

White Paper – PERFORMANCE ENERGY

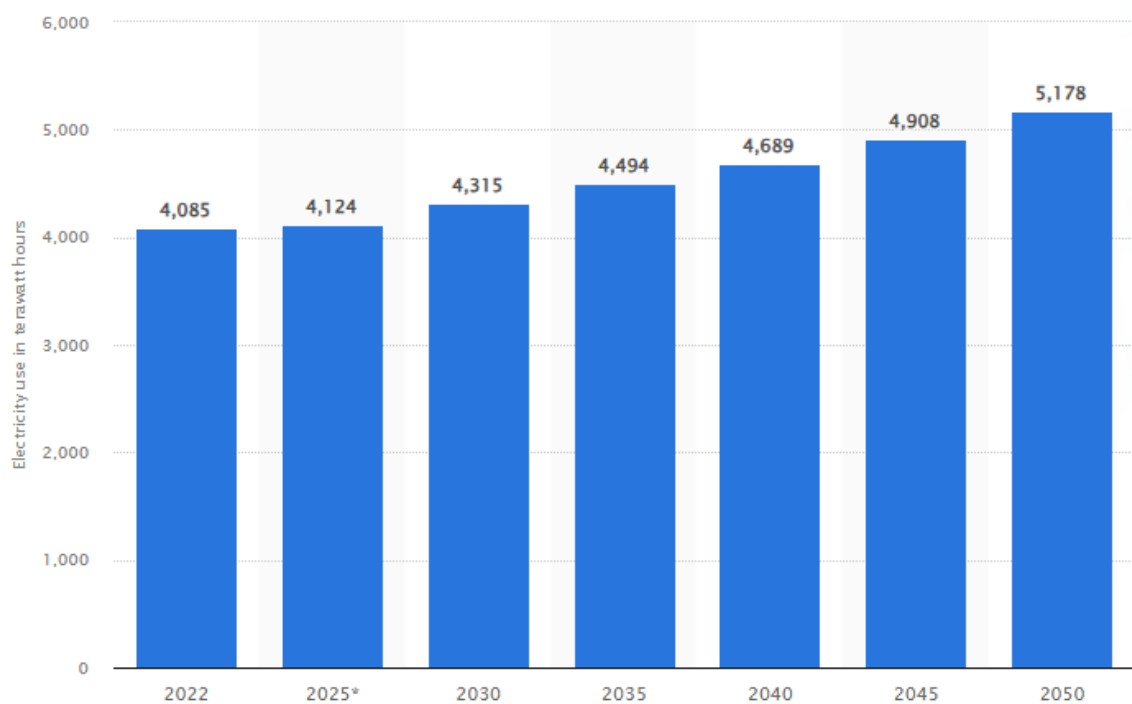
Keywords: *supply electricity (74k), retrofitting (22.2k), nuclear power (14.8k), energy efficiency (9.9k), levelized cost of energy (2.9k), average household electricity usage (2.4k), energy infrastructure (590), environmental benefits (320), energy retrofitting (140), retrofitting cost (50)*

Performance Energy

Transforming Energy Retrofitting at Scale

Introduction

Given current demographic trends and technologies, electricity consumption in the United States is projected to grow to approximately 5,178 TWh by 2050—a substantial 27% increase from 2022 levels.



© Statista 2024

With current energy infrastructure struggling to meet demand as it is, there are only two ways forward to address this: build additional capacity or reduce energy demand.

Needless to say, reducing demand is the preferred option for any number of reasons, from financial cost to environmental impact—with energy retrofitting a potential solution. The retrofitting process, which involves upgrading the energy efficiency of existing buildings (typically by improving insulation, upgrading HVAC systems, and sealing air leaks) directly translates to lower energy use and reduced environmental impact. Despite these advantages, however, retrofitting has struggled to achieve scale due to the logistical challenges involved.

In a bid to address these challenges, Performance Energy has developed an innovative suite of tools designed to streamline and scale the retrofitting process. With over 20 years of expertise in building technology, the company's innovative solutions—including the Retrofitter App™, BackPack™, and Lenses™—allow homes to be retrofitted much more efficiently than before. In this white paper, we'll explore the advantages of energy retrofitting, the problems it faces, and how Performance Energy may well be the way forward.

The financial case for retrofitting

Setting aside scalability issues for a moment, retrofitting offers a highly cost-effective solution, certainly when compared to the expenses associated with building new energy infrastructure.

If we look at nuclear power, for example, a single nuclear power plant typically costs \$6–\$9 billion to build and generates around 1,000 MW of power. For simplicity, let's assume therefore that a 1,000 MW plant costs \$7.5 billion.

A nuclear power plant this size can supply electricity to approximately 750,000 homes, assuming an average household electricity usage of about 10,649 kWh per year (U.S. average). Dividing the total plant cost by the number of households, we arrive at an upfront construction cost per household for nuclear energy of approximately \$10,000.

The cost to retrofit a home varies widely but generally ranges between \$2,000 and \$8,000 for comprehensive upgrades that improve insulation, air sealing, and energy efficiency. For this comparison, let's take an average retrofitting cost of \$5,000 per household.

Beyond initial cost, however, retrofitting can reduce average household electricity usage by 15-30%. For a typical U.S. home that uses 10,649 kWh per year, a 25% reduction would save around 2,662 kWh annually, or \$400–\$500 per year, based on an average U.S. electricity rate of 15 cents per kWh.

This clearly illustrates that retrofitting is not only more affordable per household but also yields ongoing savings—as well as environmental benefits. With Performance Energy's solutions reducing the cost of retrofitting a typical residential property from \$3.75 per square foot to \$2.50 per square foot, the financial argument of retrofitting is compelling, to say the least.

Retrofitting vs renewables

Similarly, the levelized cost of energy (LCOE) for building new renewable infrastructure, such as wind or solar farms, is remarkably high. For example, a new utility-scale wind farm has an LCOE of around \$36 per megawatt-hour (MWh), with utility-scale solar costs running at approximately \$30–\$45 per MWh. While renewables may offer long-term benefits, these costs still remain high compared to retrofitting, where immediate energy savings start as soon as upgrades are completed.

This expedited timeline adds considerable value to the retrofitting equation. Large-scale infrastructure projects, such as nuclear plants, often take between 10 to 19 years to plan, approve, and construct. Even wind and solar farms can take three to five years to complete.

In contrast, an individual building retrofit can be completed within weeks, allowing utilities to reduce energy demand in critical areas more rapidly and cost-effectively. This immediacy is vital in peak demand scenarios, where utilities face pressures to address energy shortages without delays.

Retrofitting's ROI becomes especially valuable when considering the cumulative impact across thousands of homes. For example, reducing energy use by 25% across 21,500 homes could offset the need for a new peak plant in certain areas, saving millions in avoided infrastructure costs.

With retrofitting solving so many energy issues, the question remains—why is it not more widespread as a solution?

The historic barriers to wide-scale retrofitting

For many years, retrofitting projects were prohibitively expensive due to high material and labor costs. Additionally, homeowners and landlords often hesitate to invest in energy efficiency upgrades due to limited access to financing or incentives. Unlike large infrastructure projects that receive state and federal funding, retrofitting has struggled to attract substantial financial support, particularly for low-income housing.

Skilled labor shortage

Retrofitting has always required expertise, particularly in energy auditing and the installation of specialized materials. With the rapid growth in demand for energy efficiency, there has been a shortage of trained professionals who can implement these projects. According to a report by the National Association of State Energy Officials (NASEO), energy efficiency jobs are among the hardest to fill in the clean energy sector. This shortage has historically slowed the scaling of retrofitting initiatives.

Lack of standardized, scalable tools

Without standardized tools, each retrofit project has required customized assessments and solutions, leading to inconsistent quality and scalability issues. This lack of efficiency made retrofitting less attractive to utilities, as the cost and time requirements were simply too high. The absence of scalable systems also posed challenges in monitoring and verifying the performance of completed retrofits, which is central to assessing impact and securing ongoing investment.

Limited awareness and support from utilities

Utility companies have traditionally focused on expanding infrastructure rather than investing in demand-side solutions. However, the increasing strain on the grid and the rising costs of peak plants are beginning to shift this perspective. Utilities are now more open to considering retrofitting as a viable method for managing demand. That said, widespread implementation still requires a significant shift in awareness and operational priorities.

The Performance Energy approach

At Performance Energy, we see energy retrofitting as more than just a necessary step toward sustainability—it's an opportunity to bring about systemic change. Our methodology is rooted in scalability, precision, and meaningful impact, using accurate data and highly efficient processes to deliver dramatic energy savings.

Our CEO and founder, Paul Hoover, has over twenty years of experience in automation, envelope technology, and chemistry instrumentation. This highly technical background has resulted in him designing the Retrofitter™—an innovative solution that merges advanced hardware and software to tackle the specific challenges of energy retrofitting.

Paul recognized early on that traditional energy audits are limited by manual methods, which are often labor-intensive and costly. These legacy processes make large-scale retrofitting challenging, especially when high accuracy is required. The Retrofitter™ solves these problems by incorporating automation to streamline data collection and analysis, allowing even relatively inexperienced technicians to perform high-quality audits with ease.

Through simplifying the inspection and analysis processes, Performance Energy's technology reduces human error, supports better-informed decision-making, and creates high levels of value for both utilities and stakeholders.

Systems and processes built for scale

The company aims to change the standard of energy retrofitting across the industry and make a measurable impact on energy efficiency on a national scale. It's an ambitious aim that requires more than just advanced technology—it demands highly efficient operational systems that can adapt to a wide range of environments and building types.

Performance Energy's system allows us to standardize retrofitting across different regions while retaining the flexibility needed to adapt to local conditions. By automating data collection, we reduce reliance on highly specialized training and reduce the risk of human error, creating a solution that is both accessible and effective.

Most importantly, it's a system that's been built on years of refinement and real-world testing. The effectiveness of our system was demonstrated in a trial in Georgia, where we retrofitted approximately 6,000 homes in two years, achieving a peak rate of 35 homes per day. The trial not only demonstrated the capabilities of Performance Energy's technology and approach but highlighted its scalability. Given the budget, we could feasibly increase this operational rate by tenfold, allowing us to address energy inefficiency in a far broader way.

Our core hardware and software

The Retrofitter™ system incorporates a full suite of hardware and software that work together to create a viable solution to large-scale energy retrofitting.

Retrofitter BackPack™

At the heart of Performance Energy's system is the Retrofitter BackPack™, a wearable device designed for technicians. This advanced and highly functional piece of equipment is compact yet powerful, featuring more than ten sensors and cameras that collect a comprehensive array of data during energy inspections.

The sensors include thermal, infrared, and optical technologies that capture critical information about a building's energy performance. The device records temperature variations, performs spatial mapping, and provides detailed visuals of potential energy loss points such as air leaks, insulation gaps, and duct inefficiencies.

The BackPack™ makes sure that each inspection delivers a precise and thorough analysis of a building's energy profile in real time. Using the device's extensive capabilities, technicians can identify areas of energy inefficiency that might otherwise go unnoticed, providing accurate actionable insights to make targeted improvements.

Retrofitter Lenses™

Working in tandem with the Retrofitter BackPack™, Performance Energy's Retrofitter Lenses™ are a specialized set of headsets equipped with both thermal and optical cameras. These lenses allow technicians to conduct faster and more efficient inspections by allowing them to visually identify problem areas that are often missed with the naked eye, such as duct leaks, gaps in insulation, and areas of thermal bridging.

The ability to visually pinpoint issues in real time heightens a technician's ability to quickly assess and address potential energy inefficiencies. With this tool, technicians can see beneath the surface, revealing hidden problems that can be easily overlooked in traditional inspections.

Retrofitter App™

Serving as the brains of the system is the Retrofitter App™—the central hub for data collection, analysis, and reporting. The app coordinates and processes information from both the BackPack™ and the Retrofitter Lenses™, providing technicians with real-time data analysis. It guides them through the inspection process, simplifying complex calculations and enabling even less experienced technicians to conduct thorough and accurate energy audits. The app's user-friendly interface ensures that data is organized, easy to interpret, and actionable.

Unifying hardware and software into a seamless, integrated platform, the Retrofitter™ system eliminates inefficiencies, reduces the learning curve, and improves the overall accuracy and speed of inspections.

Our training centers

While hardware and software are an integral part of our energy retrofitting solution, they require a skilled workforce to realize their full potential. To this end, we've developed modular, mobile training centers that can be deployed across the country.

These centers provide comprehensive training on both theoretical and practical aspects of the Retrofitter™ technology, equipping technicians with the skills they need to perform high-quality audits and retrofits. Our curriculum is designed to accommodate a variety of educational backgrounds, making it possible to rapidly train a workforce capable of supporting large-scale retrofitting programs.

Each training center is equipped with a full set of Retrofitter™ hardware and software, allowing trainees to gain hands-on experience in a controlled environment. Our program covers everything from operating the Retrofitter Backpack™ and Lenses™ to navigating the Retrofitter App™ and interpreting data.

Technicians learn how to conduct thorough energy assessments, identify common energy inefficiencies, and follow standardized procedures that ensure consistent quality. The flexibility of our training centers enables us to deploy them quickly in response to regional needs, whether in urban areas with high demand or rural communities where energy retrofits are less accessible. This adaptable, mobile approach not only addresses the logistical challenges of training a large workforce but also creates job opportunities in underserved areas, contributing to economic growth and environmental sustainability across the country.

Standardization: The key to scalability

At Performance Energy, we've developed a consistent approach to energy audits that allows every technician to follow the same high standards and procedures, regardless of region or building type.

Our Retrofitter App™ is designed to guide technicians through each stage of the inspection process, providing visual prompts and automated data entry that reduce the need for extensive technical training. This user-friendly approach allows technicians to focus on conducting thorough assessments without worrying about complex data processing or analysis.

The benefits of a standardized platform extend beyond individual projects, creating a foundation for large-scale retrofitting initiatives that deliver consistent results. Our training programs are tailored to meet the needs of both inspectors and retrofit crews, enabling them to work in harmony and reduce project timelines.

This compatibility between inspection and retrofit teams improves efficiency, reduces costs, and ensures that retrofits are completed to the highest standards.

Maintaining high quality at scale

Scaling up energy retrofitting requires a delicate balance between speed and quality. Performance Energy has achieved this balance, using advanced hardware and software to ensure each project maintains consistent accuracy and reliability.

The Retrofitter™ system combines state-of-the-art sensors, thermal imaging, and spatial mapping technology to create a precise, data-driven overview of each building's unique energy profile. By measuring parameters with exact detail, our tools allow technicians to identify areas for improvement with pinpoint accuracy, making sure that every retrofit maintains the same level of reliability and high standard.

In addition, our Retrofitter App™ incorporates powerful, automated quality assurance processes that uphold these standards across all projects. Through real-time validation, the software cross-references incoming data and automatically flags inconsistencies, enabling technicians to address any quality issues on the spot.

This technology-driven approach minimizes human error and guarantees consistent outcomes—maximizing cost savings for homeowners while reducing energy demands on the grid.

Adding AI to the retrofitting equation

Integrating artificial intelligence into the retrofitting process heightens the capabilities of the Retrofitter App™ by creating a dynamic, self-learning system that adapts with each use. Using machine learning algorithms, the Retrofitter App™ analyzes data from each inspection, continuously refining its outputs to deliver more precise, actionable insights to technicians.

This advanced capability allows the system to adapt easily to diverse building types, energy infrastructures, and regional climate conditions—making it a powerful solution for energy retrofitting across various geographical areas.

Moreover, the Retrofitter App™ goes beyond immediate inspection data, offering a comprehensive data repository that utilities and contractors can leverage for long-term planning and predictive maintenance. Storing and analyzing historical data on energy performance, our system provides a detailed overview of patterns and trends, supporting data-driven decisions that can improve the overall effectiveness of retrofitting programs.

These insights help energy providers and contractors not only meet immediate efficiency goals but also optimize energy consumption and reduce costs over time. As a result, Performance Energy's AI-enhanced platform is well-positioned to drive innovation and progress within the energy sector.

The future of retro

As the need for energy efficiency grows more pressing, Performance Energy stands ready with a fully tested, technology-driven approach that transforms the efficiency and accuracy with which homes can be retrofitted.

More than simply adding another step to existing methods, Performance Energy is introducing a shift in how the entire retrofitting process can be pursued—an approach where high-quality, large-scale retrofits become achievable outcomes for utilities, contractors, and communities alike.

Our systems demonstrate that scalability is no longer a distant goal in retrofitting. Our Retrofitter™ technology, mobile training centers, and tailored software have proven that a new standard in efficiency and quality is possible, even for non-experts. By prioritizing easily accessible training and rapid deployment, we're able to meet current needs and lay a strong foundation for future resilience in energy management.

Partner with Performance Energy

With a proven track record that demonstrates large-scale energy retrofitting is both achievable and efficient, we invite utilities and implementers to explore how our innovative solutions can support their energy efficiency goals at scale.

Take a meaningful step toward sustainability. Get in touch with the Performance Energy team and discover a faster and more effective route to energy efficiency.

CTA: Contact Us

Email info@performanceenergy.com

Web www.performanceenergy.com

Phone 1-(912)-208-3000

References:

Electricity Consumption Projections

- <https://www.statista.com/statistics/192872/total-electricity-use-in-the-us-since-2009/>

Nuclear Power Plant Costs

- U.S. Energy Information Administration (EIA). "Updated Capital Cost Estimates for Electricity Generation Plants." [EIA Capital Cost Report](<https://www.eia.gov/analysis/studies/renewables/capitalcosts.pdf>)

- World Nuclear Association. "Nuclear Power Economics." [World Nuclear Economics](<https://www.world-nuclear.org/information-library/current-and-future-generation/nuclear-power-economics.aspx>)

Electricity Usage Per Household

- U.S. Energy Information Administration (EIA). "Average U.S. Household Electricity Consumption." [EIA Household Consumption Data](<https://www.eia.gov/tools/faqs/faq.php?id=97&t=3>)

Cost of Home Retrofitting

- Department of Energy (DOE). "Energy Saver: Home Energy Audits." [DOE Retrofitting Guide](<https://www.energy.gov/energysaver/home-energy-audits>)
- National Renewable Energy Laboratory (NREL). "Building America Program." [NREL Building America](<https://www.nrel.gov/docs/fy12osti/55284.pdf>)

Energy Savings from Retrofitting

- American Council for an Energy-Efficient Economy (ACEEE). "The Efficiency Boom: How Energy Efficiency Can Unlock a \$5 Trillion Opportunity." [ACEEE Report on Energy Savings](<https://www.aceee.org/research-report/u1706>)

Average Electricity Rate

- U.S. Energy Information Administration (EIA). "Electricity Prices." [EIA Electricity Prices Data](<https://www.eia.gov/electricity/data/eia861/>)

Cost Per Square Foot for Retrofitting

- ACEEE. "Energy Efficiency Programs and Policies in the States." [ACEEE State Energy Efficiency](<https://www.aceee.org/research-report/u2006>)

Levelized Cost of Energy (LCOE) for Renewables

- Lazard. "Levelized Cost of Energy Analysis." [Lazard LCOE Report](<https://www.lazard.com/media/451773/lazards-levelized-cost-of-energy-version-140.pdf>)
- National Renewable Energy Laboratory (NREL). "2021 Renewable Energy Data Book." [NREL Renewable Energy Data](<https://www.nrel.gov/docs/fy22osti/81764.pdf>)

Construction Timeline for Infrastructure Projects

- U.S. Department of Energy (DOE). "Nuclear Power Plant Construction Timeline." [DOE Nuclear Energy Report](<https://www.energy.gov/ne/articles/nuclear-power-plant-construction>)

Financial Support for Retrofitting

- U.S. Department of Energy (DOE). "Financing Energy Efficiency." [DOE Financing Report](<https://www.energy.gov/eere/slsc/maps/financing-energy-efficiency>)

Skilled Labor Shortage in Energy Efficiency

- National Association of State Energy Officials (NASEO). "2021 Energy Efficiency Workforce." [NASEO Report](https://www.naseo.org/data/sites/1/documents/publications/NASEO_Workforce_Report.pdf)

Standardization and Scalability in Retrofitting

- National Renewable Energy Laboratory (NREL). "Market Opportunities for Energy Efficiency." [NREL Market Report](<https://www.nrel.gov/docs/fy13osti/58623.pdf>)

Utility Company Investments

- Edison Electric Institute (EEI). "Electric Company Industry Overview." [EEI Utility Investment Report](<https://www.eei.org/resourcesandmedia/industrydataanalysis/industryoverviews/Pages/default.aspx>)