INDUSTRIAL CASE STUDY: ENERGY OPTIMIZATION & BILLING ANALYSIS

Improving efficiency and reducing operational costs effectively

INTRODUCTION

CASE STUDY OVERVIEW

Energy Optimization Objective

The study aimed to identify inefficiencies in energy usage and billing at an industrial site with a 40 MVA transformer.

Technical Challenges

The project faced multiple technical challenges related to energy measurement and billing structure analysis.

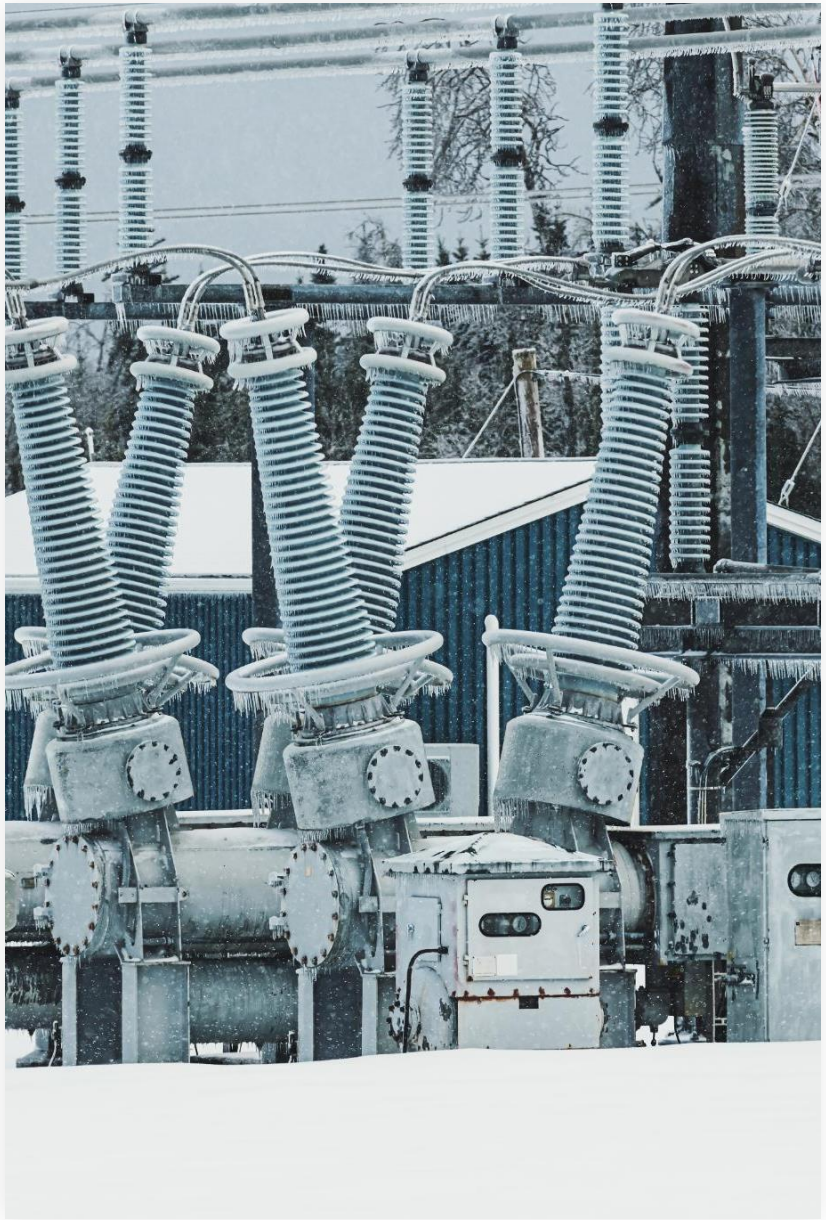
Implemented Solutions

Corrective measures were deployed to optimize energy use and improve billing accuracy, leading to cost savings.

Financial Outcomes

The case study demonstrated substantial cost savings and serves as a model for other industrial operations.

EXECUTIVE SUMMARY



KEY FINDINGS AND SAVINGS POTENTIAL

Energy Inefficiencies Identified

Audit revealed issues in transformer loading, voltage regulation, and billing causing significant inefficiencies.

Annual Savings Potential

Potential annual savings range between £885,000 and £1,774,000, realistically expected between £1.2M and £1.4M.

Proposed Energy Measures

Measures include shutting down underutilized transformers, installing OLTC, and consolidating electricity meters.

Financial Projections

Projected 10-year Net Present Value up to £9.3M with payback periods between 3 to 12 months.

SITE OVERVIEW AND CHALLENGES

TRANSFORMER CONFIGURATION AND OPERATIONAL ISSUES

Transformer Utilization

Four transformers with 40 MVA total capacity operated at only 40% utilization, causing inefficiencies.

Underloaded Transformer Losses

Transformer 4 was underloaded at 10%, resulting in excessive no-load losses and energy waste.

Elevated Low-Voltage Effects

High LV levels between 420V and 440V reduced motor efficiency and worsened power factor.

Metering and Billing Complications

Multiple electricity meters caused duplicate billing and loss of diversity benefits, complicating cost management.

SOLUTIONS IMPLEMENTED

TECHNICAL MEASURES AND OPERATIONAL CHANGES

Transformer Optimization

Shutting down Transformer 4 eliminated no-load losses and redistributed load to improve efficiency.

Voltage Control via OLTCs

On-load tap changers maintain optimal voltage, enhancing motor efficiency and reducing reactive power penalties.

Billing Structure Review

Consolidating billing minimized standing charges and avoided capacity overpayments, optimizing cost efficiency.

TECHNICAL ANALYSIS

LOSS CALCULATIONS AND EFFICIENCY IMPACT

Transformer Energy Losses

Transformer 4 experienced continuous energy losses of 12.6 kW, costing over £33,000 annually at current rates.

Voltage Optimization Savings

Reducing LV from 420V to 400V improves motor efficiency, saving up to £383,573 annually and reducing penalties.

Extreme Voltage Savings

Operating at 440V could yield savings exceeding £741,918 through enhanced efficiency despite higher voltage.

Billing Inefficiency Impact

Billing inefficiencies add potential savings of £195,000, identified through monitoring and historical data analysis.

SAVINGS SCENARIOS

CONSERVATIVE, MODERATE, AND OPTIMISTIC OUTCOMES

Conservative Savings Scenario

Minimal voltage reduction and partial billing improvements yield £341,633 annual savings with moderate confidence.

Moderate Savings Scenario

7.5% voltage reduction and broader billing optimization result in £656,000 savings, showing stronger financial viability.

Optimistic Savings Scenario

Full voltage correction and complete billing restructuring achieve up to £1.18M in annual savings, highest confidence level.

Investment Justification

All scenarios provide clear payback estimates and demonstrate strong financial viability for stakeholders.

IMPLEMENTATION PHASES

AUDIT, QUICK WINS, CAPITAL IMPROVEMENTS, AND MONITORING

Phase 1: Performance Audit

An 8–12 week audit employed LoRa wireless sensors to monitor transformer performance and voltage levels effectively.

Phase 2: Quick Wins

Immediate payback was achieved by shutting down Transformer 4 and optimizing billing processes for efficiency.

Phase 3: Capital Improvements

Capital upgrades included OLTC installation and centralized power factor correction, resulting in significant cost savings.

Phase 4: Ongoing Monitoring

A subscription-based monitoring service ensured sustained optimization and identification of future opportunities.

FINANCIAL IMPACT

RETURN ON INVESTMENT AND NET PRESENT VALUE

Investment and Savings

Initial investment of £238,000 returned £360,000 in savings in Year 1, showing strong financial benefits.

Payback Periods

Payback periods ranged from 7.9 months in the conservative case to 4.4 months in the optimistic scenario.

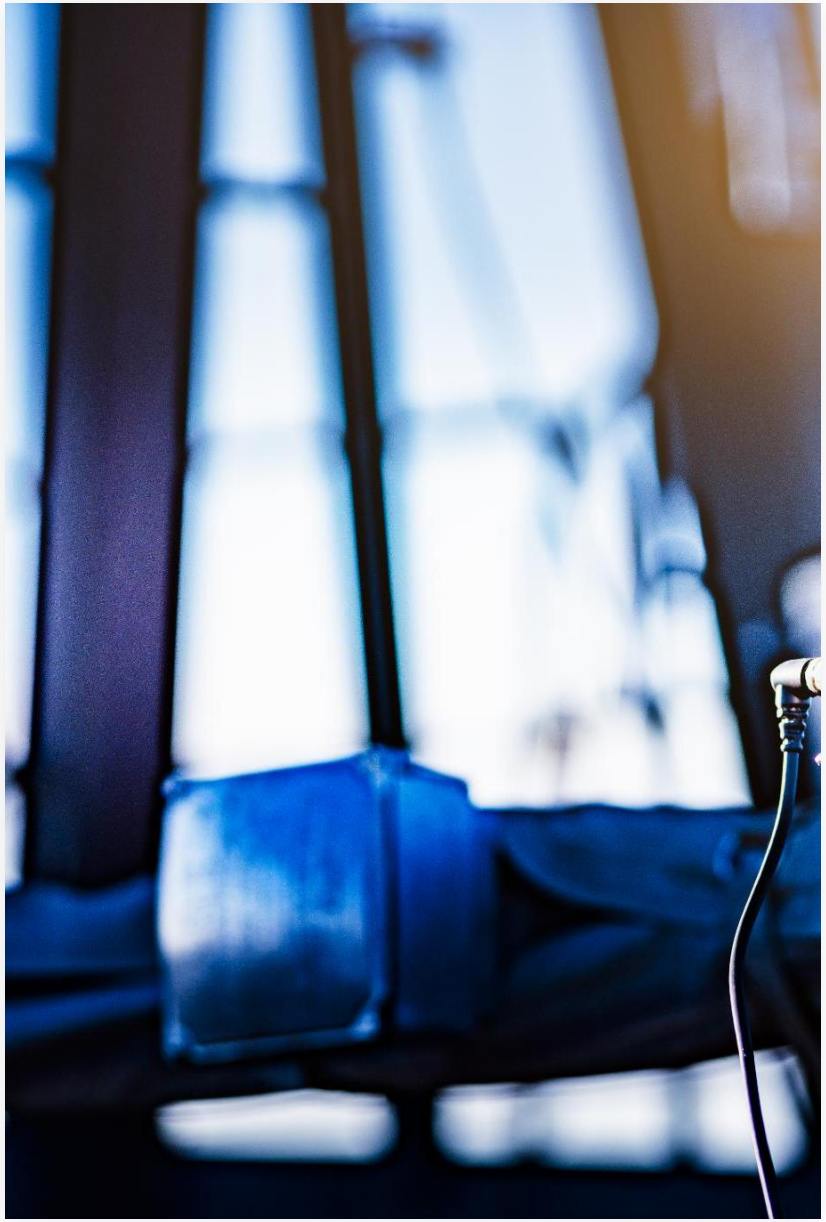
Net Present Value

NPV over 10 years ranged from £5.3M in moderate to £9.3M in optimistic scenarios, confirming project value.

Business Case Validation

Even worst-case savings exceeded £265,000 annually, supporting energy optimization and data-driven decisions.

RISK MITIGATION AND LESSONS LEARNED



ASSUMPTIONS, GUARANTEES, AND STRATEGIC INSIGHTS

Risk Mitigation Strategies

Validating assumptions using audit data and offering performance-based guarantees reduces project risks effectively.

Voltage Control Importance

Effective voltage control is essential for improving motor efficiency and reducing energy consumption in industrial settings.

Billing Optimization & Monitoring

Optimizing billing structures and continuous energy monitoring drive cost savings and operational efficiency.

Strategic Energy Optimization

Targeted interventions yield rapid ROI and support long-term sustainability in industrial energy management.

CONCLUSION

STRATEGIC VALUE OF ENERGY OPTIMIZATION

Cost Savings and Operational Gains

Energy optimization leads to significant cost savings and improved industrial operational efficiency.

Technical Focus Areas

Key focus areas include transformer loading, voltage regulation, and billing inefficiencies for optimization.

Structured Implementation Approach

Real-time monitoring and detailed analysis ensure effective implementation and sustained energy performance.

Encouraging Broader Adoption

Organizations are encouraged to adopt energy optimization methods to reduce costs and support sustainability.