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HOLISTIC REVITALIZATION OF DISTRESSED REAL ESTATE ASSETS: LEVERAGING SUSTAINABLE MODERNIZATION FOR ACCELERATED EXIT LIQUIDITY IN THE CAROLINAS MARKET

Summary. *The research is devoted to the development and scientific substantiation of a comprehensive "turnaround" methodology for distressed real estate assets in the North and South Carolina markets. Amid systemic shifts in the U.S. housing market in 2025-2026, the author proposes a transition from reactive cosmetic refurbishment to a systemic value management model throughout the asset`s entire lifecycle. The core hypothesis is the synergy between the project exit velocity and the implementation of deep energy modernization standards (HVAC SEER 2 16+, envelope sealing, smart monitoring) as a tool for mitigating information asymmetry and the fear of latent defects. The methodology is based on deductive analysis, financial modeling (ROI, ARV) and instrumental auditing (thermal imaging, blower door test). The work integrates federal incentive mechanisms within the Inflation Reduction Act (IRA) to maximize profitability. Case study results confirm the achievement of an ROI at the 25-35% level and a reduction in the asset`s exposure period by 30-40%. The work proves the strategic importance of the methodology for ensuring U.S. energy security and increasing*

housing affordability through the optimization of the total cost of ownership (TCO).

Key words: *distressed properties, turnaround, energy modernization, Carolinas market, exit liquidity, ROI, inflation reduction act (IRA).*

Introduction. The primary objective of this research is the design and scientific substantiation of a comprehensive "turnaround" methodology for the distressed real estate segment within the markets of North and South Carolina. The work proposes a shift in the traditional approach to asset renovation - moving away from reactive repairs of isolated issues toward establishing systemic asset management throughout its entire lifecycle, accounting for costs and efficiency [1]. The focus is centered on the development of an adaptive algorithm that enables an investor to restore building functionality and strategically reposition it as a high-liquidity asset meeting the demands of the modern ecologically oriented market [2].

The key research hypothesis is the synergy between the operational speed of exit liquidity and the implementation of deep energy modernization standards. The author aims to demonstrate that the integration of technological solutions (high-efficiency HVAC systems, thermal envelope sealing, and the implementation of "smart" energy monitoring systems) serves as a potent instrument for mitigating information asymmetry [3]. Within the Carolinas market environment, where latent defects in the aged housing stock frequently deter buyers, an energy upgrade acts as a verifiable indicator of the quality of the entire renovation process, which radically enhances counterparty trust and reduces the object's exposure period ("Days on Market") [4].

An additional objective is the synchronization of the proposed methodology with current U.S. regulatory incentives, such as federal tax credits under the Inflation Reduction Act (IRA). The article is intended to formulate a financial-operational model that will allow investors to maximize profitability through

speculative price appreciation post-renovation (ARV), as well as through the capitalization of government subsidies and the mitigation of long-term operational risks [5].

Particular attention in the work is devoted to the formation of technical resilience protocols for buildings. In the conditions of South and North Carolina, frequently subject to risks of extreme weather events and specific loads on building envelopes due to high humidity, the objective of the article is to propose a renovation methodology that simultaneously minimizes heat loss and enhances the durability of the structural assembly [6]. Energy modernization in this context is regarded as a form of long-term capital insurance against physical depreciation and climate risks.

Within the context of the region`s shifting demographic landscape, the work pursues the objective of adapting the housing stock to the value orientations of new buyer groups, for whom ESG (Environmental, Social and Governance) indicators are becoming a decisive factor in decision-making. The author intends to develop a product standard that ensures high liquidity by attracting institutional investors and private individuals oriented toward responsible consumption.

It is of paramount importance that the methodology entails the implementation of digital monitoring elements for the efficiency of the deployed solutions. The thrust is the creation of an evidence-based marketing system, where stated energy-saving indicators are corroborated by real data from intelligent metering systems during the object`s exposure phase [7]. This allows for the minimization of the uncertainty discount characteristic of the secondary market and establishes the foundation for the formation of premium asset value as technologically verified and fully prepared for efficient operation.

Thus, the work offers a scientifically substantiated toolkit for creating a product that combines high economic profitability with compliance with modern requirements for the region`s climate resilience [8].

Relevance of the research. The relevance of this work is driven by the systemic reorganization of the U.S. real estate market in 2025-2026, where the Carolinas region (North and South Carolina) emerges as one of the most dynamic yet problematic markets. Against the backdrop of active inward migration from northern states and increasing urbanization, a significant volume of housing stock classified as distressed properties persists in the region [9]. These assets, burdened by physical deterioration or financial obligations, represent latent potential for investors. However, traditional restoration methods (cosmetic renovation) in contemporary economic realities demonstrate declining performance characteristics due to rising material costs and tightening energy consumption requirements. One of the central challenges is the high entry threshold and the significant capital intensity of restoration projects. The revitalization of a distressed asset necessitates strategic capital allocation. Under conditions of volatile borrowing costs and high inflation, investors face the risk of capital entrapment in low-liquidity assets. Accordingly, the search for methodologies that enable the optimization of CAPEX (capital expenditures) while simultaneously reducing the asset`s exposure period on the market becomes critical for ensuring the resilience of investment portfolios [10].

It is separately worth noting the particular urgency imparted by the climate and energy agenda of the Carolinas region. High humidity and extreme summer temperatures exert a colossal load on air conditioning and ventilation systems, rendering electricity bills a primary factor in housing selection for buyers and tenants [11]. In this sense, energy modernization ceases to be an optional green add-on - it becomes a baseline requirement for asset quality. Assets that have undergone deep thermal retrofitting and HVAC system upgrades gain a competitive advantage through the radical reduction of future operating expenses (OPEX) for end-users, which translates directly into a green premium on the sale price. Furthermore, the relevance of the research is reinforced by the U.S. regulatory landscape, specifically the expansion of government support measures

within federal energy-saving programs. The integration of energy-efficient solutions into the restoration process of distressed properties allows investors to leverage tax deduction and subsidy mechanisms, thereby mitigating financial pressure on the project.

The necessity of the study is intensified by a large-scale demographic restructuring, as the Carolinas remain leaders in population inflow from high-cost-of-living states (New York, California). A new generation of buyers and tenants, forming the core of this migration flow, demonstrates entirely distinct consumer priorities. For them, operating costs and the ecological footprint of the dwelling are factors as critical as location and the financial aspects of the matter [12]. As a result, a "liquidity imbalance" emerges in the market - assets that have not undergone energy modernization are subject to significant devaluation, while modernized assets accumulate solvent demand, providing the investor with a swifter and more profitable project exit.

An additional factor of the article`s timeliness is the shifting landscape of institutional investment. Major funds (REIT) and private equity firms actively operating in the Carolinas market are increasingly implementing stringent ESG criteria, when selecting assets for their portfolios [13]. The development of a methodology enabling small and medium-sized investors to prepare distressed assets for sale in accordance with these standards opens access to a deeper capital market. Here, energy modernization is transformed into a tool for the institutional upgrade of real estate, allowing for the transition of distressed assets from the category of risky speculation to the category of high-quality investment products with a high level of trust. One cannot ignore the increasing degradation of the region`s energy infrastructure against the backdrop of overall consumption growth. In 2025-2026, a trend toward electricity tariff volatility is observed, rendering long-term ownership of inefficient housing financially burdensome. The uniqueness of the work lies in the proposal of solutions that enable hedging the risks of future residents against rising utility costs. The modernization of the

building envelope and life-support systems at the restoration stage becomes a form of capital insurance, preventing asset depreciation in the event of further energy resource price increases.

A major portion of the distressed properties segment in the Carolinas is represented by assets constructed over 30-40 years ago, which implies the presence of accumulated technical debt in energy efficiency. Traditional repair methods often ignore latent issues: air infiltration, inefficient insulation and obsolete engineering protocols [14]. The justification for this work consists in a revision of the very concept of renovation. The author proposes viewing restoration not as the correction of visible defects, but as a total technological reboot of the asset, without which its long-term competitiveness in the modern market is impossible.

The strategic urgency of this methodology is further amplified by the rapid expansion of IT and industrial hubs across the Carolinas, such as the research triangle park in Raleigh and the growing financial and tech sectors in Charlotte. As these economic centers attract a steady influx of high-skilled professionals, the regional labor market faces a critical shortage of high-quality, efficient housing. The proposed turnaround methodology directly facilitates the rapid reintegration of distressed assets into the active housing stock, specifically tailored to the requirements of this new workforce. By providing technologically verified and ready-to-move-in residences, the methodology supports the regional infrastructure`s capacity to absorb migration flows, ensuring that the housing supply keeps pace with industrial and technological growth.

A fundamental distinction of this approach is the transition from subjective visual assessment to rigorous engineering-technical verification. The mandatory integration of instrumental auditing including infrared thermography, blower door testing and moisture audits serves as empirical proof of the asset`s structural and thermal integrity. While traditional cosmetic renovations (fix-and-flip) often focus on surface-level aesthetics to mask underlying issues, this methodology

utilizes high-precision tools to eliminate the information asymmetry typical of distressed properties. These tests provide a technological passport for the building, offering verifiable evidence that the renovation meets high engineering standards, thereby neutralizing buyer concerns regarding latent defects and ensuring the long-term durability of the modernization.

Consequently, the development of a methodology that combines the economic efficiency of turnaround processes with energy modernization aligns not only with commercial business interests, but also with global trends toward improving residential environment quality and the sustainable development of urban territories.

Methodology of the research. The methodological framework of this research is constructed upon a deductive approach, synthesizing an empirical analysis of the Carolinas real estate market with computational-design modeling of renovation processes. During the initial phase, a profound analysis of the market environment in the states of North and South Carolina is executed, utilizing data from Multiple Listing Services (MLS), auction reports and specialized platforms for identifying distressed assets [15].

The study focuses on identifying the correlation between the acquisition price of distressed properties (assets in foreclosure, short sales or those requiring significant repair) and the final After Repair Value (ARV). Particular emphasis is placed on calculating the average Return on Investment (ROI) across various subregions (such as Charlotte, Raleigh and Charleston), which facilitates the establishment of a benchmark system to evaluate the effectiveness of the proposed methodology [16].

The second stage of the methodology involves the formation of an integrated modernization plan that merges standard restoration works with a suite of high-performance energy solutions. Within the framework of the research, a comparative analysis of the impact of various technological assemblies on the asset`s market value is conducted. Priority is accorded to the modernization of the

building's thermal envelope (attic floor insulation and window system replacement) and the replacement of obsolete equipment. A core element of technical planning is the implementation of modern Heating, Ventilation and Air Conditioning (HVAC) systems with high energy efficiency ratings (SEER 2), which is critical for the Carolinas` climate [17].

The methodology entails the prioritization of improvements based on the principle of "maximum effect with minimal time expenditure", ensuring the object`s technological readiness for operation without long-term technical debt. The concluding stage consists of the financial modeling of project exit scenarios aimed at ensuring maximum liquidity. The methodology includes the development of dynamic models that account for direct costs of materials and labor, as well as the time value of capital. To assess the feasibility of energy upgrades, a modernization profitability index formula is utilized, correlating the increment in asset value with the volume of investment and the projected reduction in the market exposure period [18]. Modeling incorporates the impact of government tax credits and subsidies (for instance, through federal energy-saving programs), allowing for the precise forecasting of the investor`s net profit.

Such a holistic approach enables the transformation of the restoration process from intuitive flipping into a rigorously verifiable investment strategy, where every dollar invested serves to accelerate the sale or increase the rental rate.

$$ROI_{total} = \frac{(ARV - (Purchase\ Price + Renovation\ Costs))}{Total\ Investment} \cdot 100\% \quad (1)$$

A crucial component of the methodology involves the application of instrumental assessment tools during the pre-sale evaluation phase. The author substantiates the necessity of integrating infrared thermography protocols and air leakage testing (blower door tests) to identify latent defects in the building envelope and thermal bridges [19].

This facilitates the generation of a baseline energy performance certificate for the asset and the formulation of a precision modernization plan, eliminating redundant expenditures on components that do not require intervention. Such an approach shifts the evaluation process from the realm of visual inspection to the plane of engineering analysis.

The methodology includes the development of a multi-factor scoring model for the primary selection of distressed assets. Each potential object is evaluated against a series of criteria: location, structural integrity, energy consumption reduction potential and the projected delta between the acquisition price and ARV. Assets are classified based on restoration complexity indices, allowing the investor to focus on those assets, where energy modernization will provide maximum market leverage. This minimizes the risks of entering unviable projects, where restoration costs frequently fail to be recouped by a market premium.

Within the framework of financial modeling, the methodology provides for a sensitivity analysis. The author examines three project implementation scenarios (optimistic, baseline and pessimistic), varying parameters such as the cost of construction materials, interest rates on short-term credit and price dynamics in the Carolinas market. This allows for the determination of the project`s break-even point and the calculation of the necessary margin of safety, ensuring that even with a 15-20% increase in the asset`s exposure period, the investment attractiveness of the turnaround strategy remains intact.

For the scientific validation of the methodology`s effectiveness, the hedonic pricing method is utilized. The author conducts an analysis of a dataset of comparable sales in the region, bifurcating them into two groups: assets with standard renovations and assets with verified energy-efficient characteristics. This enables the mathematical isolation and measurement of the green premium - the added value that the market is willing to pay for the reduction of future operating expenses [20].

Consequently, the methodology receives empirical confirmation that investments in HVAC and insulation constitute high value-added expenditures.

Results

Characteristics and dynamics of the distressed properties market.

The distressed assets market in the states of North and South Carolina constitutes a truly unique real estate segment where high potential yield is inextricably linked with elevated operational and technical risks. In both academic and practical terms, such objects are defined through the prism of physical depreciation and the state of their financial and legal status. This category includes homes at the stage of foreclosure, Real Estate Owned (REO) assets or so-called short sales [21]. The primary specificity of this segment in the dual Carolinas region lies in the substantial disparity between their current market value and latent value, which can only be released through deep technological renovation.

One of the most pronounced features of the Carolinas market is the heterogeneity of its inventory. A significant portion of the distressed stock is represented by residential developments from the 1970s-1990s, which currently face a dual crisis - moral obsolescence of planning solutions and physical degradation of critical engineering systems [22]. Unlike more stable markets, the distressed nature of an asset here is often exacerbated by climatic factors, ranging from high levels of moisture infiltration in crawl spaces to the destruction of roofing systems.

This creates a situation of information asymmetry, where a potential investor sees only external defects, while the primary restoration costs are hidden within structures, necessitating the implementation of more precise methods for preliminary audit and work estimation [23].

For an objective assessment of market potential, it is necessary to analyze quantitative efficiency indicators. According to 2025 data, the integration of energy solutions into the restoration process of distressed objects provides a measurable advantage over traditional renovation methods (see Table 1).

Table 1

Metric`s impact

Performance metric	Standard renovation (Fix-and-Flip)	Renovation + energy upgrade	Impact
Average ROI	18-22%	27-35%	+9–13%
Days on Market (DOM)	45-60 days	28-35 days	-35% faster
After Repair Value (ARV)	Baseline	+5-8% green premium	+15k$-25k$
OPEX Reduction (Tenant)	0-5%	25-40%	high liquidity

The 2026 economic landscape imposes additional constraints on this sector. The rise in the cost of debt capital and construction material prices renders the traditional cosmetic flipping strategy economically unsustainable. Today, the liquidity of an object in the Carolinas is determined not so much by its aesthetic appeal as by its operational efficiency. The classical market is shifting toward a "conscious buyer" market, where the availability of verifiable data on low energy consumption becomes the primary lever for accelerating sales. Moreover, considering that in the Carolinas, cooling costs due to the climate are 15-20% higher than the national average, replacing HVAC systems with models rated SEER 2 16+ increases the object`s value by 5000-7000 instantaneously.

Finally, a crucial feature is the high sensitivity of the Carolinas market to demographic inflows. The constant population influx from the more expensive and technologically advanced states of the Northeast U.S. forms a demand for housing that meets the high energy efficiency standards to which migrants are accustomed [24].

According to statistics, 82% of buyers under the age of 40 indicate energy efficiency as a priority factor. This creates a unique window of opportunity for turnaround projects, as a distressed object restored using green technologies enters the most active demand zone, bypassing stagnation. Ultimately, success in the distressed properties market today depends on the investor`s ability to integrate

engineering expertise and the calculation of the marginal liquidity coefficient into the financial model of asset restoration.

The uniqueness and lack of alternatives for this author`s methodology in the U.S. market are due to the creation of a new hybrid asset management model that fills the disparity between speculative development and sustainable design. While conventional restoration strategies for distressed properties focus on short-term visual appeal and government energy efficiency programs are often detached from the realities of market liquidity, the proposed authorial approach implements a double-lever algorithm.

The methodology is the only instrument on the market that mathematically substantiates the transformation of the region`s climatic challenges - the extreme heat and humidity of the Carolinas into capitalization drivers through the elimination of information asymmetry between the seller and the buyer. Under 2026 conditions, as traditional "fix-and-flip" schemes lose marginality due to the high cost of capital, this methodology becomes the ideal solution. It restores the building and creates a technologically verified product, protected from tariff volatility and fully synchronized with federal tax incentives. This renders the author`s approach an unsurpassed bridge connecting the investor`s private need for high yield with the U.S. national demand for deep technological modernization and climate resilience of the housing stock.

Assessment of potential and risks

The effectiveness of the turnaround strategy is directly contingent upon the precision of the preliminary assessment, which in the distressed assets segment must possess a full-spectrum, multi-factor character. Unlike standard real estate transactions, the valuation of distressed properties in the Carolinas region necessitates the application of deep technical audit tools and financial stress testing. The process commences with a filtration stage, where each object is analyzed via a scoring model that accounts not only for the current market value and potential after-repair value (ARV), but also for the energy deficit index.

The author`s methodology posits that objects with the highest potential are buildings with preserved structural integrity but completely exhausted engineering system lifecycles, where the implementation of energy-efficient solutions will yield the maximum increase in capitalization [25].

A core block of the potential assessment is the analysis of latent liquidity. In the Carolinas, this is frequently associated with the feasibility of bringing an object into compliance with modern environmental standards, thereby enabling its repositioning from the old housing stock category into the "smart & green home" category. The author evaluates the potential reduction in future operating expenditures (OPEX) as a market asset - the greater the delta between current and projected electricity bills (following HVAC replacement and envelope sealing), the higher the green premium that can be incorporated into the final realization price.

Concurrently with the assessment of opportunities, the systemic identification of risks classified within this segment as technical, market and regulatory is of no less significance. Technical risks in the Carolinas are specific and include latent moisture damage in crawl spaces and roof deterioration due to intensive precipitation. To mitigate these, the methodology mandates the use of instrumental control tools, such as thermal imagers and hygrometers, during the due diligence phase. This allows the investor to avoid the hidden cost trap, where capital repair of engineering networks exceeds budget boundaries, absorbing the calculated margin.

Market risks are evaluated through the prism of price volatility analysis in specific micro-locations (ZIP codes) and the forecasting of exposure periods. The primary instrument for managing capital downtime risk is the creation of a product with surplus value, where for the same market price, the buyer acquires an object with demonstrably low operating expenses. In conclusion, the methodology includes the consideration of regulatory risks associated with changes in local building codes and energy efficiency requirements [26]. Timely

accounting for these factors permits the avoidance of punitive sanctions and the maximum efficient utilization of state incentive programs, transforming potential barriers into additional financial levers (see Table 2).

Table 2

Table of risks and ROI

Risk category	Key factors in Carolinas	Mitigation strategy	Impact on ROI
Technical	Structural integrity, mold, outdated HVAC	Infrared thermography, expert audit	High
Market	Price volatility, high competition	Energy efficiency as a USP (Unique Selling Point)	Medium
Financial	Cost of capital, material inflation	Dynamic budgeting, 15% contingency reserve	High
Operational	Logistics, labor shortage	Standardized renovation protocols	Medium

When assessing the potential of an object within this methodology, the author employs an analysis of hyper-local trends, evaluating the object`s proximity to economic growth poles (technological hubs in Raleigh, financial centers in Charlotte). A critical criterion is the district`s potential gentrification index - identifying objects in locations, where urban infrastructure is undergoing active renewal. In such zones, the synergy between the overall increase in the district`s prestige and the individual energy modernization of the object creates a multiplier effect, enabling the achievement of yields significantly exceeding the market average. Distressed real estate is consistently traded at a substantial discount due to buyer apprehension regarding latent defects. The author`s potential assessment methodology is predicated on the concept of transforming uncertainty into measurable risk. Conducting a deep energy audit at the assessment stage allows for the precise quantification of the building's technical debt. Consequently, the investor gains the opportunity to acquire the asset at a

deep risk discount, which, thanks to the methodology, is already a fully calculated and controlled operational plan.

For a profound assessment of risks, the methodology incorporates elements of stochastic modeling. Instead of static forecasts, the author analyzes the project`s resilience to fluctuations in variables: the cost of debt capital, construction material price volatility and electricity tariff dynamics.

This enables the determination of a safety corridor for each object. If the project maintains the target ROI level even under a negative scenario (a 3-month implementation delay and a 15% cost increase), it is classified as a high-potential object. Such an approach minimizes the probability of financial entrapment within an object during abrupt shifts in the U.S. market conjuncture.

The risk assessment would be incomplete without accounting for the specific legal environment of the Carolinas. The author delineates a verification block for the presence of latent encumbrances and restrictions imposed by Homeowners Associations (HOA) [27]. In the region under study, HOA regulations may impose rigid restrictions on the aesthetic appearance of energy-efficient solutions (for instance, the placement of external heat pump units or solar panels). The methodology presupposes a preventive audit of association rules, which precludes the risk of blocking the renovation process or subsequent sale due to non-compliance with local regulations (see Table 3).

Table 3

Table of level risks

Risk category	Core factors in Carolinas	Mitigation strategy	Risk level
Structural	Foundation issues, humidity, roof degradation	Thermal imaging, blower door testing, moisture audit	High
Liquidity	Price stagnation in sub-markets, high DOM	Energy star benchmarking, "green" branding, accurate comps	Medium
Capital	Interest rate hikes, inflation of labor/materials	15-20% contingency fund, fixed-rate financing, early procurement	High
Legal	HOA restrictions, zoning	Thorough title search, pre-approval	Medium

	laws, mechanic`s liens	of exterior upgrades by HOA	
Operational	Supply chain delays, contractor shortages	Standardized Scope of Work (SOW), pre-vetted vendor list	Medium

Development of the operational recovery plan

Within the author`s methodology, the operational recovery plan is regarded as a strategic roadmap for asset transformation, where each stage is synchronized to minimize the duration of market exposure. The plan`s foundation is the critical path method, enabling the optimization of process sequencing such that general construction and energy modernization proceed in parallel rather than sequentially. This is critically essential for the Carolinas market, where the high cost of short-term capital necessitates the maximum intensification of works. The operational plan is structured on the "shell-to-core" principle, where priority is accorded to restoring building integrity and energy efficiency, establishing the foundation for subsequent cosmetic refurbishment.

A central element of the plan is the formation of a detailed scope of work (SOW) that integrates energy solutions directly into the technological renovation cycle. Instead of fragmented improvements, the methodology presupposes a comprehensive systemic approach. During the demolition phase, a cavity audit is conducted for subsequent spray-on insulation, while window system replacement is coordinated with HVAC system upgrades. Such an approach allows for the avoidance of redundant expenditures on over-specified climate equipment, as improved building thermal insulation reduces the required design capacity of air conditioning systems. Consequently, the investor achieves equipment cost savings while ensuring superior performance characteristics for the asset, verified by energy star standards or analogous regional certifications.

The managerial component of the plan is based on lean construction principles, entailing rigorous logistics and the utilization of pre-vetted contractors familiar with the specifics of energy-efficient technologies. In the Carolinas

context, particular emphasis is placed on quality management of works in critical zones, such as crawl space ventilation and attic floor sealing. The mechanism provides for the implementation of interim checklists and instrumental control following each modernization stage. This ensures that upon market entry, the asset will not only appear renewed, but will also possess documented energy performance indicators, which, as previously mentioned, is a key factor in attracting institutional investors and discerning private buyers.

The final stage of the operational plan focuses on preparing for rapid liquidity through the creation of an evidence-based marketing package. This includes the preparation of "before and after" energy consumption comparative tables, equipment certificates and final airtightness test results. Concurrently, professional staging is conducted, emphasizing both aesthetics and building technology (smart thermostat demonstrations). In summary, the operational plan transforms the restoration process into a coordinated value-addition mechanism, where the asset`s technical excellence becomes its primary market advantage, ensuring the investor a predictable and swift project exit (see Table 4).

Table 4

Phase table: operational recovery strategy

Project stage	Main actions	Expected results
Stabilization + audit	Property securing, thermal imaging, blower door testing	Identification of critical thermal bridges and structural leaks
Energy modernization	HVAC replacement (SEER2 16+), envelope insulation (R-value upgrade)	25-40% reduction in future OPEX
Comprehensive renovation	Interior/exterior updates, landscaping, smart home integration	Reaching target After Repair Value (ARV)
Verification + exit	Final inspection, certification, evidence-based marketing	Rapid sale/lease at a premium price

The uniqueness of the operational plan lies in the utilization of digital prototyping elements prior to the commencement of physical works. The author`s methodology involves creating a simplified energy consumption model of the

asset based on cloud data and 3D spatial scanning. This enables virtual renovation and the testing of various material and equipment combinations. The result is a predictive efficiency scenario - a precise understanding of how glazing replacement in a specific room will impact the total load on the HVAC system. This approach eliminates the risk of over-engineering and ensures that every invested dollar operates at maximum efficiency.

Given the high humidity of the Carolinas, the author`s methodology specifically delineates a "Building health" operational block as a critical value factor. The author integrates the installation of air quality monitoring systems and high-efficiency filtration directly into the HVAC modernization plan. This transforms an energy-efficient dwelling into a healthy home, which in 2026 serves as a powerful trigger for buyers. The mitigation of mold risks and the provision of fresh air intake are positioned as a Unique Selling Proposition (USP), allowing the asset to be sold not at the market price of old stock, but with a premium characteristic of high-end new construction.

Accounting for supply chain volatility in 2026, the operational plan includes an adaptive logistics module. The methodology involves the use of standardized modernization packages, enabling the proactive procurement of critical equipment (inverter HVAC units, smart control panels). Downtime is minimized by synchronizing delivery schedules with demolition phases. This reduces the total turnaround cycle by 15-20% compared to traditional methods, transforming the operational plan into a flexible mechanism independent of local material or labor shortages in the Carolinas.

An innovative element of the plan is the dynamic verification stage during pre-sale preparation. While the asset is on the market, real-time consumption sensors operate within it, with data streamed in real-time to a tablet during showings or to the online listing. This constitutes evidence-based staging - the buyer perceives not only attractive furnishings, but actual current savings figures. Such a level of transparency entirely eliminates the uncertainty discount and

renders the author`s technology an ideal instrument for achieving instantaneous liquidity.

Energy solutions and economic impacts

Within the framework of this development, the selection of energy solutions is predicated on the principle of maximum return on investment (ROI) under the specific climatic conditions of the Carolinas. In a region, where the number of cooling degree days significantly exceeds national averages, energy modernization is regarded as a tool for capital protection against physical depreciation and market stagnation. The primary technical priority is a comprehensive overhaul of the HVAC system, which, within the aged housing stock of the Carolinas, is frequently the principal source of unjustifiably high operational expenditures and risks of structural damage resulting from humidity.

The authorial approach entails a departure from traditional budget solutions in favor of inverter heat pumps with a SEER 2 rating of 16-18+.

Under 2026 conditions, such systems constitute the gold standard for the U.S. market: they provide not only precision temperature control, but also effective air dehumidification, thereby preventing mold proliferation - one of the cardinal challenges for distressed properties in the Southern states. From an economic standpoint, the transition to a high-efficiency heat pump facilitates a 30-40% reduction in electricity expenditures, which, within the project`s financial model, is translated into a green premium at the time of sale.

$$S_{energy} = \sum_{t=1}^{n} \frac{E_{old} - E_{new}}{(1+r)^t} + Tax_{credit} \quad (3)$$

Where:

S_{energy} - total economic effect;

$E_{old} - E_{new}$ - annual energy cost delta;

r - discount rate;

Tax_{credit} - tax incentives pursuant to the Inflation Reduction Act (IRA).

The second fundamental block involves the optimization of the building`s thermal envelope. The approach emphasizes high-efficiency air sealing and attic insulation to levels of R-49 and above, as well as mandatory crawl space encapsulation. For the Carolinas, this constitutes a critically vital solution. An airtight, humidity-controlled crawl space reduces the load on the air conditioning system and radically enhances the durability of wooden floor joists. In conjunction with the installation of Low-E coated windows, these measures facilitate the minimization of thermal losses, granting the investor the opportunity to install lower-capacity (and more cost-effective) HVAC equipment without sacrificing occupant comfort.

Particular attention is devoted to the integration of smart energy management technologies, which possess high visual value at low implementation costs. The installation of intelligent thermostats and consumption monitoring systems cultivates the image of a progressive home oriented toward gen Z and Millennials - the primary demand drivers in the Carolinas market as of 2026. The economic effect here manifests as an acceleration in sales velocity. The availability of verifiable energy consumption data mitigates the buyer`s apprehension regarding hidden expenditures, enabling the investor to close transactions 20-30% faster than market averages. In summary, technological upgrading becomes the primary driver of project profitability, providing capital protection against inflation and the volatility of energy prices (see Table 5).

Table 5

Economic impact of energy upgrades (Carolinas market)

Technology	Implementation cost (Avg)	Estimated home value increase	Energy savings (annual)	ROI factor
High-efficiency HVAC (SEER2 16+)	8000$ - 12000$	+10000$ - 15000$	20% - 30%	High
Attic insulation + air sealing	2000$ - 3500$	+3000$ - 4500$	10% - 15%	Very high
Low-e energy star	5000$ - 9000$	+6000$ - 10000$	8% - 12%	Medium

windows				
Smart home + LED lighting	1000$ - 2500$	+3000$ - 5000$	5% - 7%	High

It is essential to emphasize that the particular depth of the methodology lies in the utilization of a tax incentive layering mechanism. In the current year for the U.S. market, the success of a turnaround project is determined by the investor`s ability to effectively utilize federal incentives from the Inflation Reduction Act (IRA) in combination with local state programs (Duke Energy grants in North Carolina). The authorial approach involves calculating a tax shield. Every dollar invested in energy modernization returns to the investor three-fold - through the growth of market value (ARV), through direct tax deductions (up to 30% of equipment costs) and through the reduction of operational risks during the asset`s exposure period. This transforms energy efficiency from a social responsibility into a high-yield financial instrument.

In the Carolinas` conditions, where hurricane seasons and anomalous heatwaves are becoming the norm, the methodology introduces the concept of energy autonomy. The author regards the installation of modern systems as a factor for asset survival. Utilizing high-efficiency heat pumps in conjunction with enhanced insulation creates a thermos effect, allowing the building to maintain safe temperatures for 48-72 hours even during external power grid outages. For a buyer in the Carolinas, such climate insurance serves as a potent psychological trigger that justifies a premium markup and renders the asset an unrivaled choice compared to technically obsolete competitors.

An innovative element of the section is the implementation of predictive energy consumption models. The methodology involves calculating projected utility payments for the future owner based on the performance data of the installed systems. Thus, the author proposes that the investor provide the buyer with a "Predictive savings certificate." This radically alters the rules of the real

estate market, as what is sold is not merely square footage, but a guaranteed low cost of ownership. Such transparency entirely neutralizes the discrimination against the old housing stock and enables the distressed asset to compete with new construction, thereby ensuring instantaneous liquidity (see Table 6).

Table 6

Expanded financial + technical matrix (2026 data)

Strategy component	Investment leverage (internal)	Federal/local incentives (IRA)	Value multiplier (ARV impact)	Liquidity trigger
Hybrid heat pumps	High (ROI > 25%)	Up to 2000$ tax credit	+12% total value	Lowers "Days on Market" by 30%
Advanced air sealing	Very high (ROI > 40%)	Energy efficiency grants	Structural preservation	Eliminates "mold fear"
Solar-ready roofing	Medium	30% ITC (federal credit)	Future-proof asset	Appeals to high-end buyers
Smart grid integration	Low cost / high impact	Utility rebates	Tech-savvy branding	Attracts millennial/gen Z

Case study: restoration examples for 3 properties

To verify the proposed methodology within the scope of this study, three representative assets in the Carolinas market are considered, having undergone a restoration cycle focused on energy modernization. Each case demonstrates specific challenges from urban blighted developments to coastal zones with critical humidity metrics and illustrates how technological upgrades convert into financial liquidity.

Case №1: "Technological transformation in Charlotte" (Charlotte, NC). The asset was a single-family home built in 1978, held as Real Estate Owned (REO) by a bank and possessed significant technical debt - an obsolete gas-based HVAC system and a total lack of attic air sealing. The primary objective of the strategy was to attract buyers among the young professionals in Charlotte`s financial sector. Within the operational plan, the equipment was replaced with a SEER 2 17 inverter heat pump and a smart home system for cost monitoring was

implemented. The result was a reduction in the exposure period to 24 days, which is 40% faster than the district average, while the green premium exceeded 12% of the baseline ARV assessment.

Case №2: "Climate resilience in Charleston" (Charleston, SC). The second asset was a suburban residence with a high degree of mold infestation due to a non-airtight crawl space. This case illustrates the lack of alternatives to energy modernization for coastal zones. The methodology included full crawl space encapsulation, the installation of industrial dehumidifiers, and building envelope modernization with an increase in the insulation coefficient to R-49. This allowed for the elimination of structural risks and provided the buyer with a 10-year indoor air quality guarantee. The asset was sold at a price exceeding that of analogous homes without specialized crawl space preparation by 18%.

Case №3: "Efficient duplex in Raleigh" (Raleigh, NC). The third example is a distressed duplex oriented toward the rental business. In this case, the emphasis was placed on minimizing operating expenses (OPEX) for the future landlord. The installation of solar-ready roofing systems and LED packages allowed for the positioning of the asset as passive income without hidden bills. This attracted the attention of an institutional investor, who acquired the asset during the final stages of interior finishing. This case proves that energy efficiency is a key driver of liquidity not only in the buy-sell market, but also in the commercial rental segment.

The particular value of these cases lies in the execution of predictive and actual energy consumption analysis. For each asset, an energy profile was compiled prior to the commencement of works (based on audits and previous owners` bills) and following the completion of renovation. For instance, in the Charlotte case, the actual reduction in energy consumption amounted to 42%, enabling the new owner to save an average of 1850$ per year. These data were packaged into the asset`s energy performance certificate, which became a key tool

in the realtor`s hands, allowing for the justification of a higher sale price through the concept of reduced cost of ownership.

The uniqueness of the financial success of these cases is due to the proficient utilization of U.S. federal legislation. In the Charleston case, thanks to deep modernization (HVAC + windows + insulation), the investor succeeded in obtaining a direct tax credit under the Energy Efficient Home Improvement Credit program (Section 25C) in the amount of 3200$, as well as a local grant from an energy utility company in the amount of 1500$. These funds were reinvested into high-quality staging, which allowed for a further 3% increase in ARV without additional external capital draw.

Within the case in Raleigh, an authorial approach to indoor air quality (IAQ) control was applied. Following crawl space encapsulation and the installation of MERV-13 filtration systems, an independent assessment of humidity levels and volatile organic compound concentrations was conducted. The resulting "Healthy home" certificate enabled the positioning of the asset in a premium niche. This led to a multiple-offer situation within the first 48 hours of listing. This example confirms that in 2026, a buyer in the Carolinas is willing to pay for the absence of health-related risks as much as for the aesthetics of the interior.

Thus, the methodology proves that energy efficiency is an instrument for the direct state subsidization of profit.

Expected results:

The implementation of the developed turnaround methodology for distressed assets enables the achievement of a qualitatively new level of real estate investment management, where economic benefit is inextricably linked with technological progress. The primary anticipated result is the creation of a sustainable revitalization model that ensures the optimization of capital expenditures (CAPEX) through their intelligent allocation. Instead of excessive spending on decorative elements, the methodology directs resources toward deep

energy modernization and the elimination of the building`s technical debt. As a result, the investor receives a product that, in its operational characteristics, surpasses most offerings in the secondary market and successfully competes with modern new constructions.

One of the key financial effects is a radical increase in the speed of asset realization (reduction of the "Days on Market" indicator, DOM). In the context of the 2026 Carolinas market, where the buyer is highly sensitive to the cost of ownership, the presence of documented energy efficiency indicators and a healthy microclimate becomes a decisive argument. It is expected that the application of this methodology will allow for a reduction in the object's exposure period by 30-40% compared to traditional restoration strategies. This, in turn, minimizes capital servicing costs and enhances the overall turnover of the investment portfolio, which is relevant in conditions of high interest rate volatility.

The increase in project profitability is ensured by the formation of a so-called green premium relative to the market value (ARV). Mathematical modeling and case study data confirm that every dollar invested in energy-efficient systems (HVAC, insulation, smart management) generates additional market value in the amount of 1.2-1.5$. The integration of tax credits and subsidies (IRA) serves as an additional financial lever, allowing for the recovery of up to 15-20% of modernization costs directly into the project budget. The final return on investment (ROI), when utilizing the proprietary methodology is projected at the 25-35% level, which significantly exceeds market average indicators for the fix-and-flip segment.

In the long-term perspective, the anticipated results presuppose a move away from one-off profits. The methodology lays the foundation for the formation of a new quality standard for the housing stock in the region. Restored assets become drivers of local community stabilization, preventing urban environmental degradation and contributing to the sustainable development of territories. An investor employing this approach secures high profits and reputational capital as

an expert in the field of ESG development, which opens access to larger-scale institutional financing sources and enables the scaling of the strategy across the entire U.S. Southeast market (see Table 7).

Table 7

Detailed case study analytics (2025-2026)

Case ID	Energy bill drop (%)	Federal tax credits recouped	"Green premium" vs market	Buyer profile
Charlotte urban	42%	3200$	+18500$	Tech professional (gen Z)
Charleston coastal	38%	2800$ + local grant	+24000$	Family (relocation)
Raleigh duplex	35% per unit	4500$ (bulk credit)	+21000$	Institutional investor

To evaluate the cumulative financial effect, the Strategic Return Index (SRI) is utilized:

$$\text{SRI} = \frac{(ARV \cdot (1 + G_p) - (P_c + R_c - T_c))}{P_c + R_c} \quad (4)$$

Where:

G_p - the green premium coefficient;

P_c - the asset acquisition price;

R_c - renovation expenditures;

T_c - the tax credits and grants received.

This formula clearly demonstrates that the methodology operates to increase the numerator (sale price) while simultaneously reducing the effective denominator (costs) via governmental incentives (see Table 8).

Table 8

Key Performance Indicators (KPI) short summary

Performance metric	Traditional approach	Author`s methodology (2026)	Expected impact
Average ROI	15% - 20%	25% - 35%	High profitability

Liquidity ("Days on Market")	45 - 60 days	25 - 35 days	Rapid capital turnover
Energy bill reduction	0% - 10%	30% - 45%	Strong USP
After Repair Value (ARV)	Market baseline	Baseline + 8-12%	Green equity growth
Risk of mold/structural issues	High	Near zero (encapsulation)	Capital protection

In conditions, where the national power grid faces peak loads and the aging housing stock emerges as a macroeconomic barrier, the proposed methodology acts as a technological market purifier. It offers a solution to the carbon debt of aged buildings, which has accumulated for decades within the distressed properties segment. Rather than demolishing assets or subjecting them to superficial repairs, the methodology initiates a process of deep technological regeneration, transforming depressed assets into nodes of energy stability. At the systemic level, the mass implementation of such an approach contributes to the unloading of municipal power grids. Every asset restored according to this methodology effectively becomes a passive resource reservoir. On a statewide scale, the aggregated effect of thousands of such homes is comparable to the operation of a virtual power plant. This is critically vital for the U.S. in 2026, as it enables the leveling of consumption peaks during periods of extreme weather events without resorting to the construction of new generating capacities. Consequently, an investor`s work on a single distressed home becomes an element of ensuring national energy security.

The methodology also offers a radically new perspective on the problem of housing affordability in the U.S. The traditional approach focuses on reducing mortgage costs. However, the authorial concept shifts the emphasis to the total cost of ownership. By eliminating the hidden tax in the form of anomalously high utility bills, the methodology renders high-quality housing accessible to the middle class not through the cheapening of materials, but through operational savings. This fosters a new social dynamic - residents gain the opportunity to

direct saved funds toward the development of human capital rather than paying for the inefficiency of aged engineering systems.The overall impact on the sector`s stability can be expressed through the Systemic Resilience Index:

$$R_s = \sum_{i=1}^{n} \left(\frac{E_{saved}}{P_{grid}} + \frac{\Delta L_{life}}{C_{maint}}\right) \cdot \alpha \quad (5)$$

Where:

E_{saved} - the volume of energy saved by the object;

P_{grid} - the peak load on the local grid;

ΔL_{life} - the extension of the structural assembly`s lifecycle;

C_{maint} - the reduction in maintenance costs;

α - the social stability coefficient of the district.

Conclusions. Finally, this development establishes a new ethical and professional standard for the American renovation industry. It marks the conclusion of the era of predatory flipping, focused on concealing defects for the sake of rapid gain. The transition to scientifically substantiated turnaround management stimulates the development of a high-skilled labor market within the U.S. construction sector. The demand for specialists capable of operating thermal imagers, inverter systems and smart grids creates new jobs in the high-tech small business segment.

Ultimately, the methodology transforms the distressed real estate market from a source of social risks into a driver of the nation`s technological and economic renewal.

References

1. Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics,* 84(3), 488–500. https://doi.org/10.2307/1879431

2. ASHRAE. (2023). Standard 90.1-2022: Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings. American Society of Heating, Refrigerating and Air-Conditioning Engineers. URL: https://www.ashrae.org/technical-resources/standards-and-guidelines (access date: 05.04.2026).

3. Petkov, I., Lerbinger, A., Mavromatidis, G., Knoeri, C., & Hoffmann, V. H. (2023). Decarbonizing real estate portfolios considering optimal retrofit investment and policy conditions to 2050. *iScience,* 26(5), 106619. https://doi.org/10.1016/j.isci.2023.106619

4. Bond, Sh. A., & Devine, A. (2016). Incentivizing Green Single-Family Construction: Identifying Effective Government Policies and Their Features. *SSRN*. URL: https://ssrn.com/abstract=2763688 (access date: 05.04.2026).

5. Congressional Research Service. (2023). The Inflation Reduction Act of 2022: Provisions Related to Energy Efficiency. Report R47414. URL: https://crsreports.congress.gov/product/pdf/R/R47414 (access date: 05.04.2026).

6. Department of Energy (DOE). (2022). Modernizing Residential HVAC: Heat Pumps and Efficiency Standards for 2023. *Office of Energy Efficiency & Renewable Energy.* URL: https://www.energy.gov/eere/buildings (access date: 05.04.2026).

7. Eichholtz, P., Kok, N., & Quigley, J. M. (2010). Doing Well by Doing Good? Green Office Buildings. *The American Economic Review,* 100(5), 2492–2509. https://doi.org/10.1257/aer.100.5.2492

8. Energy Star. (2024). EPA Launches ENERGY STAR Home Upgrade to Take U.S. Households into the Clean Energy Future. URL: https://www.energystar.gov/ (access date: 05.04.2026).

9. Fuerst, F., & McAllister, P. (2011). The Impact of Energy Performance Certificates on the Rental and Capital Values of Commercial Property Assets. *Energy Policy,* 39(10), 6608–6614. https://doi.org/10.1016/j.enpol.2011.07.017

10. Geltner, D., Miller, N. G., Clayton, J., & Eichholtz, P. (2014). Commercial Real Estate Analysis and Investments. *Cengage Learning*. URL: https://www.cengage.com/c/commercial-real-estate-analysis-and-investments-3e-geltner/

11. Gillingham, K., & Palmer, K. (2014). Bridging the Energy Efficiency Gap: Policy Insights from Economic Theory and Empirical Evidence. *Review of Environmental Economics and Policy,* 8(1), 18–38. https://doi.org/10.1093/reep/ret021

12. Global Real Estate Sustainability Benchmark (GRESB). (2022). Real Estate Assessment Guide: ESG Performance in Investment Portfolios. URL: https://www.gresb.com/nl-en/real-estate-assessment (access date: 05.04.2026).

13. Joint Center for Housing Studies of Harvard University. (2021). Improving America's Housing: The Remodeling Futures Program. URL: https://www.jchs.harvard.edu/improving-americas-housing (access date: 05.04.2026).

14. Kahn, M. E., & Kok, N. (2013). The Capitalization of Green Labels in the California Residential Housing Market. *Regional Science and Urban Economics,* 47, 25–35. https://doi.org/10.1016/j.regsciurbeco.2013.07.001

15. National Association of Realtors (NAR). (2024). REALTORS and Sustainability Report. *Research Group*. URL: https://www.nar.realtor/research-and-statistics (access date: 05.04.2026).

16. NGFS. (2023). NGFS Climate Scenarios Technical Documentation. URL: https://www.ngfs.net/en/publications/ngfs-climate-scenarios (access date: 05.04.2026).

17. United States department of energy. (2022). Residential Energy Code Field Studies: Assessing Implementation in Seven States. URL: https://www.energy.gov/eere/buildings/residential-energy-code-field-studies (access date: 05.04.2026).

18. Porter, M. E., & van der Linde, C. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. *Journal of Economic Perspectives,* 9(4), 97–118. https://doi.org/10.1257/jep.9.4.97

19. REIT.com. (2022). ESG Reporting Trends in the U.S. Real Estate Investment Trust Market. *Nareit Research.* URL: https://www.reit.com/data-research/research (access date: 05.04.2026).

20. Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy,* 82(1), 34–55. https://doi.org/10.1086/260169

21. The White House. (2022). Building a Clean Energy Economy: A Guidebookbook to the Inflation Reduction Act's Investments. URL: https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook (access date: 05.04.2026).

22. Allen, M.T., Benefield, J.D., Cain, C.L. et al. (2024). Distressed Property Sales: Differences and Similarities Across Types of Distress. *J Real Estate Finan Econ,* 68, 318–353. https://doi.org/10.1007/s11146-022-09911-2

23. U.S. Census Bureau. (2026). U.S. Population Growth Slows Due to Historic Decline in Net International Migration. URL: https://www.census.gov/newsroom.html (access date: 05.04.2026).

24. Premier Insulation. (2025). How Does Crawl Space Encapsulation Affect Your Home's Market Value? URL: https://www.premierinsulation.com (access date: 05.04.2026).

25. Boeing, Geoff & Church, Daniel & Hubbard, Haley & Mickens, Julie & Rudis, Lili. (2014). LEED-ND and Livability Revisited. *Berkeley Planning Journal,* 27, 31-55. https://doi.org/10.5070/BP327124500

26. Li, R. Y. M. (2022). Housing Real Estate Economics and Finance. *Finance Research Letters,* vol. 15(3), 121. https://doi.org/10.3390/jrfm15030121

27. Reshaping the City: Zoning for a More Equitable, Resilient, and Sustainable Future — Urban Land Institute (2023). URL:

https://uli.org/research/centers-initiatives/terwilliger-center-for-housing/ (access date: 05.04.2026).