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Synthetic Asset Lifecycle Analysis Report

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DISCLAIMER

The analysis presented in this report is based on a synthetic asset dataset representing equipment installed across the facilities of a major UK retailer operating hundreds of sites across the UK and Ireland.

The dataset reflects a point-in-time snapshot of asset condition, estimated end-of-life dates, and indicative replacement costs as structured within the synthetic case study. No independent verification or audit of the underlying dataset was performed.

Accordingly, the accuracy of all results, figures, and cost estimates is dependent on the completeness, quality, and internal consistency of the synthetic source data. While every effort has been made to ensure analytical robustness, the findings are intended solely for illustrative, educational, and portfolio demonstration purposes.

All calculations, rankings, and cost estimates were generated using standard analytical techniques applied to the synthetic dataset. These values should not be interpreted as engineering-certified assessments, market-based quotations, or operationally validated forecasts. Actual asset conditions, replacement timelines, and costs in real-world contexts may vary significantly due to market dynamics, inflation, maintenance history, or differences in operational environments.

Neither the author nor any associated party accepts responsibility or liability for any direct, indirect, or consequential loss arising from the use of this report or its contents. All financial figures represent indicative values produced as part of the synthetic modelling exercise.

1 EXECUTIVE SUMMARY

This report presents a ten-year asset lifecycle analysis for a major UK retailer with hundreds of stores across the UK and Ireland. The analysis is based on a synthetic dataset that mirrors the structure of the original asset register, with all sensitive information anonymised and facility names replaced by generic identifiers (e.g. “Town A”, “Town EK”).

The purpose of the work is to quantify replacement demand between 2025 and 2034, highlight cost concentrations, and identify the asset categories and locations that carry the greatest operational and financial exposure.

1.1 Ten-Year Financial Outlook

Across the 2025–2034 period:

- **23,234 assets** are forecast to reach end-of-life
- The estimated total replacement cost is **£114.39M**

Cost exposure is heavily front-loaded:

- **2025** accounts for **12,432 assets (53.5%)** and **£68.71M (60.1%)**
- A secondary cost spike occurs in **2030**, with **3,425 assets (14.7%)** and **£23.57M (20.6%)**

Together, **2025 and 2030 represent over 80% of all replacement cost**, creating two major peaks that will require focused capital planning and coordinated delivery.

1.2 Category-Level Cost Concentration

Replacement costs are dominated by a small number of categories:

- **Roof** – £41.37M (36.1%)
- **Roller Shutters** – £17.09M (14.9%)
- **Heat Emitters** – £7.88M (6.9%)
- **LV Distribution** – £6.99M (6.1%)
- **Air Conditioning** – £6.60M (5.8%)

The **top five categories account for almost 70%** of ten-year expenditure.

The remaining 30+ categories together make up less than 13% of total cost, confirming that long-term capital exposure is highly concentrated in a narrow group of building systems.

1.3 Replacement Timing Distribution

Replacements were grouped into three strategic horizons:

Short Term (2025–2027):

- **13,733 assets (59.1% of total assets).**
- **£71.97M (62.9% of total cost).**

This period is dominated by the 2025 peak and represents the most urgent replacement demand.

Medium Term (2028–2030):

- **5,379 assets (23.2%).**
- **£30.10M (26.3%).**

Although 2028 and 2029 show relatively low replacement needs, **2030 introduces a major second peak**.

Long Term (2031–2034):

- **4,122 assets (17.7%).**
- **£12.31M (10.8%).**

This phase shows lower, more predictable replacement levels, suitable for long-term programme planning.

1.4 Facility-Level Replacement Exposure

Replacement costs are unevenly distributed across the estate.

- In **2025**, the most exposed facility (e.g. “Town EK”) faces close to **£0.89M** of replacement cost, with several others above **£0.6M** in that year alone.
- Other “Town” locations appear persistently in top 10 rankings across the decade, indicating clusters of high-value assets and recurring renewal patterns.

These findings highlight the need for **targeted site-level planning**, as a relatively small number of facilities account for a substantial share of total lifecycle cost.

1.5 Cost Concentration Summary

Across all categories:

- The **top 25% of categories (11 out of 44)** account for approximately **£101.85M**, or **~89%** of total ten-year replacement cost.
- The remaining categories form a long tail of low-cost items that can be addressed opportunistically or aligned with broader refurbishment works.

This extreme concentration reinforces the value of **category-focused strategies** such as framework agreements, standardised specifications, and bundled programmes targeting high-value systems like roofing, shutters, electrical distribution, HVAC, and lifts.

2 INTRODUCTION

2.1 Client Context

The organisation analysed in this case study is a **major UK retailer with several hundred sites across the UK and Ireland**, operating a diverse estate of retail units, service hubs, and distribution-type facilities. These sites rely on a broad range of mechanical, electrical, structural, safety, and building-fabric assets to support daily operations, customer service, regulatory compliance, and business continuity.

To better understand the condition and remaining useful life of these assets, the retailer previously commissioned a network-wide asset assessment. The resulting asset register serves as the foundation for this analysis. For the purposes of this portfolio project, all original data has been replaced with a **synthetic dataset** that replicates the structure, complexity, and analytical value of the original, while removing all sensitive information.

2.2 Business Challenge

Managing and maintaining these assets presents significant challenges. Without clear visibility into the condition and lifecycle stage of critical equipment, the risk of unexpected failures, costly downtime, and inefficient capital allocation increases.

2.3 Project Objective

The primary objective of this project is to conduct a structured asset lifecycle analysis using the synthetic dataset. The analysis aims to:

- Identify all assets projected to reach end-of-life between **2025 and 2034.**
- Quantify associated replacement costs over the ten-year period.
- Highlight cost concentration by asset category, asset type, and facility location.
- Provide a clear breakdown of short-, medium-, and long-term renewal needs.
- Establish a factual baseline that can support capital planning and strategic decision-making.

This analysis is intended to demonstrate best-practice lifecycle analytics using anonymised data, suitable for portfolio presentation without revealing any real client information.

2.4 Scope

The scope of the analysis includes:

- All assets contained within the synthetic asset register.
- Condition, criticality, and estimated end-of-life data.
- Replacement cost estimation.
- Ten-year forecasting (2025–2034).
- Aggregation and interpretation of results across categories, asset types, and facility locations.

The analysis **does not** include:

- On-site inspections or physical validation.
- Real cost benchmarking beyond the synthetic values provided.
- Operational constraints such as staffing, contractor capacity, or supply chain variables.
- Prioritisation weighting (e.g., safety vs. commercial importance) beyond the descriptive analytics framework.

The results therefore provide **analytical insight only**, forming a base from which more detailed operational planning, stakeholder engagement, and programme design can be developed.

3 DATA UNDERSTANDING

3.1 Data Sources

The dataset used in this analysis is a **synthetic asset register** created to mirror the structure, complexity, and analytical behaviour of a real-world multi-site asset assessment. It represents a consolidated snapshot of equipment installed across the estate of a **major UK retailer with hundreds of locations across the UK and Ireland**.

The synthetic dataset replicates key characteristics of a comprehensive asset survey, including category classifications, condition ratings, criticality indicators, estimated end-of-life dates, and indicative replacement costs. All values, facility identifiers, and asset details have been anonymised or generated synthetically to ensure that **no real client information is included**.

3.2 Dataset Description

The synthetic dataset contains **33,886 individual asset records**, each representing a single piece of equipment installed within the retailer's UK and Ireland estate.
The dataset mirrors the breadth and structure of a comprehensive asset register, with assets spanning a wide range of categories, including:

- Electrical systems
- HVAC equipment
- Fire safety components
- Doors and shutters
- Building fabric
- Lighting
- Water and drainage systems
- Lifts and vertical transportation
- Communications and controls
- General mechanical and infrastructure assets

Each row in the dataset corresponds to a unique asset and includes key fields such as:

- Asset category and sub-classification
- Facility location (anonymised as “Town A”, “Town B” … etc.)
- Asset condition
- Asset criticality
- Estimated end-of-life year
- Replacement cost estimate

The dataset represents a **point-in-time snapshot**, with all lifecycle expectations expressed as revised end-of-life dates rather than historical time series or maintenance records.

3.3 Data Quality & Limitations

As a synthetic dataset, the register was constructed to replicate realistic data patterns, but several limitations are inherent to its structure:

Missing or Sparse Fields

Certain fields intentionally contain high levels of missingness to reflect real-world survey constraints, such as incomplete technical specifications, absent safety notes, or absent validation records. These fields were removed or deprioritised during analysis where they did not affect lifecycle calculations.

Inconsistent Classifications

Some fields contain varied or inconsistent entries (e.g., broad system paths, differing naming conventions, or partial identifiers). These inconsistencies were standardised during preprocessing to ensure reliable grouping and aggregation.

Anonymised Location and Asset Identifiers

All location information has been replaced with synthetic identifiers (e.g., “Town AK”).
Asset IDs that were missing or inconsistent were replaced with surrogate identifiers to maintain referential integrity.

Synthetic Cost Assumptions

Replacement cost values are indicative and modelled to reflect typical ranges rather than market-validated prices. These figures should therefore be interpreted as analytical estimates only.

Despite these limitations, the dataset retains all fields necessary for high-quality lifecycle and cost analysis, including condition, criticality, end-of-life year, and replacement cost. These form the core of the ten-year forecast and underpin the results that follow.

3.4 Data Preparation

To ensure the dataset could be reliably analysed, several preprocessing steps were applied before the lifecycle and cost analysis was carried out:

Re-categorisation

Asset categories were standardised by using the original "System Full Path" field to derive two new classification fields:

- **Revised Asset Description** – a high-level asset category (e.g. "Roof", "Air Conditioning", "Fire Safety Systems").
- **Revised Asset Detail** – a more specific asset type (e.g. "Sub Distribution Board", "External Manual Roller Shutter", "Fan – Extract").

This re-categorisation reduced the large number of raw system path values into a clearer, more consistent hierarchy suitable for aggregation and reporting.

Handling Missing Values

- Columns with extremely high levels of missing data and limited analytical value were removed from the working dataset.
- Descriptive fields with missing values (e.g. facility identifiers) were standardised by replacing ambiguous or placeholder entries with a single "Unknown" label, ensuring that missingness did not fragment groupings during analysis.

Cleaning & Standardisation

- Inconsistent text entries (e.g. variations in capitalisation, spacing, or spelling) were normalised to ensure that assets belonging to the same category, system, or location were grouped correctly.
- Placeholder values (such as "NaN", "TBC", blank strings, or similar markers) were converted into true missing values and then handled according to the rules above.
- Data types were checked and corrected where required (for example, ensuring cost fields were numeric and date-related fields were correctly interpreted for lifecycle calculations).

These preparation steps produced a cleaned, consistently structured dataset that could be used confidently for the ten-year asset lifecycle and replacement-cost analysis described in the sections that follow.

4 METHODOLOGY

4.1 Approach

The analysis followed a structured workflow designed to ensure data integrity, clarity, and actionable insights. The key steps were:

1. **Import & Initial Inspection** – Loading the dataset and reviewing its structure, column headers, and data types.
2. **Data Cleaning** – Standardizing headers, correcting data types, handling missing values, and removing irrelevant or non-informative columns.
3. **Initial Exploration** – Using visual inspection tools such as correlation heatmaps to understand potential relationships between variables.
4. **Exploratory Data Analysis (EDA)** – Assessing the distribution of key fields (e.g., condition, criticality, cost) to build a baseline understanding of the dataset.
5. **Feature Engineering** – Developing new features to enhance analysis, including:
    - **Condition & Criticality Scoring:** Translating qualitative ratings into quantitative scores.
    - **Replacement Rank:** Applying weightings to combine condition and criticality scores, allowing assets to be ranked in terms of urgency of replacement.
      Note: In a real-world application, urgent vs. long-term prioritisation of assets using the Replacement Rank metric would typically be informed by stakeholder priorities and operational context. For the purposes of this synthetic case study, no business-specific weighting scheme has been applied.
    - **Revised Asset Categorization:** Using engineering expertise to re-categorize the 258 unique values in the *System Full Path* column into two clearer fields:
        - *Revised Asset Description* (high-level category, e.g. “HVAC”).
        - *Revised Asset Detail* (specific asset type, e.g. “Air Handling Unit”).
6. **Visualization & Summarization** – Creating charts, tables, and visual summaries to highlight patterns and support interpretation.

The primary focus of the methodology was **descriptive analysis** — consolidating and simplifying the dataset to provide an accurate high-level view of asset condition, lifecycle, and criticality.

4.2 Analytical Techniques

The analysis made use of summary statistics and aggregation methods, including:

- **Counts and Frequency Distributions** (e.g. number of assets per category, per facility).
- **Central Tendency Metrics** such as means and averages (e.g. average replacement cost per category).
- **Ranking and Prioritization** through the weighted *Replacement Rank* metric, which combined asset condition and criticality into a single index to guide prioritization decisions.

No predictive or machine learning models (e.g. regression, classification) were used, as the focus was on descriptive insights rather than forecasting.

4.3 Validation

To ensure reliability, the analysis results were validated through a series of consistency checks:

- **End-of-Life Alignment:** Cross-checking ranked replacement priorities against assets' reported lifecycle end dates to ensure consistency.
- **Criticality Alignment:** Cross-checking ranked placement priorities against assets' reported criticality description to ensure consistency.
- **Category Integrity:** Reviewing the re-categorized *Revised Asset Description* and *Revised Asset Detail* fields against the original *System Full Path* entries to confirm accurate classification.
- **Sensitivity Testing:** Reviewing the impact of different weightings in the *Replacement Rank* metric to ensure the prioritization remained robust.

4.4 Tools & Technology

The analysis was carried out in **Python**, using Jupyter Notebooks. Key libraries included:

- **Pandas, NumPy** – for data manipulation and aggregation.
- **Matplotlib, Seaborn** – for visualization and exploratory plots.
- **Regex, Datetime** – for data cleaning and transformation.

Graphs and visual outputs were generated to support exploration and illustrate findings for client presentation.

4.5 Methodological Limitations

The analysis was subject to several constraints:

- **Point-in-Time Snapshot:** The dataset lacked historical time-series information, limiting the ability to model asset degradation trends or forecast future failures dynamically.
- **Data Completeness:** High levels of missingness in several fields (e.g., technical specifications, safety notes, validation status) restricted their use in the analysis. As a result, the focus was placed on the most consistently populated fields (condition, criticality, cost, and facility).
- **Replacement Ranking Assumptions:** The *Replacement Rank* metric relied on engineered weightings of condition and criticality scores. While reviewed for robustness, different weighting schemes could shift priorities.
- **No External Benchmarking:** The analysis was limited to the dataset and did not incorporate external benchmarks or industry failure-rate data, which could further enhance lifecycle predictions.

Despite these limitations, the methodology provided a rigorous, structured basis for generating meaningful insights into asset condition, lifecycle, and replacement priorities.

5 RESULTS

5.1 Headline Insights

The synthetic asset dataset indicates that **23,234 assets** across the retailer's UK and Ireland estate are projected to reach end-of-life between **2025 and 2034**, with an associated total replacement cost of **£114.39M**. The distribution of replacements is highly uneven, with two dominant peaks early and mid-decade.

5.1.1 Major Cost Peaks

- **2025** is the single largest replacement year, with
  12,432 assets (53.5%) and **£68.71M (60.1%)** of total cost.
- A secondary spike occurs in **2030**, with
  3,425 assets (14.7%) and **£23.57M (20.6%)**.

Together, these two years account for **over 80% of total ten-year cost exposure**, indicating two pronounced renewal surges requiring targeted capital planning.

5.1.2 Overall Ten-Year Outlook (2025–2034)

Over the ten-year period from 2025 to 2034, a total of **23,234 assets** across the estate are projected to reach end-of-life, with an estimated cumulative replacement cost of **£114.39 million**. This equates to an average of approximately **£4,923 per asset**, although costs vary significantly by category and location. The renewal cycle is heavily front-loaded: **2025 alone accounts for 60% of total replacement cost**, driven by a substantial volume of end-of-life assets identified in that year. A secondary cost peak occurs in **2030**, contributing a further **21%** of total expenditure. Combined, these two years represent **around 81%** of all forecast replacement costs across the decade, highlighting two major budgetary and operational pressure points that will require coordinated planning and resource allocation.

5.1.3 Short-, Medium- and Long-Term Horizons

To support capital planning, the ten-year window is segmented into three periods:

- **Short Term (2025–2027): 13,733 assets (59.1%)** and **£71.97M (62.9%).**
- **Medium Term (2028–2030): 5,379 assets (23.2%)** and **£30.10M (26.3%).**
- **Long Term (2031–2034): 4,122 assets (17.7%)** and **£12.31M (10.8%).**

Nearly two-thirds of all replacements occur within the first three years, underscoring the need for concentrated short-term investment.

5.1.4 Category-Level Concentration

Replacement costs are dominated by a small group of asset categories:

1. **Roof** – £41.37M
2. **Roller Shutters** – £17.09M
3. **Heat Emitters** – £7.88M
4. **LV Distribution** – £6.99M
5. **Air Conditioning** – £6.60M

These five categories together account for **nearly 70%** of total ten-year replacement expenditure. Across all 44 categories, the top quartile (11 categories) represents approximately **£101.85M**, or **89%** of total cost.

5.1.5 Geographic Distribution

Replacement cost exposure varies significantly across facilities, with a small number of locations repeatedly driving the highest annual totals. In **2025**, the most exposed facility requires around **£0.89M** in replacements, with several others exceeding **£0.6M**. A similar pattern occurs in **2030**, where top-ranking sites again show concentrated high-value renewal demand. This highlights the importance of targeted site-level capital planning.

5.2 Category-Level Results

The synthetic dataset contains **44 distinct asset categories**, each representing a broad grouping of related equipment types across the estate. Replacement cost exposure is highly uneven across these categories, with a small number of high-value systems dominating the ten-year outlook.

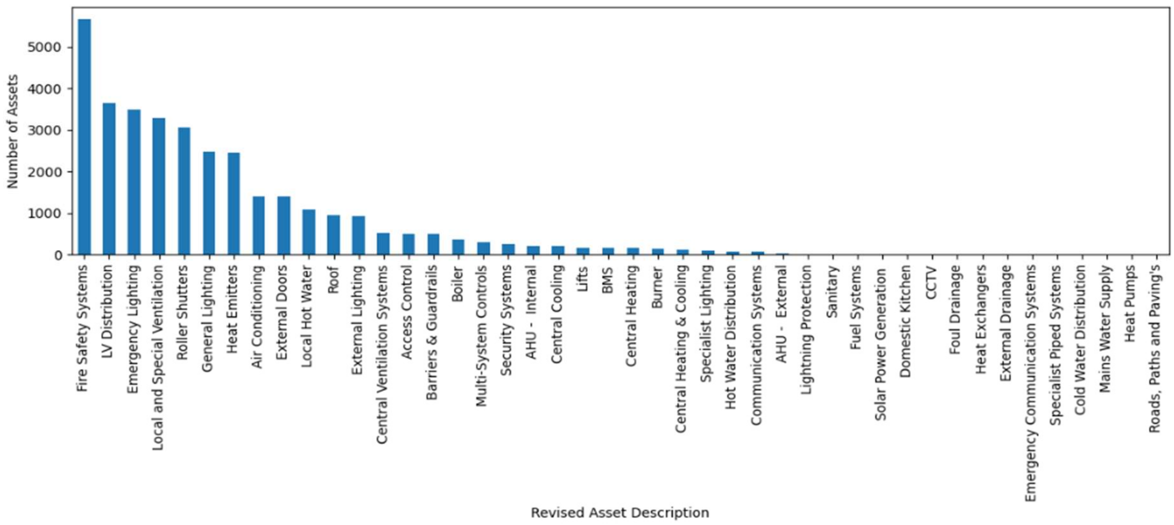

Figure 1 - Total Asset Category Count

5.2.1 Overview of Category Performance

Across all assets, there is significant variation in both asset condition and lifecycle stage by category. The analysis identified several key patterns:

- **High-Volume, Short-Lifecycle Systems**: Categories such as Local and Special Ventilation, LV Distribution, Heat Emitters, Roller Shutters, and Fire Safety Systems represent a large share of total assets. Some of these systems typically operate under continuous load, which can lead to wear and tear and shorter replacement cycles, resulting in a steady flow of near-term replacement demand.
- **High-Value Structural Assets:** The Roof category, while lower in asset count, carries a disproportionately high total replacement cost — approximately **£41.37M**, or **one-third of total projected expenditure** over the next decade. This is followed by the Roller Shutter category with a replacement cost of approx. **£17.09M.**

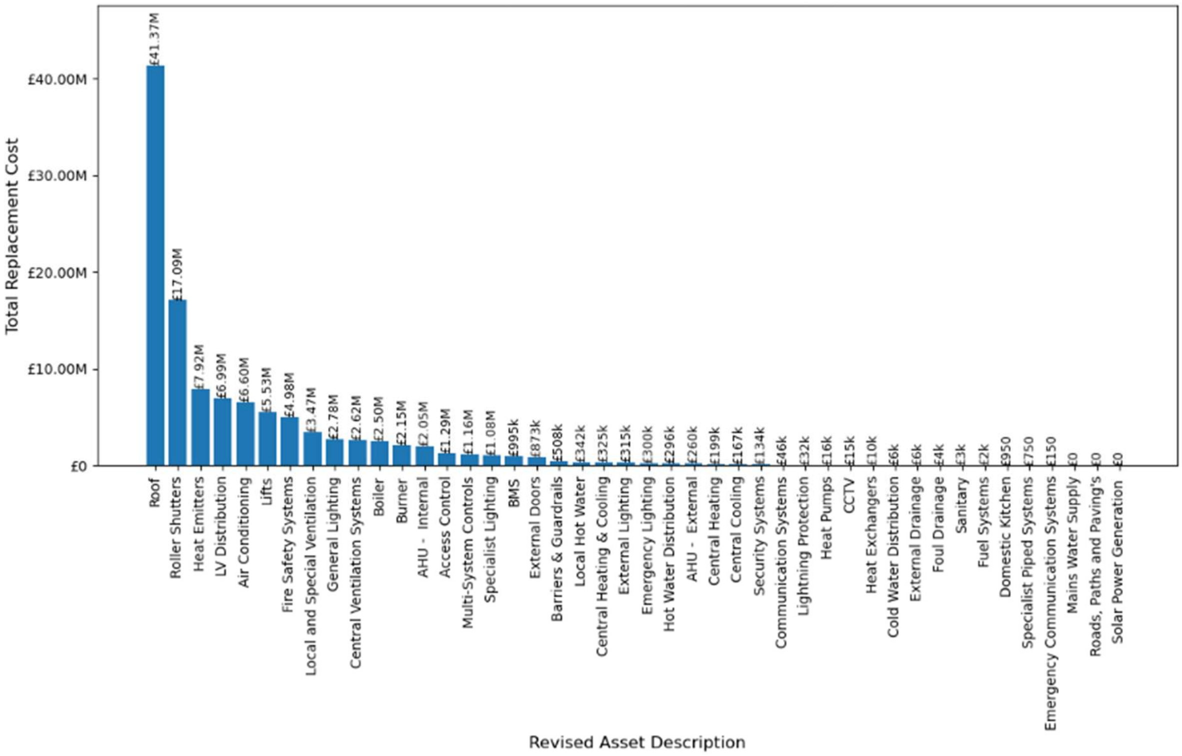

Figure 2 - Total Replacement Cost by Asset Category (2025-2034)

- **Moderate Cost Categories:** A number of categories fall near the average replacement cost per category, with mid-range levels of financial exposure.
  - **General Lighting — £2.78M.**
  - **Central Ventilation Systems — £2.62M.**
  - **Boiler — £2.50M.**

    - **Burner — £2.15M.**
    - **AHU – Internal — £2.05M.**

- **Low-Cost Ancillary Systems:** Categories such as **Utilities**, **Fuel Systems**, **Sanitary**, **Drainage**, and **Controls** represent a relatively small portion of total cost exposure. Although inexpensive, they remain essential for compliance, safety, and basic building functionality.

5.2.2 Implications Summary – Category View

Operational Implications:
A small number of asset categories drive the majority of replacement activity. Operational planning should prioritise:

- Roofs
- Roller Shutters
- Heating assets (Heat Emitters)
- Ventilation equipment
- Electrical distribution systems (LV Distribution)

These categories are critical to maintaining safe, compliant, and operational facilities.

Risk Implications:
High-volume categories include equipment central to building safety, statutory compliance, and operational continuity.
Deferring replacements in ventilation, electrical, or fire safety systems increases the likelihood of:

- Service disruption
- Safety hazards
- Non-compliance events

Budget Implications:
Replacement cost exposure is heavily concentrated in the top categories.
The top quartile of categories represents nearly **89%** of ten-year expenditure, driven by structural, electrical, and mechanical systems. Capital planning should weight investment toward these high-impact categories to align budgets with actual lifecycle demand.

5.3 Replacement Timing

Understanding when assets are expected to reach end-of-life is essential for effective long-range capital planning. The synthetic dataset provides a clear projection of replacement demand across the next ten years (2025–2034), revealing three distinct investment horizons: **Short-term** (2025–2027), **medium-term** (2028–2030), and **long-term** (2031–2034). These periods show pronounced variation in both asset volumes and replacement cost intensity, with two major peaks concentrated in **2025** and **2030**.

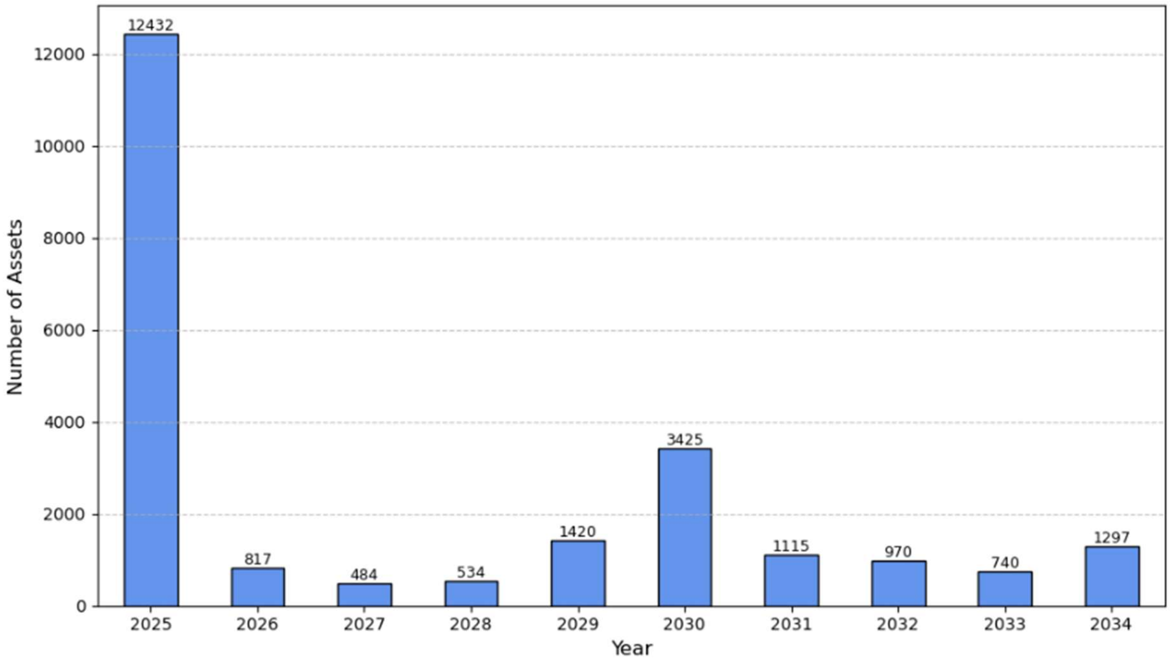

Figure 3 - Total Expiring Assets (2025-2034)

5.3.1 Short-Term Outlook (2025–2027)

The short-term period represents the **most urgent operational and financial priority**. Between 2025 and 2027:

- **13,733 assets** reach end-of-life (**59%** of the decade total).
- Replacement cost is approximately **£71.97M** (**63%** of total cost).
- **2025 alone contributes 12,432 assets and £68.71M**, overwhelmingly driving short-term demand.

The 2025 surge accounts for over **90% of the short-term cost exposure**, confirming that this period is dominated by backlog or near-end-of-life assets identified in the 2024–2025 dataset.

5.3.1.1 Asset Category Inspection

Table 1 - Top 5 Asset Categories Expiring (2025 - 2027)

Rank	Asset Category	Asset Count
1	Local & Special Ventilation	2,159
2	LV Distribution	1,849
3	Heat Emitters	1,704
4	Roller Shutters	1,482
5	Fire Safety Systems	1,226

Key Patterns and Risks:

- **Dominant Categories:** Ventilation and electrical distribution systems top the short-term list due to their high asset counts and intensive usage cycles.
- **Nature of Risk:** These categories include equipment central to:
  - Fire safety compliance.
  - Safe ambient conditions.
  - Electrical integrity.
  - Access and security.
- **Operational Implications:** Delaying replacements in 2025–2027 could result in:
  - Increased likelihood of system failures.
  - Elevated safety risk.
  - Unplanned downtime or store disruption.
  - Regulatory non-compliance.

Strategic Focus:

A high priority coordinated programme is recommended, focusing on:

- Ventilation and air-handling units.
- Critical electrical distribution equipment.
- Shutter and access systems.
- Heating assets and safety systems.

This stabilises the operational baseline before entering the medium-term planning window.

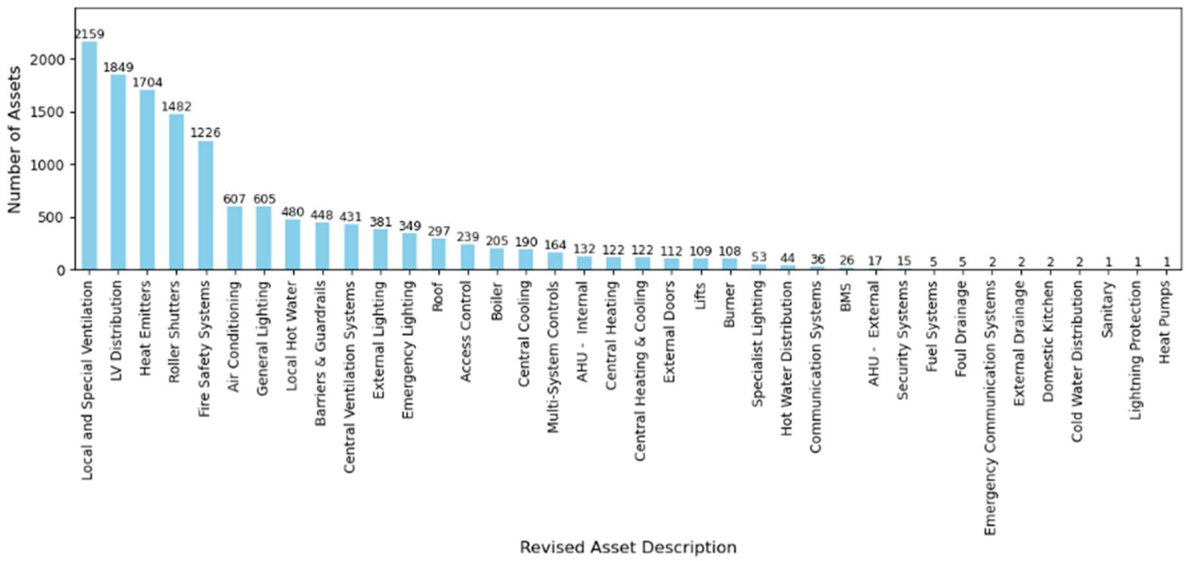

Figure 4 – Number of Assets Expiring by Category (2025 - 2027)

5.3.1.2 Specific Asset Type Inspection

The short-term period remains dominated by electrical distribution and mechanical ventilation assets, reflecting the high operational intensity of these systems. These assets are typically high-frequency, moderate-cost components that underpin facility operations and safety compliance across the estate.

Table 2 - Top 5 Asset Types Expiring (2025 - 2027)

Rank	Asset Type	Asset Count
1	Sub Distribution Board	1,204
2	External Manual Roller Shutter	874
3	Fan – Extract	812
4	Electric Heaters	780
5	Fan – Axial	722

Interpretation:

Electrical infrastructure (distribution boards) and air-handling components dominate near-term replacement activity. Roller shutters and heating units also feature prominently, indicating that coordinated replacement across electrical, HVAC, and building access systems will be necessary to manage risk and minimise disruption in the 2025–2027 period.

5.3.2 Medium-Term Outlook (2028–2030)

During 2028–2029, replacement activity transitions from high-volume, urgent renewals to steadier, planned lifecycle management. However, in **2030** there is a significant spike in the number of assets expiring, leading to approximately **£23.6M** in associated replacement costs for that year.

The **23% of assets (5,379 units)** expiring in the 2028–2030 period contribute around **£30.1M (26% of the total asset replacement cost for 2025–2034)**.

Key Figures:

- Annual asset share:
  - **2028:** 1.2%
  - **2029:** 4.5%
  - **2030:** 20.6%
- Total cost peaks in **2030** at **£23.6M**, following two relatively quiet years
- **Key categories include** Fire Safety Systems, LV Distribution, Local & Special Ventilation, Roof, Heat Emitters.

5.3.2.1 Asset Category Inspection

Table 3 – Top 5 Asset Categories Expiring (2028-2030)

Rank	Asset Category	Asset Count
1	Fire Safety Systems	1,798
2	LV Distribution	553
3	Local & Special Ventilation	459
4	Roof	424
5	Heat Emitters	356

Interpretation:
The medium-term period represents a stabilisation phase, allowing replacements to be planned strategically rather than reactively. This period offers an opportunity to reallocate budgets, refine prioritisation models, and introduce predictive-maintenance techniques. Fire Safety Systems remain a recurring replacement driver. Roof assets begin to emerge, signalling a shift toward structural and envelope renewals in the medium term.

Strategic Focus:

Implement a phased renewal programme — smoothing spending patterns, extending asset life where viable, and preventing another cost spike similar to 2025. This is an opportunity to re-balance expenditure, using predictive maintenance and targeted mid-life refurbishments to extend asset life. Budget smoothing during this phase will mitigate large fluctuations and prepare for the next structural renewal wave.

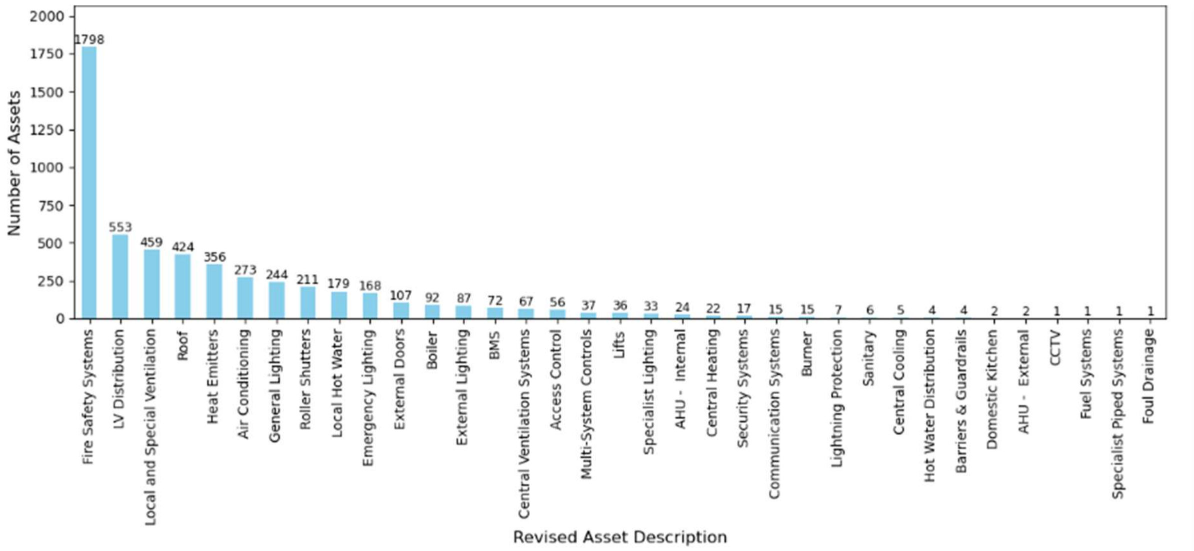

Figure 5 – Number of Assets Expiring by Category (2028 – 2030)

5.3.2.2 Specific Asset Type Inspection

Table 4 - Top 5 Asset Types Expiring (2028-2030)

Rank	Asset Type	Asset Count
1	Fire Extinguishers – Foam	711
2	Fire Extinguishers – CO_2	619
3	Roof	424
4	Sub Distribution Board	391
5	LED Fittings & Luminaires	244

Interpretation:

This period represents a regulatory renewal cycle for safety-critical assets (e.g., extinguishers), alongside early-stage building fabric replacements (Roof). The inclusion of Sub Distribution Boards and Lighting suggests continued turnover of electrical infrastructure.

Strategic Focus:

- Coordinate fire-safety renewals into multi-site frameworks to maintain compliance and consistency.
- Plan phased structural and lighting upgrades during quieter replacement years (2028–2029) to smooth future spending.

5.3.3 Long-Term Outlook (2031-2034)

The long-term phase (2031–2034) includes **17.8% of all expiring assets (4,122 units)** and **£12.31M (10.8% of total cost)**. While overall replacement volume decreases, the period remains characterised by recurring fire-safety renewals and continued electrical infrastructure turnover, accompanied by lighting and HVAC replacements.

5.3.3.1 Asset Category Inspection

Table 5 - Top 5 Asset Categories Expiring (2031-2034)

Rank	Asset Category	Asset Count
1	Fire Safety Systems	1,225
2	Local & Special Ventilation	400
3	Air Conditioning	349
4	LV Distribution	328
5	Roller Shutters	291

Interpretation:

Long-term replacements primarily consist of Fire Safety Systems, with a shift toward HVAC, electrical distribution, and mechanical systems with significant operational impact. Although fewer in number, these assets account for approximately **£12.31M.**

Strategic Focus:

Incorporate these replacements into long-range maintenance planning, aligning major renewals with energy optimisation and sustainability goals to maximise long-term value.

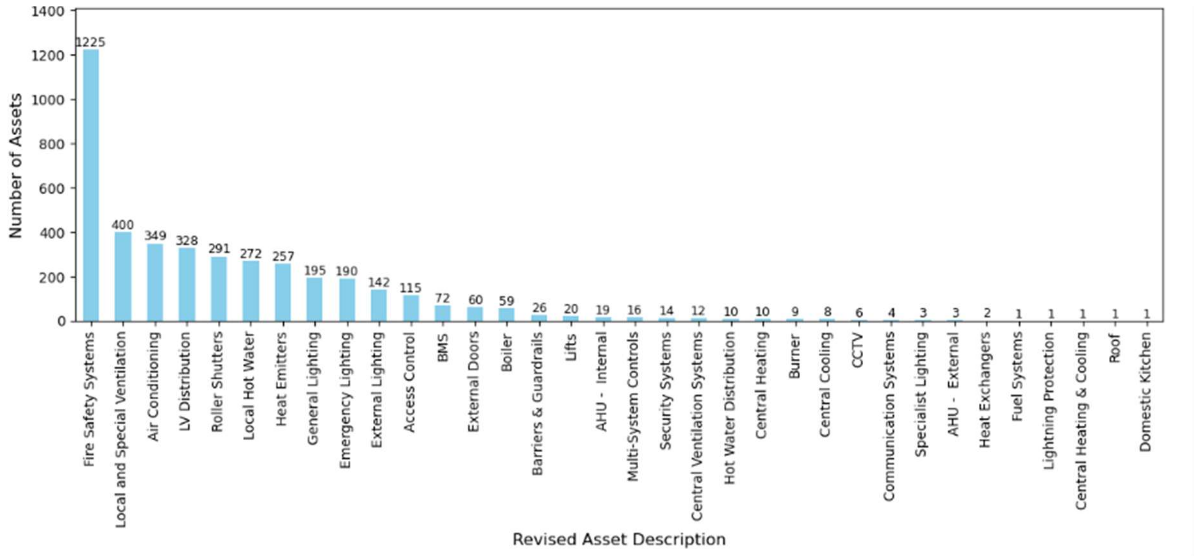

Figure 6 - Number of Assets Expiring by Category (2031 – 2034)

5.3.3.2 Specific Asset Type Inspection

The long-term phase (2031–2034) shows fewer total assets, but continued replacement of recurring safety equipment alongside HVAC and electrical infrastructure.

Table 6 - Top 5 Asset Types Expiring (2031-2034)

Rank	Asset Type	Asset Count
1	Fire Extinguishers – Foam	439
2	Fire Extinguishers – CO_2	413
3	LED Fittings & Luminaires	195
4	Sub Distribution Board	188
5	Fan – Window / Wall-mounted	178

Interpretation:

Fire-safety equipment continues to dominate replacement activity, accompanied by the recurring expiry of lighting and electrical distribution assets, followed by a relatively small number of mechanical ventilation components.

Strategic Focus:

- Incorporate fire-safety and electrical replacements into multi-year service frameworks to improve consistency and procurement efficiency.

- Coordinate lighting replacements with sustainability initiatives, focusing on LED standardisation and energy reduction.
- Use this period for capital optimisation, aligning replacement activity with wider refurbishment and decarbonisation programmes.

5.4 Facility and Region Results

This section analyses the spatial distribution of replacement costs across the retailer's UK and Ireland facility network for the period 2025–2034. It identifies the locations with the highest forecast replacement expenditure and highlights potential regional patterns of investment intensity.

The aim is to support geographically informed decision-making—helping the organisation to coordinate renewal programmes, allocate budgets proportionally across regions, and plan contractor resources effectively.

5.4.1 Short-Term Outlook (2025–2027)

During the short-term period, replacement costs are heavily concentrated in several high-exposure locations across the UK and Ireland.

The synthetic dataset shows strong clustering around a small group of facilities with significant 2025 cost peaks.

Table 7 – Top 5 Facility Locations by Total Replacement Cost (2025-2027)

Year	Facility General Location	Total Cost Range (£ M)
2025	Town EK (0.89), Town CA (0.82), Town JC (0.78), Town HU (0.72), Town A (0.67)	0.56 – 0.89
2026	Town GN (0.13), Town JG (0.09), Town LI (0.08), Town AO (0.07), Town OW (0.07)	0.06 – 0.13
2027	Town IF (0.07), Town SK (0.07), Town TW (0.07), Town JA (0.06), Town ME (0.06)	0.06 – 0.07

Interpretation:

- **2025 is the dominant year**, with Town EK, Town CA, and Town JC together representing more than **£2.48M** in replacement cost.
- Geographic spread is broad, but **2025 sites show clustering in major UK urban centres**, reflecting higher asset volumes and more complex infrastructure.

- **Irish locations appear from 2026 onward** (e.g., Town LI, Town AO), indicating consistent lifecycle timing across the wider estate.

Strategic Focus:

- Prioritise high-exposure UK facilities identified for 2025 to stabilise short-term operational risk.
- Use shared regional contractor frameworks to capture economies of scale across neighbouring sites.
- Schedule 2026–2027 works to maintain continuity of delivery while reducing operational disruption.

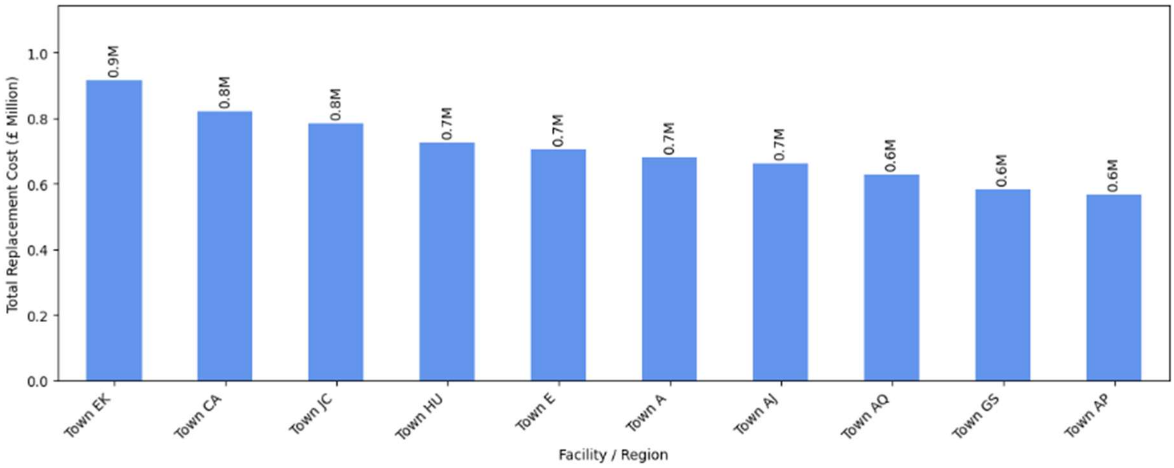

Figure 7 - Top 10 Locations by Replacement Cost (2025-2027)

5.4.2 Medium-Term Outlook (2028–2030)

In the 2028–2030 period, cost intensity becomes more geographically diverse, with prominent peaks across both UK and Irish sites. The most significant spike occurs in **2030**, driven by a cluster of high-value facilities.

Table 8 - Top 5 Facility Locations by Total Replacement Cost (2028-2030)

Year	Facility General Location	Total Cost Range (£ M)
2028	Town EE (0.06), Town DM (0.06), Town CZ (0.06), Town J (0.06), Town LO (0.05)	0.03 – 0.06
2029	Town FI (0.16), Town RZ (0.14), Town FF (0.13), Town J (0.11), Town V (0.10)	0.08 – 0.16
2030	Town RZ (0.37), Town JC (0.37), Town AH (0.29), Town EP (0.27), Town BI (0.22)	0.19 – 0.37

Interpretation:

- **2030 shows a marked spike**, with two facilities—Town RZ and Town JC—each exceeding **£0.35M** in replacement cost.
- Locations such as Town AH, Town EP, and Town BI indicate **broad regional distribution** across the UK.
- Several Irish sites appear in 2028–2029, demonstrating consistent maintenance needs across the UK–Ireland network.

Strategic Focus:

- Implement phased refurbishment programmes across high-density urban regions.
- Align structural and critical system renewals to reduce business disruption during 2030's major peak.
- Use quieter years (2028–2029) to prepare procurement pipelines and resource plans for the 2030 surge.

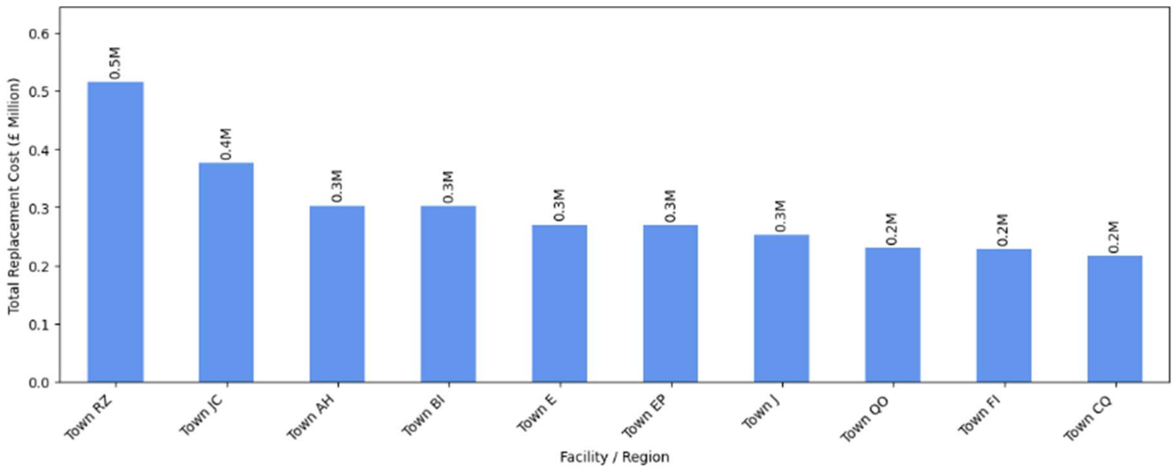

Figure 8 - Top 10 Locations by Replacement Cost (2028-2030)

5.4.3 Long-Term Outlook (2031–2034)

The long-term period demonstrates a stabilisation of cost distribution across UK and Irish regions, with a more evenly dispersed set of high-value sites.

Table 9 - Top 5 Facility Locations by Total Replacement Cost (2031-2034)

Year	Facility General Location	Total Cost Range (£ M)
2031	Town LI (0.24), Town H (0.12), Town EK (0.09), Town FM (0.08), Town J (0.08)	0.06 – 0.24
2032	Town KY (0.12), Town BI (0.08), Town FC (0.08), Town A (0.08), Town IH (0.06)	0.04 – 0.12
2033	Town ON (0.08), Town RP (0.08), Town TV (0.07), Town E (0.06), Town JF (0.05)	0.04 – 0.08
2034	Town AJ (0.11), Town AH (0.09), Town HG (0.09), Town JE (0.09), Town PJ (0.09)	0.07 – 0.11

Interpretation:

- Long-term costs are **more evenly distributed**, with Town LI standing out as the highest-value site in 2031.
- Facilities across England, Scotland, and Ireland all appear in annual top five rankings, indicating a **mature and geographically balanced renewal cycle.**
- Average project values decline relative to earlier peaks, suggesting **targeted renewals** rather than network-wide interventions.

Strategic Focus:

- Integrate long-term replacements into the organisation's capital forecast with predictable yearly allocations.
- Maintain regional contractor partnerships to control mobilisation costs across dispersed sites.
- Use this period for sustainability-oriented upgrades and lifecycle optimisation.

5.4.4 Implications Summary – Geographic View

Operational Implications:

High replacement activity is concentrated in specific high-value facilities. Coordinated planning will be required to minimise disruption where multiple major renewals may coincide.

Risk Implications:

Locations repeatedly appearing in annual top five cost rankings represent **elevated lifecycle risk**. Targeted intervention is needed to ensure compliance and avoid operational impacts.

Budget Implications:

Cost exposure is uneven across regions. Capital budgets should be weighted proportionally toward higher-exposure areas while maintaining adequate provision for lower-cost but critical sites.

5.5 Cost Analysis

The synthetic dataset provides a detailed view of replacement cost exposure across the ten-year period (2025–2034), allowing a clear comparison of how expenditure varies by year, by category, and by overall portfolio distribution. The analysis highlights two major cost peaks driven by large volumes of expiring assets, followed by a transition toward a more stable cost profile in the latter years.

5.5.1 Annual Replacement Cost Profile (2025–2034)

Replacement cost exposure is heavily front-loaded, with substantial investment required in the early years. The total estimated expenditure across the ten-year window is **£114.39M**, with annual values showing significant variation.

Key Annual Cost Peaks:

- **2025:** £68.71M (60% of decade total).
- **2030:** £23.57M (21% of decade total).

The remaining years (2026–2029 and 2031–2034) show considerably lower replacement spending, ranging between **£1.9M and £4.5M** per year, offering opportunities for more predictable budget allocation.

5.5.2 Year-on-Year Cost Distribution

Table 10 – Replacement Cost Distribution (2025-2034)

Year	Replacement Cost (£M)	% of Total
2025	68.71	60.08
2026	1.87	1.63
2027	1.39	1.22
2028	1.35	1.18
2029	5.18	4.53
2030	23.57	20.60
2031	3.5	3.06
2032	2.38	2.08
2033	1.89	1.65
2034	4.54	3.97
Total	**£114.39**	**100 %**

Interpretation:

- **2025** represents an extreme concentration of replacement activity, accounting for over **60%** of all ten-year costs.
- **2026–2029** reflect a substantial reduction in expenditure (generally **≤ £5M** per year), providing a window for phased or deferred delivery.
- **2030** introduces a **second major cost peak**, driven primarily by structural and HVAC assets entering the next renewal cycle.
- **2031–2034** show a return to a more predictable, steady-state cost profile, supporting stable long-term capital planning.

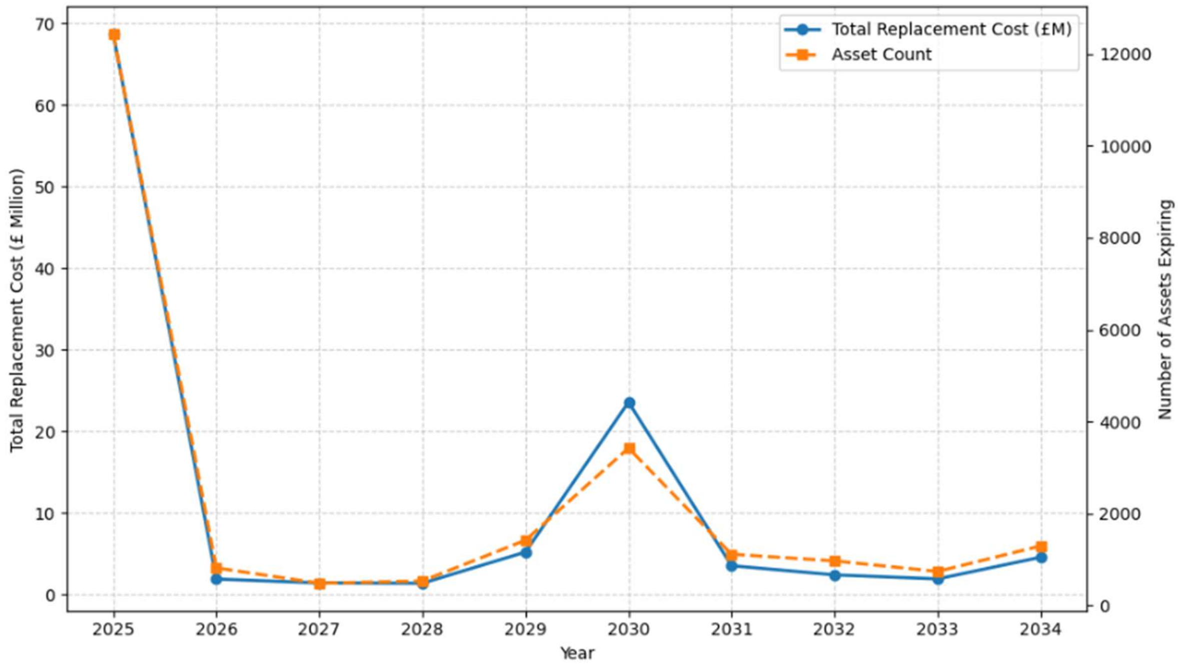

Figure 9 – Total Replacement Cost and Asset Count (2025-2034)

5.5.3 Cost by Asset Category

This subsection analyses the distribution of total replacement costs by asset category over the ten-year period (2025–2034). Replacement costs are unevenly distributed across the estate's 44 asset categories. A small number of high-value systems dominate the cost curve.

Table 11 - Total Replacement Cost per Category (2025-2034)

Rank	Asset Category	Total Cost (£M)	% of Total
1	Roof	41.37	36.1
2	Roller Shutters	17.09	14.9
3	Heat Emitters	7.88	6.9
4	LV Distribution	6.99	6.1
5	Air Conditioning	6.6	5.8
6	Lifts	5.53	4.8
7	Fire Safety Systems	4.98	4.4
8	Local & Special Ventilation	3.47	3.0
9	General Lighting	2.78	2.4
10	Central Ventilation Systems	2.62	2.3
–	Remaining Categories Combined	14.52	12.7
Total		**£114.39**	**100 %**

Interpretation

- The **Roof** category alone accounts for over one-third of all replacement expenditure **(£41M)**, reflecting extensive structural renewal requirements.
- The next most significant contributors—**Roller Shutters (£17M)**, **Heat Emitters (£7.9M)**, **LV Distribution (£7M)**, and **Air Conditioning (£6.6M)**—bring total exposure from the top five categories to nearly **70% of overall spend**.
- Building-services assets (HVAC, electrical, lifts, and lighting) collectively make up **around 30%**, emphasising their critical role in operational continuity.
- The remaining 30 categories contribute less than **13%** combined, demonstrating that cost exposure is **heavily concentrated in a small number of high-value systems**.

6 INTERPRETATION & BUSINESS IMPLICATIONS

The results of the synthetic asset lifecycle analysis reveal a highly uneven distribution of replacement demand across both time and asset categories. Two dominant peaks—in 2025 and 2030—shape the entire profile of the ten-year period, with the majority of cost and asset volume concentrated around a small subset of high-value systems and high-exposure facilities. These patterns provide clear insight into the operational, financial, and strategic considerations required to effectively manage the upcoming renewal cycle.

6.1 Interpretation of Results

6.1.1 Front-Loaded Renewal Cycle

The extreme concentration of asset expiries in 2025 creates an immediate surge in replacement demand. This single year represents:

- 53.5% of all expiring assets.
- 60% of total ten-year replacement cost.

This indicates that a substantial portion of the estate's asset base was installed or last renewed during a similar timeframe, resulting in a highly synchronised end-of-life cycle.

6.1.2 A Secondary Peak in Structural and HVAC Systems

The rise in 2030 (£23.57M, 20.6% of total cost) reflects a second wave of structural assets, HVAC components, and electrical systems reaching end-of-life. This spike suggests:

- Multiple distinct lifecycle cohorts within the estate.
- The presence of deferred renewals from earlier cycles, or asset groups with longer design lives (e.g., roofs, large HVAC units).

6.1.3 Dominance of a Small Number of Categories

The top five categories—Roof, Roller Shutters, Heat Emitters, LV Distribution, and Air Conditioning—account for nearly £80M of the total.
This concentration highlights:

- Reliance on a narrow set of core building systems.
- A strong link between building fabric and long-term financial exposure.
- The need to coordinate category-specific strategies.

6.1.4 Recurring Safety-Driven Cycles

Fire Safety Systems appear consistently across all time horizons. Their presence reflects:

- Statutory renewal cycles for extinguishers and related systems.
- The predictable nature of safety asset life expectancy.
- The importance of aligning safety renewals with compliance frameworks.

6.1.5 Geographic Cost Clustering

Analysis across facility locations shows:

- Clear spikes in major UK urban regions during 2025.
- Broadening distribution across UK and Ireland in later years.
- Repeated high-cost years for certain locations (e.g. structures appearing in both 2025 and 2030).

This suggests differing age profiles across the estate, with some sites carrying legacy backlog and others moving into later renewal cycles.

6.2 Business Implications

6.2.1 Capital Allocation: Front-Load Budget Provision

The heavy concentration of cost in 2025 and 2030 necessitates:

- Significant upfront capital allocation.
- Multi-year budgeting structures.
- Contingency planning for peak-year expenditure.

Failure to invest during these peaks increases the risk of:

- Operational disruption.
- Safety non-compliance.
- Compounding maintenance costs.
- Unplanned asset failures.

6.2.2 Category-Focused Investment Strategy

Given that the top quartile of categories drives 89% of expenditure:

- Investment planning should prioritise these categories ahead of lower-impact systems.
- Multi-year frameworks for Roofing, HVAC, Distribution Boards, and Shutters are essential.

- Procurement approaches should emphasise volume aggregation and standardisation.

6.2.3 Regional Work Programming and Resource Coordination

High-exposure sites—particularly those with >£0.5M in 2025—require:

- Early contractor engagement.
- Work bundling across geographic clusters.
- Short-term stabilisation programmes to mitigate operational risk.

Regional differences in cost distribution suggest that differing maintenance histories or building profiles must be accounted for in scheduling.

6.2.4 Risk Mitigation and Compliance Assurance

Safety-critical systems (fire extinguishers, electrical distribution, essential ventilation) dominate the medium and long-term horizons. This creates operational risk if replacements are deferred:

- Statutory compliance lapses.
- Building safety exposure.
- Interruption to store or facility operations.

Prioritising these assets through compliance frameworks and scheduled inspections reduces long-term risk.

6.2.5 Coordination of Structural and Fabric Renewals

Large-scale fabric assets (e.g., Roofs, Shutters) recur throughout the decade and account for the largest proportion of cost.
This implies:

- The need for integrated fabric refurbishment programmes.
- Combining structural renewals with HVAC or electrical upgrades where possible.
- Long-term frameworks that support consistency and quality control.

6.2.6 Opportunity for Long-Term Optimisation

The stabilised period from 2031–2034 offers:

- Predictable yearly spending.
- Opportunities for refurbishment-based life extension.
- Alignment with sustainability and decarbonisation initiatives.
- LED lighting upgrades and HVAC efficiency improvements.

This long-term window provides the capacity for strategic optimisation that is not possible during peak renewal years.

6.3 Overall Strategic Considerations

The estate’s lifecycle profile demands a proactive, programme-led investment model rather than a reactive, failure-based approach.

- Category concentration creates an opportunity to streamline procurement, reduce unit costs, and improve service consistency across the network.
- Geographic clustering of high-value sites highlights where targeted renewal will deliver the greatest operational benefit.
- The long-term horizon provides headroom to embed sustainability-driven modernisation into ongoing lifecycle management.

7 RECOMMENDATIONS

The findings from the synthetic asset lifecycle analysis highlight two major renewal peaks (2025 and 2030), significant cost concentration within a small number of asset categories, and uneven exposure across the facility network. To effectively manage risk, control expenditure, and optimise long-term asset performance, the following recommendations are proposed.

7.1 Strategic Capital Planning

7.1.1 Front-Load Capital Allocation for 2025 and 2030

Given that these two years account for **~81%** of total expenditure, capital planning should:

- Ring-fence funding specifically for 2025 backlog and 2030 structural/HVAC renewals.
- Avoid deferring 2025 replacements, as postponement will compound both cost and risk.
- Develop a rolling three-year capital plan that adapts to emerging asset-condition updates.

7.1.2 Establish Multi-Year Investment Frameworks

Use long-term frameworks to manage high-volume, repeat asset categories:

- Roofing systems.
- Roller shutters and external access equipment.
- Electrical distribution (distribution boards).
- Ventilation and air-handling units.
- Safety systems (fire extinguishers, compliance-critical assets).

Frameworks support:

- Standardised specifications.
- Negotiated unit rates.
- Streamlined procurement.
- More predictable annual budgets.

7.2 Operational Delivery

7.2.1 Prioritise High-Exposure Facilities

Facilities with >£0.5M replacement cost in peak years should be prioritised for:

- Early asset condition revalidation.
- Detailed scoping to lock down cost estimates.

- Coordinated project scheduling to minimise disruption.

Regional clustering in 2025 and 2030 provides opportunities to deliver works through:

- Regional contractor mobilisation.
- Bundled logistics.
- Shared scaffolding and access systems for structural projects.

7.2.2 Sequence Projects to Reduce Risks and Failures

Focus short-term delivery (2025–2027) on:

- Critical ventilation systems.
- Electrical distribution integrity.
- Building access and shutter systems.
- Heating and fire safety equipment.

This stabilises baseline building performance before the 2030 structural wave.

7.3 Category-Level Strategy

7.3.1 Target High-Value Categories with Life Extension Options

For costly structural and mechanical categories (Roof, AC units, Shutters), explore:

- Mid-life refurbishment.
- Localised patching for roofs before full renewal.
- Component-level replacements (motors, bearings, actuators) where viable.

Where refurbishment is not feasible, predefined replacement packages can reduce variability and cost.

7.3.2 Implement Predictive Maintenance for Electrical and HVAC Assets

Electrical and HVAC systems appear in all three horizons.
A predictive approach using:

- Periodic condition scoring.
- Remote monitoring (where applicable).
- Temperature/load trend analysis is recommended to anticipate failures ahead of critical periods.

7.4 Long-Term Optimisation

7.4.1 Leverage 2031–2034 as a Stabilisation and Efficiency Window

The lower expenditure between 2031 and 2034 offers a unique opportunity to:

- Introduce energy-efficient HVAC and lighting technologies.
- Sync replacements with decarbonisation objectives.
- Conduct refurbishments that extend asset life at lower cost.

7.4.2 Integrate Asset Renewal with Sustainability Targets

Where feasible:

- Transition lighting to LED with smart controls.
- Prioritise high-efficiency HVAC replacements.
- Combine fabric refurbishments with insulation improvements.

These upgrades reduce long-term operational costs and improve environmental performance.