ECONOMIC MECHANISMS FOR REDUCING ENERGY COSTS IN RETAIL AND FOOD SERVICE ENTERPRISES

Toyirova Hamida Umedovna
Lecturer at the Department of
Tourism and Hotel Management, Bukhara State University

Abstract. This article develops an integrated economic framework for reducing energy expenditure in retail and food service enterprises. It combines energy-use normalization, life-cycle investment appraisal, operational incentives, procurement decisions and risk-adjusted implementation. Evidence from the International Energy Agency, the U.S. Energy Information Administration and ENERGY STAR supports the importance of sector-specific measures. A transparent illustrative model for a retail store and a restaurant in Uzbekistan compares investment costs, electricity savings, operating benefits, payback periods and net present values. At an assumed electricity price of UZS 1,200/kWh and an 18% discount rate, both modelled packages yield positive NPVs, but results remain sensitive to realized savings and tariff assumptions. The study proposes a staged management mechanism linking audits, metering, financial screening, employee incentives and post-investment verification. All numerical business-case inputs are hypothetical and should not be interpreted as surveyed enterprise data.

Keywords: energy efficiency; retail trade; restaurants; energy management; operating costs; net present value; investment appraisal; life-cycle costing; Uzbekistan.

Energy expenditures influence service-sector competitiveness through operating margins, pricing flexibility and exposure to utility-price volatility. Retail stores depend on lighting, refrigeration, air conditioning and merchandising equipment; food service establishments additionally operate energy-intensive cooking, extraction, dishwashing and hot-water systems. The International Energy Agency (IEA, 2025) identifies

buildings as a major component of global final energy demand, underscoring the relevance of efficiency investment. Energy intensity varies substantially between building types. Based on the U.S. Commercial Buildings Energy Consumption Survey, the Energy Information Administration (2023) reports that food service buildings used approximately 263 thousand Btu per square foot, versus 70 thousand Btu for commercial buildings on average. These figures describe the U.S. building stock, not Uzbekistan, and cannot be transferred directly to local establishments. ENERGY STAR also emphasizes the unusually high energy requirements of restaurants. The research objective is to systematize the economic mechanisms by which retail and food service managers can reduce energy costs without compromising food safety, product quality or customer comfort. The central question is not merely which technology saves electricity, but under which prices, capital constraints, organizational incentives and performance-verification conditions an investment generates economic value. The study applies comparative institutional analysis and a deterministic discounted-cash-flow model. Energy baselines should ideally use at least 12 months of invoices and meter readings, supplemented by equipment inventories, opening hours, floor area, weather conditions and output volumes. Normalized performance indicators should be reported alongside absolute consumption to separate genuine efficiency from changes in sales activity.

Table 1.

Key performance indicators for assessing energy efficiency and economic performance in retail and food service enterprises

Indicator	Definition / managerial interpretation
Energy cost ratio	Annual energy expenditure / annual sales revenue × 100%; tracks cost pressure.
Retail electricity intensity	Electricity use (kWh) / m² of selling area; compare similar stores.
Restaurant electricity intensity	Electricity use (kWh) / meals served; adjust for menu and service format.
Energy savings rate	(Baseline kWh − verified post-project kWh) / baseline kWh × 100%.

Net annual benefit	Avoided energy cost + avoided maintenance cost − incremental operating cost.
NPV	$-I_0 + \Sigma[CF_t/(1+r)^t] + RV/(1+r)^n$.
Simple payback	Initial investment / constant annual net cash benefit; ignores discounting.

Here I_0 denotes initial investment, CF_t annual incremental net cash flow, r discount rate, RV residual value and n project life. For a meaningful comparison, the baseline must be adjusted for operating hours, weather, throughput and equipment changes. Electricity savings and maintenance savings must be measured separately to avoid double counting. The calculations below assume constant nominal electricity tariffs, annual benefits received at year-end, a five-year horizon, an 18% nominal discount rate and no tax effects, inflation, financing costs or working-capital changes. These simplifying assumptions facilitate teaching and transparent appraisal, but a bankable feasibility study would need local supplier quotations, actual tariffs, taxes, equipment lifetimes and detailed cash-flow timing.

Economic instruments for energy-cost reduction. First, energy audits and submetering reveal the economic value of waste reduction. In retail, lighting schedules, refrigerated display cases and cooling setpoints are key targets. In restaurants, refrigeration maintenance, kitchen ventilation controls and appropriately sized cooking equipment deserve special attention. Baseline metering should precede procurement so that projected savings are attributable to identifiable loads. Second, life-cycle procurement converts purchasing from a lowest-price rule into a total-cost decision. A more efficient refrigerator can have a higher purchase price yet a lower discounted operating cost. The relevant procurement criterion is incremental NPV subject to reliability, capacity and food-safety constraints. The DOE commercial refrigeration guidance illustrates this logic. Third, financial instruments can address up-front capital barriers: staged reinvestment of realized savings, equipment leasing, supplier financing, energy performance contracts and targeted credit facilities. These instruments differ in transaction costs, collateral requirements and allocation of performance risk. Their

availability and legal terms must be verified locally rather than assumed. Fourth, organizational mechanisms are essential. A store manager can be assigned an electricity-intensity target, while kitchen staff receive standard operating procedures for shutdowns, refrigeration-door discipline and preventive maintenance. Performance rewards should be based on weather- and activity-adjusted savings and should not encourage unsafe operating temperatures or reduced service quality. Fifth, tariff and demand management may reduce expenditure even when physical kWh savings are modest. Where applicable, peak-load scheduling, power-factor correction and demand-response arrangements should be evaluated using the enterprise's actual contract and tariff structure. The availability of time-of-use prices or incentives must be checked with the relevant utility. Illustrative economic assessment: retail and food service. Two hypothetical enterprises are considered: a medium-sized retail store and a full-service restaurant. The assumed energy-efficiency packages combine LED and control upgrades, improved refrigeration practices, preventive maintenance and selected high-efficiency equipment. Savings are package-level estimates; component savings are not added together, avoiding overlapping effects.

Table 2.

Baseline assumptions and investment parameters for energy efficiency projects in retail and restaurant enterprises

Assumption	Retail store	Restaurant
Baseline annual electricity consumption	120,000 kWh	180,000 kWh
Assumed electricity price	UZS 1,200/kWh	UZS 1,200/kWh
Annual electricity reduction	30,000 kWh (25%)	45,000 kWh (25%)
Initial investment	UZS 90 million	UZS 150 million
Annual avoided maintenance cost	UZS 3 million	UZS 5 million
Project life / discount rate	5 years / 18%	5 years / 18%
Residual value at year 5	UZS 10 million	UZS 15 million

All prices, costs, energy quantities and savings percentages in Table 2 are illustrative assumptions, not empirical observations or official tariffs. The assumed

electricity price is used solely to demonstrate the financial mechanism; it should be replaced with the enterprise's effective billed price including applicable charges. For the retail store, annual avoided electricity expense equals 30,000 × 1,200 = UZS 36 million; adding UZS 3 million in avoided maintenance yields UZS 39 million in annual incremental cash benefit. For the restaurant, the corresponding calculation is 45,000 × 1,200 + 5 million = UZS 59 million.

Table 3.

Comparative financial performance and investment appraisal results of energy efficiency projects in retail and restaurant enterprises

Financial result	Retail store	Restaurant
Baseline annual electricity cost	UZS 144.00m	UZS 216.00m
Annual electricity savings	UZS 36.00m	UZS 54.00m
Total annual net benefit	UZS 39.00m	UZS 59.00m
Simple payback	2.31 years	2.54 years
5-year NPV (18%)	UZS 36.33m	UZS 41.06m
NPV decision	Accept under assumptions	Accept under assumptions

The five-year annuity factor at 18% is 3.1272. Retail NPV = −90 + 39 × 3.1272 + 10/(1.18)^5 = 36.33 million UZS. Restaurant NPV = −150 + 59 × 3.1272 + 15/(1.18)^5 = 41.06 million UZS. Positive values indicate that both hypothetical packages exceed the specified 18% required return, conditional on the stated assumptions.

Sensitivity, implementation risk and verification. Investment acceptance must be tested against uncertainty. Electricity tariffs, actual energy savings, equipment utilization, maintenance outcomes and operating hours can all depart from forecasts. A simple sensitivity analysis holds the investment and residual value fixed while changing realized electricity savings; avoided maintenance benefits are held constant. This deliberately isolates electricity-performance risk.

Table 4.

Sensitivity analysis of net present value (npv) to changes in realized

electricity savings in retail and restaurant enterprises

Realized electricity savings	Retail NPV (UZS m)	Restaurant NPV (UZS m)
70% of expected electricity savings	2.56	-9.60
85% of expected electricity savings	19.44	15.73
100% of expected electricity savings	36.33	41.06
115% of expected electricity savings	53.22	66.39

At 70% of the expected electricity savings, the financial buffer narrows, demonstrating why equipment performance guarantees and verification are economically relevant. The table is a one-factor sensitivity test, not a probability-weighted forecast. Joint adverse changes in tariffs, sales volume and equipment downtime would require scenario or Monte Carlo analysis. A robust implementation sequence comprises six steps: establish a baseline; rank measures by incremental NPV and operational risk; approve a financing plan; procure equipment against measurable specifications; train personnel; and verify monthly savings against an adjusted baseline. Verification should document changes in operating hours, weather, sales volume, number of meals and refrigeration capacity. Management should investigate deviations rather than attributing every change in electricity bills to efficiency measures.

Table 5.

Key risks, potential consequences, and mitigation measures for energy efficiency projects in retail and food service enterprises

Risk	Potential consequence	Control mechanism
Lower-than-forecast savings	Reduced NPV and longer payback	Pilot tests; supplier guarantees; meter-based verification
Equipment failure	Downtime and food losses	Preventive maintenance; service contracts; redundancy
Capital or financing overruns	Higher initial outlay	Competitive quotations; contingency; staged investment
Changes in activity or climate	Misleading savings comparisons	Normalize for sales, meals, hours and weather
Staff non-compliance	Persistent energy waste	Training; clear procedures; accountable KPIs
Food safety / customer comfort	Quality and reputation damage	Non-negotiable temperature and ventilation standards

The analysis suggests that energy-cost management is best understood as an integrated economic mechanism rather than an isolated engineering retrofit. A technically effective project may fail financially if capital is expensive, maintenance is neglected or the enterprise operates at lower utilization than anticipated. Conversely, a modest equipment upgrade may create substantial value when it targets a continuously operating load such as refrigeration. Retail and food service enterprises should not be benchmarked against each other using kWh per square metre alone. Restaurant kitchens differ in meal throughput, cooking technology and ventilation intensity; retail formats differ in cold-storage requirements, display lighting and opening hours. The normalization problem identified by Goel et al. supports differentiated key performance indicators. For Uzbekistan, policy recommendations should be implemented through locally validated information: enterprise-level energy audits, transparent equipment-performance data, accessible financing and workforce training. The model does not establish national average savings or a causal effect; its contribution is a reproducible framework for project selection. Future research could collect monthly panel data from retail stores and restaurants and estimate weather- and activity-adjusted savings with difference-in-differences or matched-control methods.

The study identifies five mutually reinforcing economic mechanisms: (1) energy audits and normalized benchmarking; (2) life-cycle procurement and discounted investment appraisal; (3) financing arrangements that address capital constraints; (4) operational incentives and preventive maintenance; and (5) independent monitoring and verification. Together they transform energy conservation from an occasional cost-cutting initiative into a repeatable management process. Under the explicitly hypothetical assumptions, the retail package produces a five-year NPV of UZS 36.33 million and a simple payback of 2.31 years, while the restaurant package produces a five-year NPV of UZS 41.06 million and a simple payback of 2.54 years. These outcomes do not demonstrate actual profitability at any named enterprise. They

illustrate how a manager can translate physical savings into investment criteria and identify conditions under which a proposal should be approved, redesigned or rejected. Managers should prioritize interventions that preserve service quality, use measured baselines, evaluate cash flows over equipment life and monitor savings after installation. Researchers should complement these analytical results with field measurements, current tariff data, local procurement prices and uncertainty analysis before drawing sector-wide conclusions.

REFERENCES

1. International Energy Agency (2025). Energy Efficiency 2025: Buildings. https://www.iea.org/reports/energy-efficiency-2025/buildings
2. U.S. Energy Information Administration (2023). Food service buildings are highly energy intensive. https://www.eia.gov/todayinenergy/detail.php?id=60241
3. U.S. Environmental Protection Agency, ENERGY STAR. ENERGY STAR for Small Business: Restaurants. https://www.energystar.gov/buildings/resources-audience/small-biz/restaurants
4. International Energy Agency (2024). Energy Efficiency 2024. Paris: IEA. https://www.iea.org/reports/energy-efficiency-2024
5. U.S. Department of Energy, Federal Energy Management Program (2023 update). Purchasing Energy-Efficient Commercial Refrigerators and Freezers. https://www.energy.gov/cmei/femp/purchasing-energy-efficient-commercial-refrigerators-and-freezers
6. Goel, S., Gonzalez Matamoros, J. C., Vlachokostas, A., & Wang, N. (2018). Food Service Building Asset Rating Methodology and Analysis. ASHRAE Annual Conference. https://www.pnnl.gov/publications/food-service-building-asset-rating-methodology-and-analysis