NREL
Transforming ENERGY

Unlocking the Value of Deep Energy Retrofits

Recommendations for Creating Financial Products to Reduce Building Emissions and Improve Returns to Multifamily Building Owners

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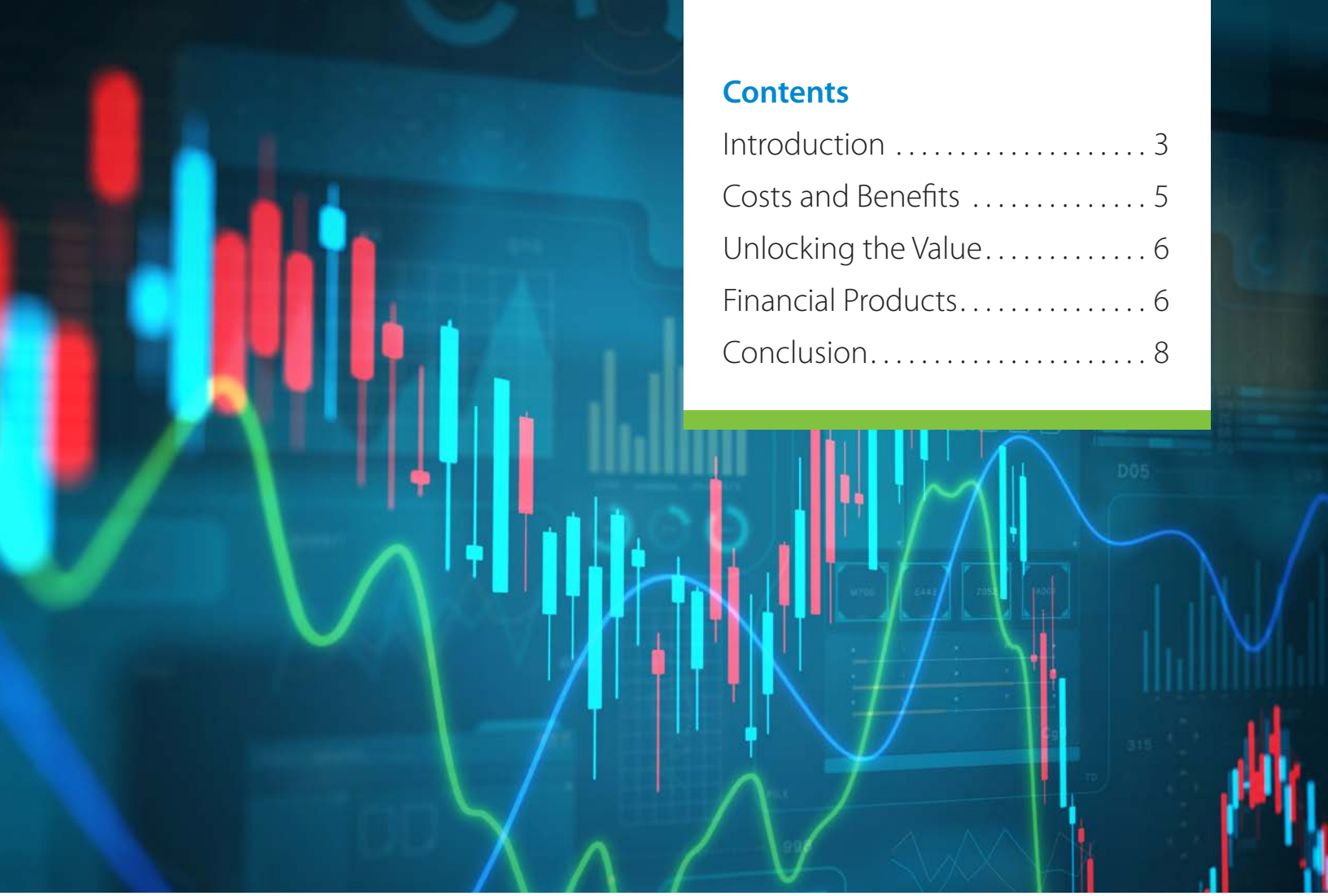
ADL VENTURES

NEW YORK STATE | NYSERDA



Contents

Background

This publication is based on an extensive study conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA) and the U.S. Department of Energy (DOE) to explore financial and risk products to accelerate the implementation of deep energy retrofit (DER) solutions to reduce costs. These financial products are intended to speed market development via three fundamental themes: reallocating risk from building owners and lenders to insurers, quantifying and monetizing previously unrecognized value associated with DERs, and providing building owners and lenders with confidence in the performance of building systems.

Findings are based on a comprehensive analysis and characterization of 100+ existing DER case studies, and more than 40 qualitative interviews with industry experts, including insurers, researchers, building owners, and policymakers. In addition, a quantitative model of overall project economics with baseline, high, and low cases was developed. This data informed the analysis that resulted in three recommended financial product solutions, which were evaluated for their potential to raise projected cash flows and finance DERs:

1. Building System Performance and Energy Savings Guarantee
2. Trade Credit Insurance
3. Ancillary Revenue Contracts.

This report identifies many value streams associated with DERs and introduces these three potential financial products, which aim to reallocate risks and reduce barriers to the adoption of advanced envelope DERs.

Introduction

The U.S. building sector is responsible for 40% of greenhouse gas emissions and remains one of the most challenging industries to decarbonize, creating a roadblock on the path to carbon neutrality by 2050.[1] Because 70% of the building stock that will be standing in 2050 has already been built,[2] achieving a net-zero economy by 2050 requires decarbonization of the existing building stock.

The building envelope drives building energy use and overall building performance. Energy lost through the opaque envelope alone is responsible for 25% of building energy use in the United States, and this value is even higher in residential buildings and older building stock.[3] Without addressing the building envelope, it is very difficult to achieve significant energy reductions or to electrify[4] gas-fueled buildings without increasing energy costs.

DERs that include significant envelope upgrades work as a unified system, reducing heating and cooling loads while replacing old systems with LED lighting, heat pump space conditioning, domestic hot water, and energy recovery ventilation. High-performing building envelopes control energy loss and can protect a building's structural integrity, resist fire and storm damage, maintain comfortable interior temperature and humidity levels, enable greater flexibility in internal load management, and reduce exterior noise intrusion.[5]

The result is a building with better energy performance that also directly improves tenant experience, increases building revenues, and reduces maintenance costs while mitigating a broad spectrum of risks. However, DERs can be challenging due to the high degree of variability in initial conditions, component selection, and design parameters.

Energy efficiency retrofit measures—such as routine air sealing, HVAC improvements, lighting, and appliance upgrades—can often be financed entirely by energy savings.

What Is a Deep Energy Retrofit?

Deep energy retrofits achieve at least 50% reduction in energy usage and usually include building envelope upgrades, building electrification, and energy conservation measures in existing buildings that result in enhanced building performance and occupant value.

Building envelopes, or the physical separator between conditioned and nonconditioned spaces, drive building energy use and overall building performance. Envelope upgrades may include panelized exterior insulation and facade panels that surpass typical air sealing and weatherization.

Building electrification, a component of DERs, refers to converting building systems that burn fossil fuels to high-efficiency electric equipment that can be powered by increasingly clean and renewable electricity.

Building envelope retrofits and building electrification directly **improve building performance** and contribute to additional building value.

[1] https://www.energy.gov/eere/buildings/about-building-technologies-office
[2] https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter9.pdf
[3] https://www.osti.gov/biblio/1821413-opaque-envelopes-pathway-building-energy-efficiency-demand-flexibility-key-low-carbon-sustainable-future
[4] While not the only pathway to decarbonization, electrification is accepted as a promising pathway to achieving building decarbonization.
[5] https://www.gciconsultants.com/blog/understanding-the-importance-of-your-buildings-envelope/

A prefab modular facade solution, when completed at scale, has been shown to reduce cost-per-unit by 20%–50%.

Image from Henning Larsen

Deeper retrofits, with additional envelope upgrades, provide greater opportunities for electrification and economic benefit but cannot typically be financed by long-term energy savings alone due to high upfront costs. While DERs generate significant co-benefits beyond energy savings, they are difficult to quantify and standardize. DERs have not been implemented at scale in the United States due to high first costs and the historic undervaluing of DER benefits.

While DERs with significant envelope upgrades offer a long-term economic means to achieve electrification, today's approaches require a significant upfront capital investment. In the United States, costs are exacerbated by a long, opaque value chain with significant information asymmetry, uncertainty around counterparty risks, and consequently high transaction costs. Moving from project-by-project delivery to integrated, prefabricated, and turnkey solutions reduces variability in finished conditions and enables quality assurance that transforms collections of unique projects into a cohesive portfolio, and allows for better risk transfer, enabling the financial products discussed in this report.

This method has been shown to reduce costs associated with public housing renovations at scale in Europe, where Energiesprong has completed thousands of retrofit units, reducing cost per unit by 20%–50%.[6] Using a prefabricated component model, solution providers in European markets have drastically reduced delivery time and improved the performance of technical building systems after installation.[7]

Existing economic payback models are limited in their ability to recognize, translate, and quantify the true value of DERs beyond energy savings. Failing to capture the benefits and profits of additional value streams results in a financing gap that has slowed the uptake of DER projects.

[6] From interviews with Energiesprong solution providers in the United Kingdom (20% savings), France, Italy (25%–30%), and the Netherlands (up to 50%).
[7] From interviews with French and Italian providers of Energiesprong retrofits.

Costs and Benefits of Deep Energy Retrofits

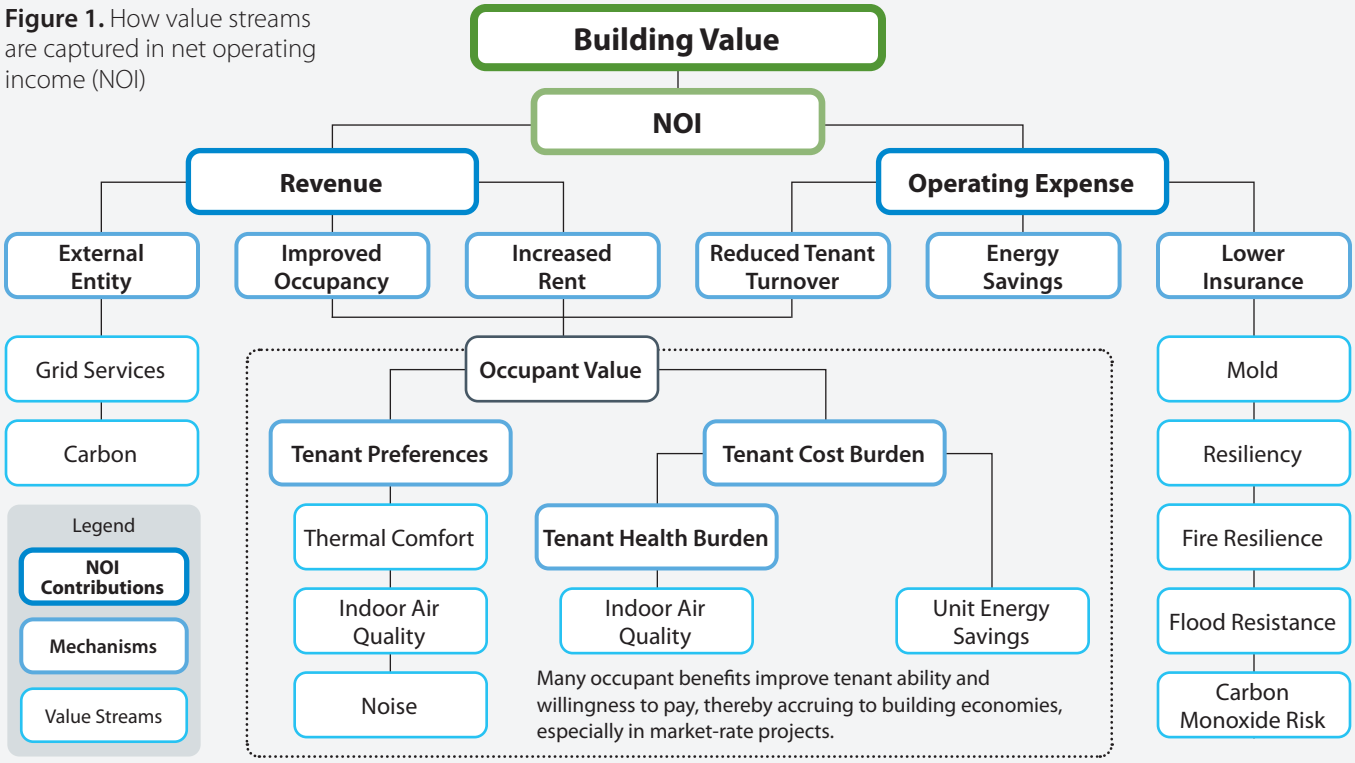
DERs offer benefits beyond improved energy performance. These can include better indoor environmental quality, increased building longevity and resilience, and improved thermal and acoustic comfort. These attributes are notoriously difficult to quantify because of varying building stock characteristics and external environmental and economic conditions that drive the measurable economic value that results from "soft" benefits. For these reasons, many DER values have historically been deeply discounted.

In an exhaustive review, ADL Ventures investigated more than 100 existing and proposed projects, discovered through interviews, reviews of trade journals, and peer-reviewed journal articles and meta studies. From this data, ADL assembled a test group of more than a dozen DERs with reasonably complete and comparable cost and performance data. Variation in cost and performance among these projects was considerable, as might be expected in a nascent but emerging industry.

Figure 1 shows disparate value streams identified through ADL's analysis that can contribute to building net operating income[8] (NOI) and value through increased operating income or decreased operating expense.

Ease of implementation varies across the sources of value that were investigated in ADL's study. While some value streams have common and accessible measurement methodologies that are clearly tied to building owner revenues, others lack consensus around both claimed value and performance measurement, which serve as a short-term roadblock to monetization. In addition to the broad analysis of each individual value stream, ADL recognized that the value streams naturally "roll up" into

Figure 1. How value streams are captured in net operating income (NOI)



[8] NOI is a key factor in assessing the value of a building. It is a calculation used to analyze the profitability of income-generating real-estate investments equal to revenue minus necessary operating expenses. NOI affects a building owner's ability to obtain financing and access loans.

points of aggregation. This means that a portion of the value associated with hard-to-measure or hard-to-value benefits can be captured at a higher-level endpoint. For example, while noise attenuation may not have sufficient evidence to support pricing on its own, it impacts tenant health and preferences, which improve rental pricing and occupancy, thus aggregating to building revenue. While aggregation does not preclude the creation of vehicles for each stream, it provides the opportunity to incorporate hard-to-value benefits via others that may be easier to measure, define, and process claims.

Once recognized, the value of DER benefits can roll up into improved NOI through higher revenue and lower operating expenses. The benefits accrue to the building owner in profitability and then to the ability to increase available loan amounts. Value is also delivered to tenants through improved thermal comfort and reduced direct costs (such as not having to purchase space heaters or fans for comfort). Reduced heating and cooling costs, healthier indoor conditions, and enhanced safety can deliver significant value to tenants that may influence willingness to pay more for market-rate and affordable housing units.

Unlocking the Value of Deep Energy Retrofits

Unlocking the full value of DERs requires new financial products that reallocate risk and standardized technology solutions that can lower costs of DERs by achieving economies of scale. A full discussion of standardized technology solutions is beyond the scope of this report. However, turnkey, prefabricated delivery of DERs is a proven way to ensure the quality assurance and standardization across an industry necessary to achieve meaningful scale, and meaningful scale is needed to support the suite of financial products introduced in this report.

Financial Products

While some existing programs recognize that better buildings reduce risk and offer improved financing terms, few programs are currently structured to support DER projects.

Three financial product solutions emerged from the analysis of building performance value streams and were selected based on their ability to effectively attract stakeholders and reduce carbon, feasibility, and use in other insurance sectors.

1 Building System Performance and Energy Savings Guarantee:

Overview:

Traditional technology warranties cover individual retrofit components for varying lengths of time. Moving to system-level warranties that include other long-term energy savings and occupant-perceived performance elements to match the financing period of 10–30 years can reduce project risk.

Problem:

Current "repair, replace, or refund" warranties for 5 years do not give sufficient assurance to building owners that they will not incur high product maintenance, repair, or replacement costs within the expected lifetime of the equipment. With new integrated systems, building owners are concerned that energy savings and other areas of performance will not be delivered.

Solution:

Energy savings guarantee products that cover measurable performance elements, such as failing to maintain temperature, that last the length of the financing period.

2 Trade Credit Insurance:

Overview:

Many retrofit benefits accrue to tenants and may lead to increases in occupancy and building-level NOI. A credit insurance product based on increased building cash flow could reduce repayment uncertainty for project lenders by paying out in the event of building owner default.

Problem:

Many benefits of retrofits accrue to tenants, which can drive improvements in building revenues. However, these benefits are difficult to model and limit owners' ability to attain financing.

Solution:

Insure against project default based on portfolio-level improvements in retrofit NOI and creditworthiness. Reduce repayment uncertainty to lenders, thus unlocking more capital per project.

3 Ancillary Revenue Contracts:

Overview:

Grid services and carbon credits may be independently structured and monetized by parties other than the tenant, landlord, or lender. Separable bilateral, long-term contracts can provide certainty in what can be a volatile market driven by regulation.

Problem:

Grid services and carbon credits will have increasing value over time, but there can be a principal-agent problem that makes monetization more difficult.

Solution:

Separable, bilateral, and long-term contracts provide certainty in a volatile market.

Existing Insurance Products

Freddie Mac's Multifamily Green Advantage Program offers better loan pricing and increased loan amounts for buildings that improve water and energy efficiency, and Fannie Mae's Green Rewards can improve loan amounts and lower interest rates for buildings with Green Building Certifications. These programs both recognize the value of energy efficiency and incentivize building upgrades. However, additional work is needed to support the financing of DERs required to meet emission reduction targets.

Limiting factors of Freddie Mac and Fannie Mae to close the financing gap of DERs include:

- Freddie Mac and Fannie Mae products only apply when a building owner applies for or refinances a mortgage.
- Similarly, other financing program loan amounts are based on discounted value of predicted energy savings, which may undervalue actual performance.
- Neither program captures nor quantifies additional value streams such as tenant comfort that increase occupancy and retention, improving NOI.

How Does a Credit Product Work?

Trade credit insurance is a method for protecting lenders against a commercial customer's inability to pay its debt.

NOI (cash flow) is the key driver of the ability for a building owner to pay off debt.

A credit product does not guarantee NOI; it insures against insolvency at the project level.

These financial products are intended to speed market development via three fundamental themes:

1. Reallocating risk from inefficient risk-averse building owners and lenders to insurers that can more cost-effectively model, price, and spread risk. This can reduce friction between parties, enable more efficient project delivery, reduce transaction costs, and reduce risk premiums.
2. Quantifying and monetizing previously unrecognized value associated with the unique benefits of advanced envelope DERs to offset construction costs and unlock additional capital.
3. Provide building owners with confidence in the performance of building systems.

These prospective financial products will make it easier to finance DERs by lowering upfront capital requirements, reducing uncertainty around financial projections, and transferring technology risks from the building owner to an insurance company.

Conclusion

Standardized DER approaches allow aggregation of a collection of unique projects into a portfolio of similar assets that can benefit from the financial products described in this study. Multifamily housing represents an attractive starting point for integrated, prefabricated DER solutions, combining significant volume in older, inefficient vintages and relatively large project size with consistent, simplified system design. The identified value streams offer the opportunity to narrow the financing gap for DER in multifamily buildings, in combination with market maturation and delivery model innovation.

Turnkey DER solution providers are beginning to emerge in the United States, spurred by programs such as RetrofitNY.[9] However, such integrated delivery remains in the pilot stage with limited and highly variable data available for U.S. markets. The extreme variation in the market and physical condition of buildings means that while some prospective DER projects can be implemented in today's market, other segments will not be economical until the market, its associated business models, and supporting financial instruments undergo further development.

Additional efforts to aggregate demand for DERs in multifamily buildings, develop standards for valuing DER benefits, and promote turnkey DER solutions in the United States will provide a strong foundation for the development of financial products that will unlock the true value of DERs.

[9] https://www.nyserda.ny.gov/All-Programs/RetrofitNY-Program

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About NYSERDA

The New York State Energy Research and Development Authority (NYSERDA) works to promote energy efficiency, renewable energy, and emissions reduction across New York's economy and energy system. In addition to supporting clean energy and technologies, NYSERDA works to advance equity and inclusivity, jobs and economic development, public health, and community resilience through our work. Collectively, these efforts are key to developing a cleaner, more reliable, and affordable energy system for all New Yorkers.

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