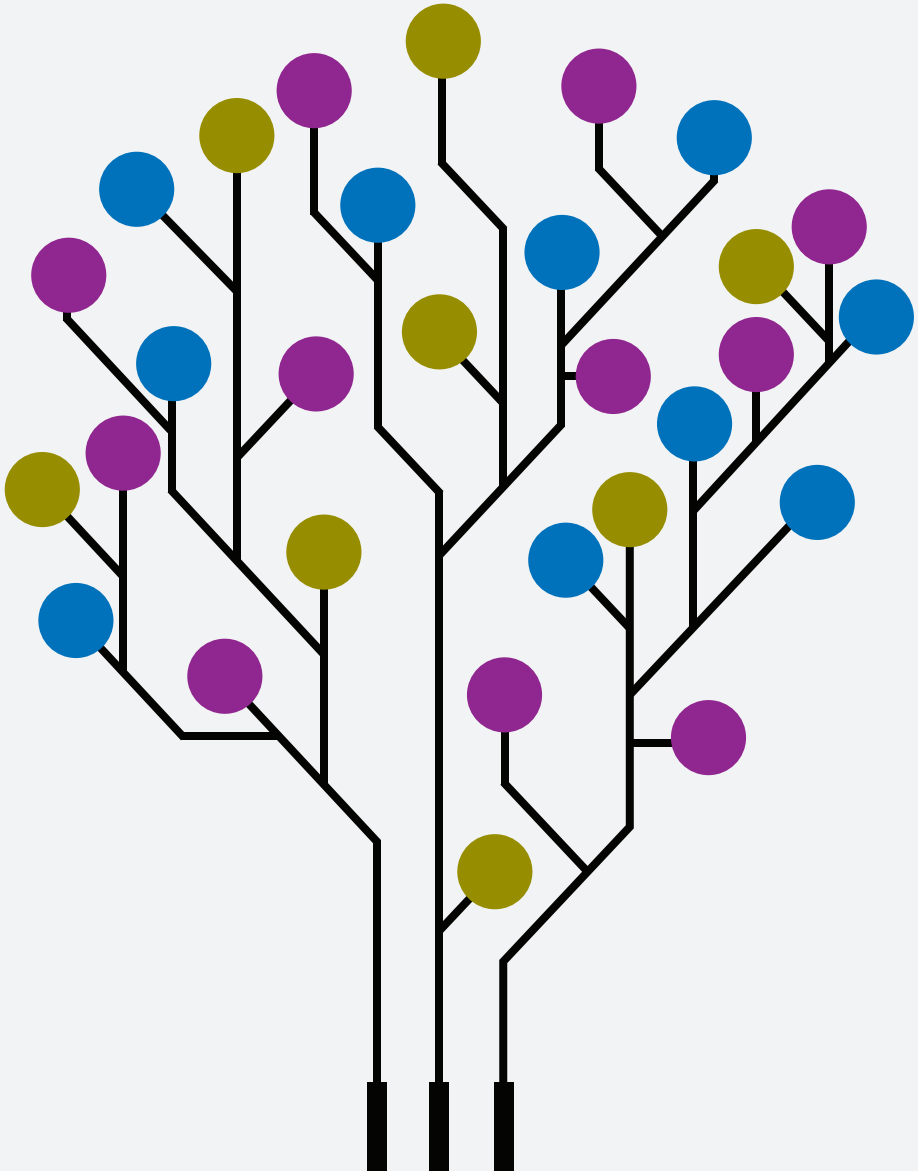
Energy as a Service

To reduce their energy footprint, commercial building sector customers are increasingly investing in energy efficiency and procuring energy from more sustainable sources. Innovative business models provide new opportunities for customers to finance energy-efficient building technologies and measures. These include pay-for-performance contracts, energy savings performance contracts, power purchase agreements, and on-bill financing.

One innovative business model gaining interest offers energy as a service. This represents a shift from customer-owned equipment toward a model where the service provider maintains ownership and the customer pays for the services provided by the equipment.[1]



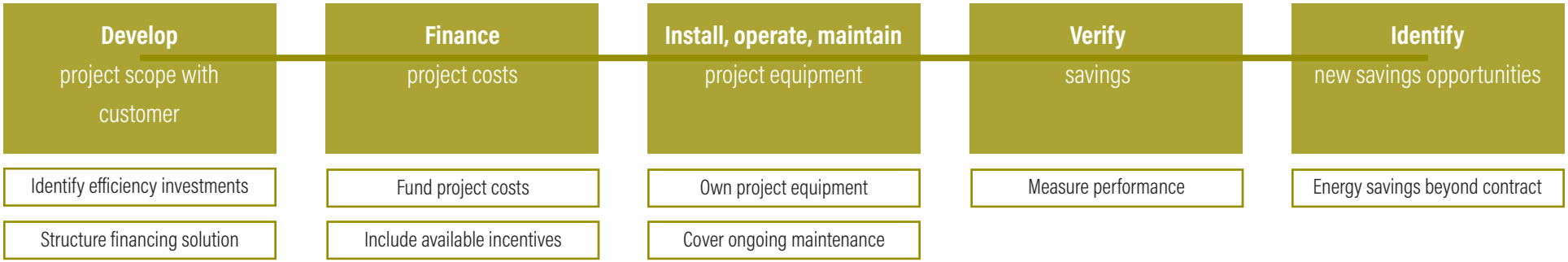


Figure 1. Roles of efficiency-as-a-service provider

This financial solution helps organizations implement energy and water efficiency projects with no upfront capital expenditure.[2] The provider designs the project scope, finances the material and construction costs, maintains project equipment, and monitors the performance to validate energy savings (figure 1).

The customer pays back the project costs through a monthly, a quarterly, or an annual fee for the service received. The payment is generally based, directly or indirectly, on the energy savings realized on utility bills. Experience to date with this service-based model reveals energy savings potential up to 20–25%.

Various efficiency-as-a-service models focus on lighting, equipment, software, and general energy management. Common solutions include lighting retrofits, upgrades to HVAC and other equipment, building automation and controls, energy storage, and water efficiency measures.

Energy as a service (EaaS) is the most common efficiency-as-a-service offering. This brief focuses on using the EaaS model to optimize building energy efficiency, summarizes the benefits, and suggests ways program administrators can accelerate its uptake.

The EaaS Model

Figure 2 shows the structure of a typical EaaS relationship.

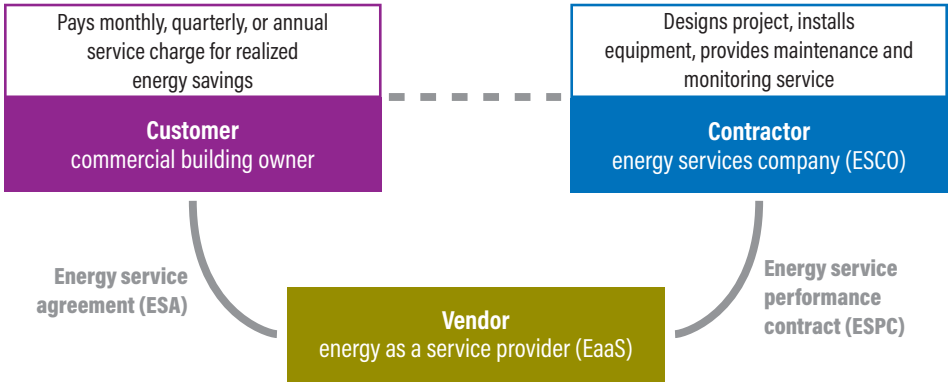


Figure 2. EaaS structure

The EaaS provider designs the scope of the project according to the customer's needs and enters into an energy services agreement (ESA) for a contracted period to cover costs and repayment of services.[3] The provider also signs an energy service performance contract (ESPC) with a contractor or an energy service company (ESCO) to install the energy measure, provide long-term maintenance, and guarantee performance throughout the term of the agreement.[4] Typically, the ESCO guarantees only a portion of the expected savings while the EaaS provider assumes the risk of realizing the full expected savings.

The EaaS model usually shifts the burden of financing, owning, installing, and managing the performance of an energy asset from the customer to the service provider.* Before an energy-saving measure is installed, the provider conducts or arranges for preliminary and detailed energy assessments to determine potential savings opportunities.[5] Once the project scope is finalized and construction completed, a measurement and verification (M&V) analysis determines the actual savings. The customer is responsible for a service fee, typically based on the units of energy saved (often referred to as negawatts). The payment can be structured either as a percentage of the customer's utility rate or as a fixed amount per kilowatt-hour (kWh) saved.[6] In any case the customer's payments are below its current utility rate. The provider promises a certain level of energy savings and adjusts payments if it is not realized.[7] At the end of the contract period (generally 5 to 15 years), the customer can purchase the equipment at fair market value, have the provider remove it, or extend the contract.[8]

Building owners in an EaaS agreement have fewer onsite equipment maintenance requests from tenants because the providers maintain the energy systems installed under the contract. In addition, owners can pass the EaaS costs to the tenants in leased spaces.[9] Tenants may find the agreement advantageous because their utility bills are reduced and they enjoy an improved indoor environment (e.g., better lighting and thermal conditions). Large buildings, or a portfolio of smaller buildings that add up to a bigger footprint, provide an opportunity for greater energy savings and simplify the contracting process.

The EaaS model may seem similar to ESCO financing, but they differ significantly. While the ESCO industry has delivered savings in the public building sectors, the EaaS model is designed to help private sector commercial building owners with limited capital and technical expertise to implement energy efficiency projects.†,[10] Using an ESPC agreement, an ESCO guarantees energy savings to a customer over a set period by installing and maintaining equipment. Depending on the ESCO, it may provide financing or require outside funding through loans, capital lease, or bond issuance, which are on-balance-sheet financing mechanisms.[12] Under this structure, the customer owns more-efficient equipment but may be vulnerable to the fluctuations in energy prices.[13] By contrast, the third-party EaaS providers are responsible for meeting the reliability and energy goals of the customer. The provider takes on financial and performance risk by guaranteeing lower energy costs from implementing the selected efficiency measures. Table 1 summarizes these differences.

Two Starwood hotels use Sparkfund's subscription model to achieve $89,000 annual energy savings

The Aloft and Element hotels in Miami Doral worked with Sparkfund to install LED lighting and smart thermostats in both hotels. The projects were financed using a 60-month Sparkfund subscription contract, with energy performance contracting company OnPeak Energy evaluating, designing, and installing the technologies.

The LED upgrade reduced lighting loads by 58%. Installation of smart thermostats in rooms saved $172 per room per year. The occupancy sensors and energy management settings in the thermostat automatically set back the temperature when rooms had no occupancy, which helped optimize HVAC runtime. The smart thermostats created additional maintenance savings by lowering the humidity in the guest rooms and preventing damage to the wallpaper. The combination of an LED lighting retrofit and smart thermostats reduced carbon dioxide (CO_2) by 1,070,157 pounds/year and energy use by 942,670 kWh/year.[11]

Table 1. ESCO financing versus EaaS

	ESCO	EaaS
Capital investment by customer	Sometimes	No
Off-balance-sheet financing	No	Yes
Ownership of equipment by customer	Often yes	Often no
Performance risk borne by the customer	Sometimes	No
Flexibility to add retrofit during contract period	Difficult	Yes
Term of contract	10–20 years	5–20 years

* Depending on the service needs of the customer, some exceptions exist. Under the metered energy efficiency transaction structure (MEETS) offered by Seattle City Light at the Bullitt Center, the equipment becomes the property of the building owner upon project completion. The financing entity that pays for the equipment retains the energy asset on its balance sheet. See details at www.meetscoalition.org/wp-content/uploads/MEETS-AC-Description.pdf.

† About 84% of the approximately $5 billion ESCO market is spent on government and municipality, university, school, and hospital (MUSH) buildings. ESCOs have faced difficulty in the commercial market due to split incentives. While industrial facilities are not a focus for this study, information on the performance of the ESCO model in the commercial and industrial sector can be found at eta-publications.lbl.gov/sites/default/files/revised_market_potential_final_25apr2017_0.pdf.

The Opportunity

The EaaS model can provide valuable services to commercial, hospital, and higher education customers. This section offers a preliminary list of benefits. More experience and data are needed to understand the best market segments and applications for this offering.

First-Cost Savings

Many commercial customers hesitate to divert capital from essential business objectives to invest in building retrofits. The EaaS model can be a good fit for organizations that want to pursue energy efficiency without using their own finances. Under an EaaS agreement, the service provider secures third-party funding to pay for all project costs, so the customer has no upfront expenses or internal capital outlay and can use their own funds for other projects.[14]

Off-Balance-Sheet Financing

EaaS offerings are typically designed as an off-balance-sheet financing solution. The use of service payments allows businesses to shift energy efficiency projects from an expense asset that they must buy, own, maintain, and depreciate to an operating expense similar to a standard utility bill or power purchase agreement.[15] Since the provider owns the energy equipment, customers have no debt on their balance sheet and their bottom line is improved. Thus they are able to secure the energy they need with fewer uncertainties because the provider has assumed the risk for achieving energy savings.

Deeper Operational and Maintenance Savings

The cost savings from energy efficiency projects are calculated and guaranteed using agreed-upon M&V protocols. Because the EaaS paradigm generally relies on the pay-for-performance model, it offers potential operational efficiencies and positive cash flow from energy, water, and maintenance cost savings. The pay-for-performance nature, along with maintenance and verification of project savings, reduces the performance risk for customers and may encourage more-persistent savings and implementation of newer technology.[16]

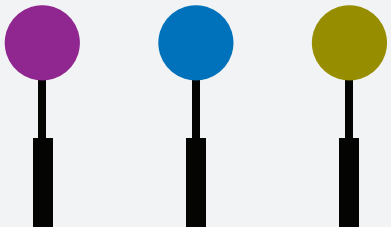
Customers have the additional benefit of being able to finance multi-measure deep energy retrofits with long simple payback periods. EaaS projects may include capital-intensive investments in HVAC upgrades with motor, pump, and boiler replacements, energy management systems, and distributed renewable energy resources.[17] These measures offer greater energy savings and optimize comfort. However they are difficult to fund under traditional financing sources due to their lower return on investment.[18]

Because the EaaS providers are responsible for the energy equipment, they pay for periodic maintenance services to encourage long-term reliability and performance. The level of such service varies by project type and customer needs. By rewarding a third-party provider for successfully managing operations, customers reduce the risks and challenges associated with implementing, managing, and monitoring new technology. Installing more-efficient equipment with continuous maintenance may also mitigate the risk of unplanned events.

Flexible Enterprise-Scale Retrofits

Owners of a portfolio of buildings find this model advantageous because providers can bundle multiple sites with smaller project opportunities into a single contract.[19] The provider can implement the same retrofit in multiple buildings, saving time and human resources. An example is Redaptive's collaboration with AT&T to upgrade more than 600 sites across 31 states with LED lighting and controls, generating annual energy savings of nearly $20 million.[20] The EaaS structure also allows the flexibility to add new efficiency measures over time, often within the same contract term and rate, increasing overall savings across the customer portfolio.[21]

"Since 2008, the AT&T Energy Program has aggressively pursued energy efficiency projects at our facilities. There came a point in time when the readily fundable projects—those with high return on investment—were gone. We needed a way to continue the momentum, and EaaS helped us overcome funding hurdles and expand our portfolio of projects tremendously." *John Schinter, assistant vice president, Energy, AT&T*



Lower Operational Risks

For many organizations, energy management is not a core competency. Staff frequently struggle with selecting technology options, sifting through incentives, and retrofitting the infrastructure. EaaS vendors provide access to experts who can design the project scope and install, maintain, and verify the performance of the efficiency measure.[22] Customers have a lower risk of paying for underperforming equipment because vendors guarantee energy savings at a known cost.[23] Long-term agreements allow customers to secure a fixed lower price for energy over the course of the contract if the service provider is able to achieve the promised savings.

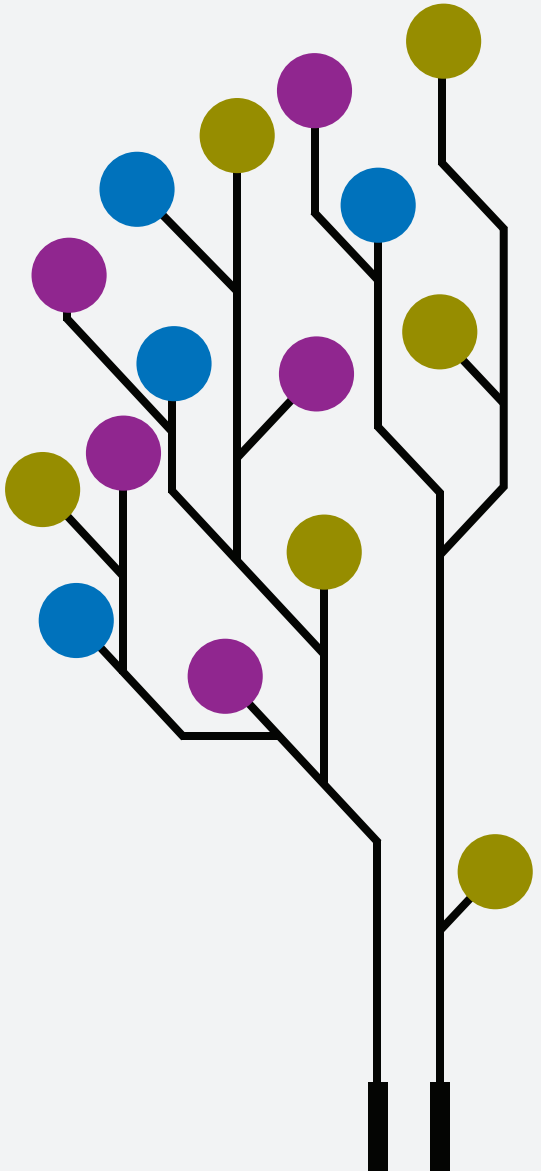
Shift to Distributed Energy Resources

In recent years the market has shifted to more distributed energy resources (DERs) in response to grid reliability issues, severe weather events, equipment failures, decreases in the costs of DERs, and customer interest in renewables.* DERs are resources close to customers that are sized to meet all or some of their particular electric or power needs. These technologies can generate power onsite to meet the needs of the distribution grid or reduce demand using energy efficiency.[24] EaaS can drive the shift to a variety of DERs, including energy efficiency, demand response, renewables, and energy storage options that may require higher upfront capital and skills beyond the customer's core expertise.[25] Building owners who adopt efficiency measures and commit to renewable sources can reduce the carbon footprint of their portfolio.

The Ohio State University, ENGIE North America, and Axium Infrastructure achieve 25% energy efficiency improvement

On behalf of Ohio State Energy Partners, ENGIE Services operates systems that heat, cool, and distribute energy to the Ohio State University campus. The plan includes annual production of 1,896,860 kLbs (kilopounds) of steam and 67,055 kTh (kiloton-hours) of chilled water and uses a geothermal system to produce 2,400 tons of cooling and 26,000 MBH (1,000 Btus/hour) of heating. The EaaS fee structure is similar to the rates Ohio State would have paid its utility and allows the university to secure a more reliable utility system and achieve energy savings across campus. Ohio State pays the provider an annual utility fee with three components: a fixed fee that starts at $45 million and grows by 1.5% each year to account for inflation, an operating fee that covers the university's average operation and maintenance (O&M) costs, and a variable fee tied to the financial return on any capital investments funded by ENGIE/Axium.

In addition to reducing energy costs by optimizing the utility system, an estimated $250 million will fund a number of energy conservation measures across campus. The partnership will invest in solar photovoltaic (PV) power, lighting retrofits, and HVAC systems upgrades to achieve a 25% reduction in consumption within the first 10 years of the agreement.[26]



* DER technologies include energy efficiency, rooftop solar, wind turbines, fuel cells, microturbines, cogeneration, and energy storage systems, which can be connected to or isolated from the electric power grid.

Program Approaches

Within the EaaS structure, we identify three offerings that are most suitable for onsite commercial building applications:

- Energy portfolio advisory services
- Onsite energy supply
- Building energy efficiency optimization solutions*,[27]

Energy portfolio advisory services represent one of the most inclusive EaaS solutions.[28] EaaS vendors provide clients with comprehensive, enterprise-wide strategic guidance to navigate energy procurement, management, financing, and technology opportunities across all energy needs of their organization. For example, Metrus offers a pay-for-performance financing solution that allows customers to implement a diverse mix of energy efficiency measures to generate the maximum electric, gas, and water savings across their portfolio.[29] BAE systems, a defense, security, and aerospace company, used Metrus's solution across its portfolio to implement longer-payback energy efficiency projects to save $4.1 million. Metrus and its project partner Siemens worked with BAE to identify the most suitable technologies to implement, and Metrus financed all the upfront costs.

Another EaaS offering, **onsite energy supply**, includes common distributed energy generation solutions such as solar PV, combined heat and power, diesel and natural gas gensets, microturbines, and fuel cells to improve energy supply. An example is the partnership among ENGIE North America, Axium Infrastructure, and the Ohio State University to form Ohio State Energy Partners. The partners signed a $1.16 billion contract under a 50-year lease to provide integrated solutions to manage utility systems and support procurement of electricity and natural gas, invest in energy conservation measures, and develop new academic opportunities for the university.[30]

Energy efficiency optimization is a building-scale EaaS offering. The EaaS provider offers a comprehensive energy efficiency assessment, business case analysis, financing, implementation, M&V, and commissioning services to help the client reduce its energy use. Depending on the services provided, several established market offerings are available. Examples include an energy service agreement (ESA), a managed energy service agreement (MESA), and software as a service (SaaS). Utilities can take advantage of this model to fund energy efficiency projects for their large commercial building customers. An example is the recent alliance between National Grid and Metrus to identify over $50 million of investment in energy efficiency projects in upstate New York.[31] As part of the marketing alliance, National Grid will review proposed EaaS solutions for large commercial customers and customize incentives according to the project requirements.[32] These incentives are generally paid at the time of equipment installation and help reduce EaaS contract term length and service payments.

Examples of Other As-a-Service Models

Lumen as a service. Customers define the desired lighting levels, in terms of foot-candles or lumens of light supplied or other metric, and the service provider designs, installs, and maintains the lighting to achieve those goals. The service provider pays the customer a fixed monthly rent, based on the economics of the project, for access to the ceiling space within the buildings. The customer, in return, pays the service provider for the full value of the lighting energy savings realized over the term of the agreement.[33]

Managed energy services agreement (MESA). Customers with a portfolio of small- and medium-sized commercial buildings outsource all management operations for a fixed annual payment over an extended period. The service provider acts as an intermediary between the customer and the utility, charging the customer an agreed-upon fixed rate based on historical consumption, protecting the customer from utility rate changes. MESA is ideal in sectors with a split incentive between landlord and tenant as the structure allows service charges to be passed on to tenants, just as other operating costs are generally passed on to the tenants.[34]

Software as a service. This service analyzes trends and nonroutine events to improve a building's performance. Offerings include customized software tools to increase customer engagement, analyzing project performance and monitoring savings, continuous tracking and fault detection, and data aggregation and management. This service supports customer engagement and communication as well as marketing and can be used for M&V of efficiency programs.[35]

* Other offerings include offsite energy supply and load management solutions.

Project Savings Potential

The EaaS market is still in the early stages, but preliminary analysis illustrates the benefits it could bring to the commercial building sectors. A 2017 Navigant Research report estimated the annual global market deployment potential of EaaS in large Fortune 500 commercial sector buildings will reach $221.1 billion by 2026.[36] Figure 3 shows that EaaS market spending in North America was $17 billion in 2016 and is expected to grow upward of $40 billion over the next few years.[37] This potential is based on the total addressable market for commercial and industrial applications and includes both the installed capital and ongoing service revenues.

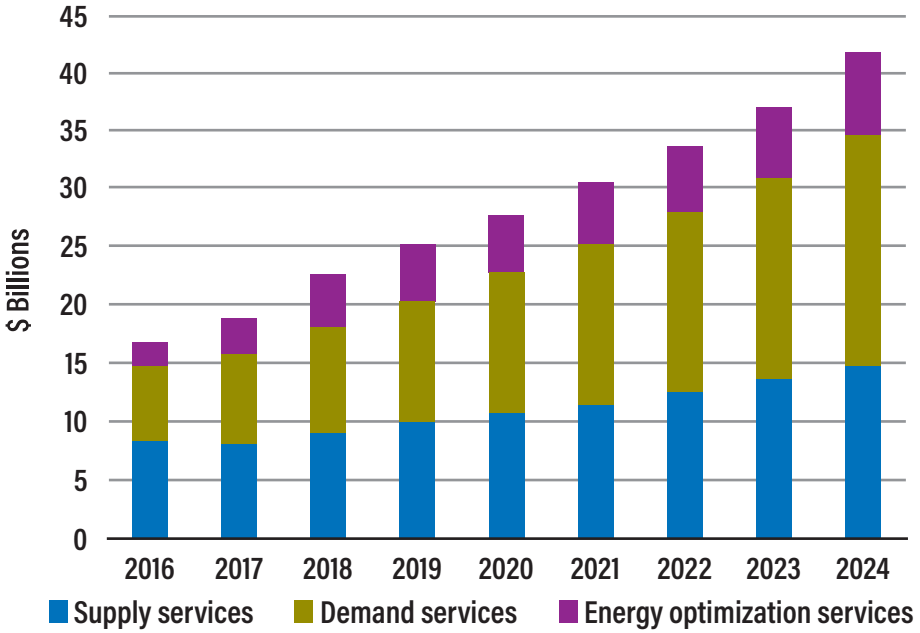


Figure 3. EaaS market growth in North America. Source: Vrins 2018.

The energy savings from different EaaS solutions depend on the selected technology, building ownership constraints, and utility rates. A lower threshold of 10% energy savings is typically achieved by comprehensive LED upgrades when the EaaS provider does not have access to other energy equipment in tenant spaces.[38] A review of case studies from different EaaS vendors shows up to 20–25% savings if the client commits to deep energy retrofits and allows access to the entire building to implement a number of efficiency measures.[39]

Potential energy savings are also determined by the length of the EaaS contract, which is based on customer needs and the thresholds set by the management and energy assessment of the facility. Redaptive estimates savings in the range of 10–22% from their portfolio of offerings for short- to long-term contracts, respectively.[40] A short-term contract typically does not allow for deep energy retrofits, leading to an emphasis on lighting retrofits that yield lower long-term savings but quicker paybacks due to smaller upfront costs. Long-term EaaS contracts can bundle multiple energy efficiency measures, including lighting retrofits, HVAC upgrades, and boiler and chiller replacements, resulting in higher savings.

BAE Systems uses Metrus's efficiency services agreement at six sites to achieve annual energy savings of $1.85 million

BAE, a global aerospace and defense contractor, has worked with Metrus Energy at six sites (close to 2 million square feet) in New York, New Jersey, and New Hampshire. The program is designed to upgrade BAE's manufacturing, office, and test facilities, increase their energy efficiency, and reduce their carbon footprints. The projects are financed under Metrus's energy service agreement, with Siemens designing, installing, and maintaining the energy conservation measures and Metrus covering 100% of the upfront costs.

A total of $11.3 million was invested in energy efficiency upgrades, including LED lighting retrofits, building automation, boiler and chiller replacement, demand-control ventilation, building envelope improvements, and operational best practices. The program has achieved annual savings of 3.6 million kWh, 153,000 therms of natural gas, and 260,000 gallons of fuel oil.[41]

Challenges and Ways Forward

With rapid paybacks, upgrades to the latest technology, and no upfront capital investment, the EaaS model could strengthen the energy efficiency market. EaaS opportunities are starting to reach a notable scale with ESA and metered energy efficiency transaction structure (MEETS) models, but tremendous potential remains. Program administrators can play a role in addressing barriers and making the model more common in the commercial building sector.

Customer hesitancy. In many markets the EaaS model is a fairly recent offering with a limited record of success and few published case studies to convince stakeholders of its benefits.[42] Risk-averse customers may hesitate to commit because they are afraid of investing in an upgrade that has the wrong cost, time span, or outcome.[43] As the number of EaaS projects grows, more data will become available to help evaluate which markets are more responsive.

In addition, the sale process for an EaaS solution is long and complicated because it requires pitching the service to multiple organizational players. Education on EaaS contracts can help overcome customer inertia and simplify communications among the different divisions that are involved in the decision process (e.g., finance, procurement, facilities, and operations departments).

Project size limitation. EaaS providers tend to finance projects with a larger building footprint, with project costs upward of $1 million, to realize a higher level of savings and cover substantial fixed costs.[44] Owners of large commercial buildings or portfolios of smaller buildings benefit as they can meet their efficiency goals without spending their own capital. Aggregating a number of small and medium buildings under a single contract can help achieve more savings across the customer's portfolio.

Building ownership constraint. The EaaS model is advantageous for customers in leased spaces as long as the contract does not extend beyond the lease term. A clear structure can help handle ownership issues in leased spaces as split incentives may create conflicts in EaaS agreements that require long-term commitments.* Even with clear ownership, in certain spaces the tenants may have limited ability to modify systems and equipment due to the building's structural limitations.

Traditional utility program design. EaaS contracts are often multi-year agreements designed around a subscription-based model. By contrast, the utility incentive structure is based on a one-time transaction that focuses on a single measure with an incentive that offsets the cost of equipment or services that may include retrocommissioning or building tune-up activities. Utilities can adapt their existing O&M rebates or strategic energy management programs into EaaS contractual agreements and provide their upfront incentive to the EaaS provider with the customer's approval. The utility programs can also complement the EaaS model by offering performance-based incentives that are applied against the annual EaaS subscription fees. In the interim, the utilities can make information on incentives and rebates easily available and have these payable directly to the EaaS providers. This will reduce transaction times and ease the partnership between the utilities and the EaaS providers.

Need for provider expertise. Service providers should be able to blend technical skills and execution expertise with financing tools to maximize value for the customer.[45] EaaS is a complex model that requires the provider to manage capital acquisition and ownership, operate and manage equipment, and adapt it to the operational needs of the customer. These functions may create additional costs and may become a barrier to customer confidence. Providers need to be trained to analyze the complex operations of an organization and address its energy procurement, financing, and technology deployment needs.

Uncertainty about agreement structure. Commercial building owners traditionally are hesitant to sign long-term financing contracts or service procurement agreements. Because the EaaS provider owns and maintains the energy equipment, customers may be uncertain about whether to treat the contract as a service agreement or a lease. Educating stakeholders on the structure and different ways of accounting for the service can facilitate wider uptake of this model.

* If tenants pay their own utility bills, and get the benefits of an energy efficiency investment, then building owners have little incentive to invest in efficiency measures.

Next Steps

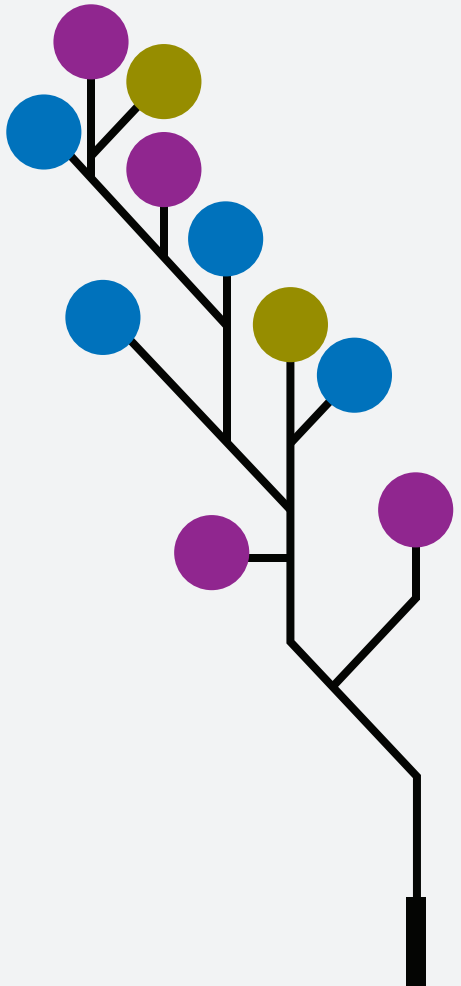
We recommend several courses of action.

Expand utility role. EaaS differs from the traditional measure-based design and incentive programs because it offers a pathway for ongoing communication and an advisory role for the utilities and other program administrators. Many utilities offer financial incentives to eligible customers to retrocommission buildings to optimize performance.* Utilities can provide similar support and incentives to engage customers and help them navigate through an EaaS agreement. The program administrators can function as market facilitators and offer guidance to customers on proposed approaches, technology packages, implementation plans, and service contracts. To offer these services, the program administrators will need to identify, vet, and select independent energy service providers that encourage different EaaS delivery models.

Conduct robust M&V process and impact evaluations. Evaluating, measuring, and verifying the performance of the EaaS offering is critical to increase the accountability of the service provider and determine the service charges. ESCOs typically use the established International Performance Measurement and Verification Protocol (IPMVP) to evaluate the performance of efficiency projects. Specification of IPMVP as the basis for design of a project's M&V brings credibility to the energy savings report and lowers the transaction cost.[46] A robust M&V process and impact evaluation using advanced metering techniques and analytics can make energy savings from EaaS projects more visible. An M&V method can also help gauge customer satisfaction and assess program efficiencies.

Document EaaS energy savings. EaaS providers are working with program administrators to offer the EaaS model to customers with some estimates of potential energy savings. However more independent evaluations and case studies are needed to document the baseline energy use and achieved energy savings to build the value proposition for this model. More data can also help in evaluating the suitability of the EaaS model for industrial or other specialty sectors. Impartial reporting on the percentage change in energy savings, in addition to the absolute savings, can enable project comparisons and make it easier to assess efficiencies. The emergence of new technologies such as energy dashboards that provide near-real-time energy consumption feedback can support this process and provide information to customers.

Pursuing an EaaS model with involvement of the utilities and other program administrators can help scale the size of the customer's project and increase its energy savings. The alliance between program administrators and the service providers can make the process of financing and providing energy efficiency services more interconnected. More case studies and a robust M&V process can further establish the energy savings potential of the EaaS model across many market sectors.



Conclusion

EaaS helps commercial building customers with limited access to capital achieve higher energy and O&M savings. It reduces operational and performance risks by eliminating customer ownership of equipment, guaranteeing energy savings, and tying service payments to performance. Even with these benefits, customer inertia, building constraints, utility program design, and lack of stakeholder awareness pose challenges to procuring energy as a service.

* The Focus on Energy retrocommissioning program provides incentives to identify and implement lower cost measures to improve the operation of existing equipment. For more details on the program, see www.focusonenergy.com/programs/retrocommissioning.

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