households in the South** and **those who rent their homes** index slightly higher than other regions and home owners for interest in smart fire notification products.

Likelihood of Buying Fire Notification Product by Fire Damage Experience

U.S. Broadband Households with Homeowners or Renters Insurance



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U.S. broadband households that have experienced fire damage in the past are more likely to purchase smart home products with fire detection and notification capabilities.

Smart Home Solutions

Among the many and varied smart home value propositions, receiving alerts in case of fire is among the highest rated capabilities.

- At the end of 2017, 6% of U.S. broadband households reported owning a smart smoke detector, and many of these households own more than one.
- Consumers who purchased a smart smoke/CO detectors in the past 12 months own an average of 1.6 devices, so many of these households are buying multiple detectors at once.

Smoke detectors are available in several product forms:

- Standalone devices that are unmonitored and unconnected to the Internet
- Professionally monitored devices unconnected to the internet as part of a security system
- Professionally monitored devices connected to the internet as part of a security or home control system
- Self-monitored devices connected to the internet

Any of the product forms can be wireless or battery-powered, but only a few models on the market are connected to the internet for remote monitoring and control. Many consumers have a basic detector connected to a security panel that allows them to check on the device's status, where the system, not the device itself, is actually connected and providing the "smart" functions, which creates confusion and over-reporting among consumers. Security monitoring companies with home control platforms, such as those offered by broadband providers, may offer a white-labeled detector that can be monitored or controlled via an app or website.

According to the National Fire Protection Association (NFPA)

- **38%** of home fire deaths resulted from fires in homes with no smoke alarms and **21%** resulted from no working smoke alarms.
- In houses with smoke alarms, **46%** of the alarms were powered by battery only, and **67%** of fire deaths in these homes were caused by fires in homes with smoke alarms powered by battery only.

21% of households that subscribe to professionally monitored security systems own a smart smoke detector.

66% of households that subscribe to professionally monitored security own a smart product.

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Self-installed and self-monitored smart detectors are Wi-Fi-connected devices that provide alarms, self-monitoring, and control via iOS and Android apps. The top players/brands are Nest and First Alert. These smart detector brands are looking to gain additional traction with consumers, and justify their premium pricing, by addressing common consumer frustrations, such as eliminating the "chirp" from a low battery, reducing false alerts, and overcoming the difficulty in identifying and silencing the detector that triggered a false alarm.

Key Product Features and Differentiators in Smart Smoke Detectors

- Combination smoke and CO detectors
- In-app testing and silence controls
- Battery power indicator, including end-of-life alerts
- Motion-sensitive LED lights
- Interconnected alarm units that audibly locate the initial alarm location
- Integration with home control systems (e.g., Apple HomeKit, "Works With Nest")

Opportunities in the Insurance Industry

Parks Associates research:

- **20-30%** of consumers with insurance are likely to purchase a fire safety package for an up-front cost of \$200-\$400
- **Nearly 40%** of consumers with insurance would switch insurance providers to obtain any smart home products

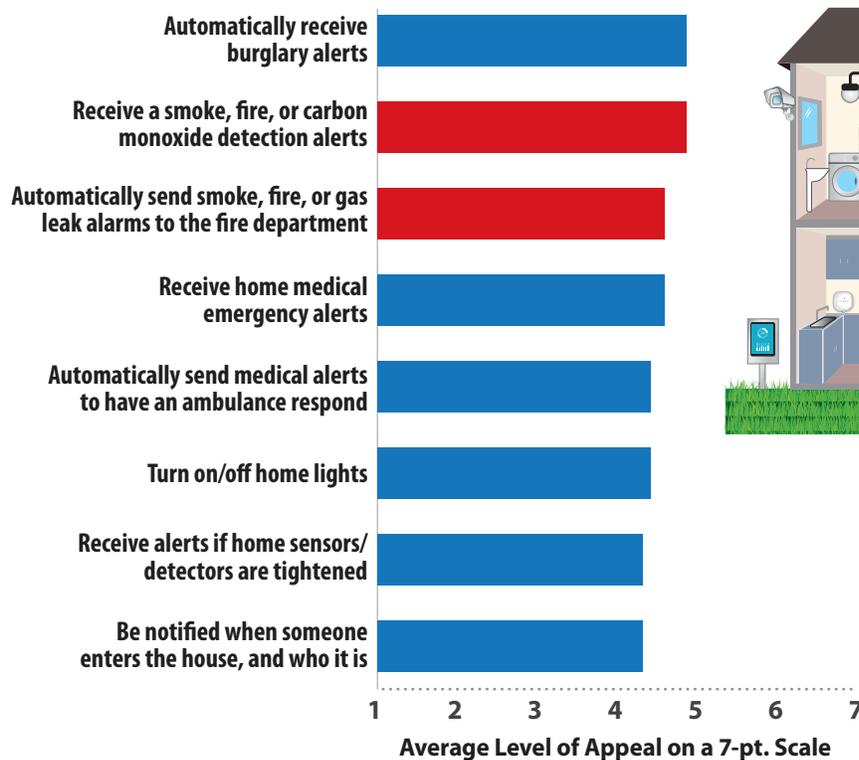
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Insurance customers who have already experienced a loss are even stronger candidates for adoption. Prior experience of water damage, fire damage, or theft drives a roughly 10% increase in the number of households likely to buy a smart product with detection features.

Liberty Mutual Insurance and Nest have already leveraged this opportunity with a cross-promotional partnership that offers new insurance customers a free detector, a 5% discount on home or rental policy, and a 20% discount on the fire premium portion of their policy.

Appeal of Smart Home Value Propositions

U.S. Broadband Households



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Additional Channel Opportunities

The insurance industry is not the only channel that could benefit from offering electrical fire detection capability to its portfolio of services. Energy providers also have an opportunity to offer fire detection products. Parks Associates data reveals that consumers are interested in electrical hazard detection as part of an energy services package for their homes.

84% of respondents find detection of electrical fires as valuable, which was the highest rated value proposition associated with energy sensing and energy management.

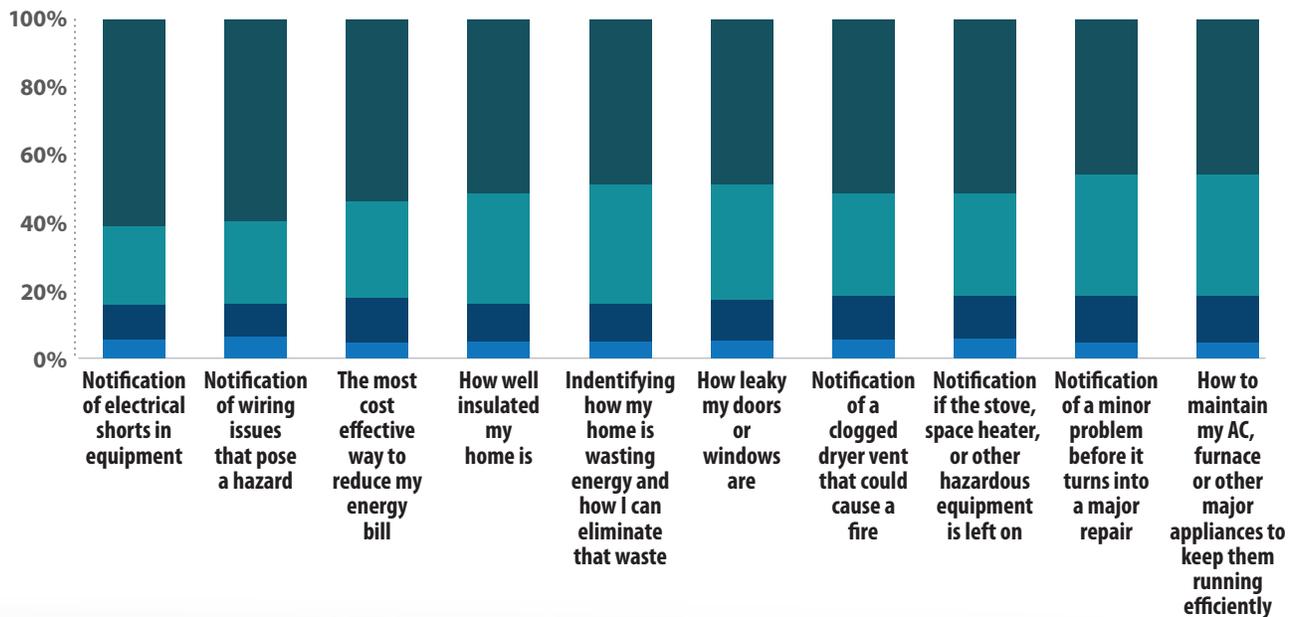
The breadth of use cases enabled by energy sensing is extensive, and consumers find significant value in a bundle of energy-sensing services. **On average consumers are willing to pay more than \$20 per month for a service that provides detection of electrical fires** along with energy and appliance monitoring, all of which are enabled by energy-sensing devices.

In addition, many current smart home owners are very interested in adding professional monitoring services to their products. **For example, 70% of smart smoke detector owners expressed interest in having their smoke detector connected to a professional monitoring service, and 51% of smart smoke detector owners would pay \$10 or more per month to monitor their products.**

Top 10 Value Propositions for Energy Sensing

U.S. Broadband Households

■ Very Valuable ■ Valuable ■ Neutral ■ Not Valuable



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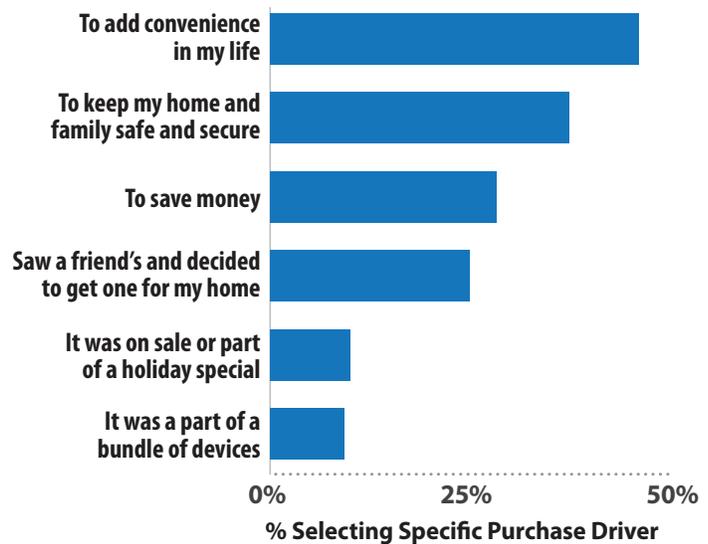
A smart home product that targets detection and prevention of electrical fires needs to be easy to install and control for the consumer, otherwise its safety features may never be realized.

Demand for Simplicity

Electricity and electrical power are confusing and poorly understood by average consumers, so a smart home product in this area is doubly challenged. Parks Associates research shows 45% of smart home device owners cite convenience as one of the primary reasons for their product purchase while 38% made their purchase to keep their home and family safe and secure. Also the vast majority of these product owners self-installed at least one of their smart home devices—73% of smart home device owners installed at least one product themselves or with help of a friend or family member.

Smart Home Devices - Top Purchase Drivers

Smart Home Device Owners in U.S. Broadband Households



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Opportunities across Industries

Given that research supports both a product and a service model for electrical fire detection, several industries have the opportunity to become a channel for new solutions that address this unmet consumer need:

- **Home insurance providers** have the opportunity to shift from a reactive to proactive home service provider with a solution that prevents electrical fires rather than just providing payment after the loss.
- **Security companies** can bundle security with electrical fire hazard detection technology to prevent fires rather than just monitoring smoke alarms that only detect fires.
- **Electric utilities** can also benefit from offering a bundle of energy monitoring services that include detection of electrical fires.

Industries including smart home service providers, insurance companies, and energy providers are all potential channel partners for electrical fire sensors. Several energy providers already sell protection plans for electrical wiring. Companies such as Reliant and Kansas City Power and Light provide home wiring protection plans as a form of insurance. Adding detectors that prevent electrical fires is certainly an improvement over existing offers.

Protecting the home involves a detailed assessment of all different types of risks. Electrical fires are one type of risk for which there are currently no economically viable solutions to address the unmet consumer demand. Solutions that address this unmet need can expect strong adoption and will create opportunities for channel partners, with benefits spanning multiple industries with a stake in the connected home.

Ting Solution

Whisker Labs sensing and software mines the home electrical network, the nerve center for the home, for electromagnetic data to enable home intelligence. Using high-speed digital signal processing and machine learning, Whisker Labs technology detects the presence of small electrical discharges and arcs prior to them becoming an imminent fire hazard. A single smart plug called Ting samples the characteristics of the electricity in the home 27 million times per second and is able to determine if there is an arc fault on *any* circuit in the home.



The Wi-Fi-enabled Ting smart plug then alerts home owners via an app to potential fire hazards. The homeowner can isolate the circuit causing the problem by cycling power to each circuit until the app indicates that all is well. By sampling information on the electrical network of the home at 27 MHz, Ting can proactively identify if any circuit in the network is experiencing electrical discharge. These processes can take place days or weeks before an arc turns into a fire, so Ting not only detects potential sources of electrical fires but also gives consumers the tools to prevent them.



While the Ting smart plug is the initial product form factor, Whisker Labs has also developed a reference design. Any product that is plugged into power in the home that has a Wi-Fi connection can integrate the Ting hardware, substantially reducing the marginal cost to offer the hardware. Products bundled with the Ting sensor address the unmet electrical fire detection needs of consumers and provide vendors with an opportunity to participate in the recurring revenue stream from the Ting services.

In addition to detecting arc faults, the Ting sensor is also able to identify power quality issues. Power surges, transients, momentary interruptions, and sags can damage electronic components and shorten the life of small motors. Understanding the power quality issues within the home enable homeowners to take preventive measures to limit damage due to electrical anomalies.

About Whisker Labs



Headquartered in Germantown, MD with offices in Oakland, CA, Whisker Labs spun out of Earth Networks in September 2017. Earth Networks, a data analytics firm that owns a network of over 10,000 weather stations, acquired Whisker Labs in late 2016. The Earth Networks team developed algorithms to monitor atmospheric electromagnetic energy and built a global lightning detection network to determine the location of a lightning strike using high frequency data. That same data analytics approach is used to identify arc faults in a home electrical network.

In addition, the world class engineering and data science team at Whisker Labs developed a thermodynamic modeling approach that combined energy or thermostat data with weather data to understand how changes in temperature, solar radiance, and wind impact a given home. The thermodynamic model is applied to automate thermostat settings to provide substantial savings to consumers. Whisker Labs also developed energy management services to intelligently reduce home energy demand during peak load times to help communities and homes save energy and money. The Connected Savings service enables energy providers to balance the grid and optimize residential thermostats for savings and comfort.

Whisker Labs has also developed an advanced sensor technology that uses remote electric and magnetic field sensing to capture high frequency voltage & current readings. The sensor can be installed without an electrician and the high frequency data can be used for advanced analytics use cases including appliance performance monitoring and fault detection & diagnostics.



Parks Associates is an internationally recognized market research and consulting company specializing in emerging consumer technology products and services.

Founded in 1986, Parks Associates creates research capital for companies ranging from Fortune 500 to small start-ups through market reports, primary studies, consumer research, custom research, workshops, executive conferences, and annual service subscriptions.

The company's expertise includes the Internet of Things (IoT), digital media and platforms, entertainment and gaming, home networks, Internet and television services, digital health, mobile applications and services, support services, consumer apps, advanced advertising, consumer electronics, energy management, and home control systems and security.

For more information, visit parksassociates.com or contact us at 972.490.1113 / info@parksassociates.com



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Tom leads Parks Associates research in the areas of home controls, energy management, and home networks. Tom authors numerous reports on energy management and home controls covering the evolution of technology, partnership opportunities, and new business models. Tom's work at Parks Associates includes managing consumer surveys that track trends and market opportunities and enable insightful evidence-based forecasting for energy, security, and home controls. Tom speaks frequently at key industry events, and his views are sought out by national press organizations and publications.

Prior to working at Parks Associates, Tom worked as director of engineering and director of product management in multiple industries. Tom began his career in the U.S. Navy nuclear power program on submarines. He holds a Bachelor of Science degree from the U.S. Naval Academy in systems engineering and a master's in software engineering from the University of Texas.

INDUSTRY EXPERTISE: Residential Security, Smart Home Products and Services, Home Network Technology, Software Systems, Electric Utilities, AMI, Home Energy Management, Demand Response

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