EV CHARGING IN UNDERGROUND CAR PARKS – SHOULD WE BE CONCERNED?

Evidence, Guidance and Practical Implications for Property Owners — **Syzygy, December 2025**

EXECUTIVE SUMMARY

This paper provides an evidence-led assessment of the fire risks associated with electric vehicles (EVs) in underground and covered car parks, alongside practical guidance for landlords, asset managers and operators on safely integrating EV-charging infrastructure. The analysis demonstrates that EVs do not present a greater inherent fire risk than petrol or diesel vehicles and that appropriate design and management allow EV charging to be implemented safely within enclosed parking environments.

KEY FINDINGS

- EVs ignite far less frequently than petrol or diesel vehicles.
- EV fires are not inherently more intense than ICE fires in full-scale testing.
- Most EV fires do not originate in the traction battery.
- When suppression is applied early, battery involvement can often be prevented.
- Operators accept EVs parking in their underground car parks; concerns relate primarily to charging design.
- Charging risks are manageable through BMS controls, regulated EVSE, and layout/detection measures.
- EV charging requirements are embedded in building regulations in the UK.
- Safe operation depends on appropriate risk assessment, electrical design, mitigations and ongoing maintenance - not on restricting EV access.
- Sprinklers, detection, and ventilation remain the core fire-safety pillars for underground car parks.
- UK and EU guidance supports EV parking and charging in covered car parks with appropriate mitigation.

STRATEGIC GUIDANCE FOR LANDLORDS

- EV charging has become standard building infrastructure and must be planned as such.
- Landlords must consider charger type, electrical capacity, tariff strategy, utilisation, service-charge implications and maintenance requirements.
- Early engagement with managing agents, fire-risk assessors and electrical consultants ensures compliant and future-proof designs.
- A structured deployment roadmap-from feasibility to long-term operation-supports safe and commercially effective EV-charging provision.

INTRODUCTION

Many real estate owners and occupiers have been installing EV charging facilities in their underground car parks for several years. However, the question regarding whether it is *safe* to do so is being asked by some owners and developers. Several landlords and asset managers remain uncertain about whether allowing EVs to charge in covered or basement car parks increases fire risk. This uncertainty appears to stem from a lack of consistency and clarity from insurers, and, in parallel, reporting in certain parts of the media where a heightened perception of danger has been created, often through dramatic but unrepresentative news stories.

This debate is happening against the backdrop of a rapid shift in the vehicle fleet. As of late 2025, there are over **1.7 million fully electric cars** on UK roads, around **5% of all UK vehicles**, with numbers having more than quadrupled since 2021. In 2024, **zero-emission cars accounted for about 19% of all new registrations**, up from 16% in 2023, and battery electric vehicle registrations have been at over 22% in 2025 to date. The UK's **Zero Emission Vehicle (ZEV) mandate** now requires manufacturers to sell an increasing share of zero-emission cars and vans, rising to **80% of new car sales by 2030** and **100% by 2035**.

For the real estate sector, the regulatory landscape is shifting just as rapidly. While national vehicle policy is accelerating the transition to electric mobility, building regulations governing development and refurbishments place clear responsibilities on asset owners.

In England, requirements for EV charging infrastructure have been embedded in Building Regulations since 2022. Approved Document S sets out mandatory provision for both new developments and certain major renovations, making EV charging capability a standard part of building design. New residential buildings with associated parking must install at least one charge point per dwelling, while new non-residential buildings with more than ten parking spaces must provide at least

one active charge point and **future-proofed cable routes for a minimum of 20% of bays**.

Scotland introduced similar provisions through amendments to the **Building (Scotland) Regulations**, which took effect in **2023**. These require EV charging infrastructure, or at least infrastructure readiness, in new domestic and non-domestic buildings and in relevant major renovations. Although the technical details differ slightly from those in England, the overall intention is aligned: to ensure that new development can support the rapid growth in electric vehicles across Scotland.

In **Wales** and **Northern Ireland**, there is currently no national regulation equivalent to England's Part S. EV charging provision is instead shaped by planning policy, local authority expectations and occupier or market demand. While the approach is less prescriptive, new developments in these countries are increasingly expected to make provision for EV charging, particularly where planning authorities view it as supporting sustainability objectives.

A summary of the current regulatory landscape is set out below:

Country	Regulatory Framework	Requirements for New Developments / Major Renovations	Implementation Date
England	Building Regulations - Approved *Document S: Infrastructure for Charging Electric Vehicles*	New residential buildings with associated parking must install at least one charge point per dwelling. New non-residential buildings with more than ten spaces must provide at least one charge point and cable routes for at least 20% of bays. Applies to certain major renovations.	In force from **15th June 2022**
Scotland	Building (Scotland) Regulations - EV charging provisions (2023 amendments)	EV-charging infrastructure or infrastructure-readiness required in new domestic and non-domestic buildings and relevant major renovations.	In force from **5th June 2023**
Wales	-	No national mandate equivalent to Part S; provision influenced by planning policy and local authority requirements.	-
Northern Ireland	-	No national mandate equivalent to Part S; provision determined by planning policy or developer choice.	-

Table 1 – Building Regulation Codes across the UK

EVs using underground car parks is therefore not an optional or fringe issue: this is an inevitable and rapidly approaching reality.

This paper sets out the current evidence. It draws on UK Government guidance, independent technical research, insurance data, and international fire statistics. The aim is to give property owners a clear, factual understanding of what is known, what remains under review, and how to approach EV charging from a risk-management perspective.

The findings are consistent across jurisdictions. **EVs ignite far less frequently than petrol or diesel vehicles**, and **their fires are not inherently more intense** than those involving internal combustion engine (ICE) vehicles. The distinctive characteristics of battery involvement do require consideration - particularly duration and re-ignition potential, but these issues are well understood in modern fire-safety engineering. The focus should be on informed mitigation, not avoidance.

SUMMARY – INTRODUCTION

- EV adoption in the UK is accelerating rapidly with over 38% of new registrations being plug-in vehicles.
- Underground car parks will inevitably contain increasing numbers of EVs.
- Evidence shows EVs ignite much less often than Internal Combustion Engine (ICE) vehicles.
- Guidance focuses on safe charging design, not restricting EV access.
- The goal is informed mitigation, not avoidance

DISTILLING THIS ISSUE INTO THREE IMPORTANT QUESTIONS

1. *Do electric vehicles present a greater fire risk than petrol or diesel vehicles?*
2. *Does the act of charging the vehicle introduce additional risk?*
3. *What does this mean for real estate owners?*

1. DO ELECTRIC VEHICLES PRESENT A GREATER FIRE RISK THAN PETROL AND DIESEL VEHICLES?

Electric vehicles have attracted disproportionate attention in the media whenever a fire occurs, often because battery-related incidents are visually dramatic and unfamiliar. However, when examined in a structured and evidence-led manner, EVs do not present a greater inherent fire risk than internal combustion engine (ICE) vehicles. In fact, the balance of international data indicates that EVs ignite far less frequently than ICE vehicles - and when they do, the fires are typically **comparable in severity** to modern petrol or diesel vehicles.

Research from the **Swedish Civil Contingencies Agency (MSB, 2022)** found:

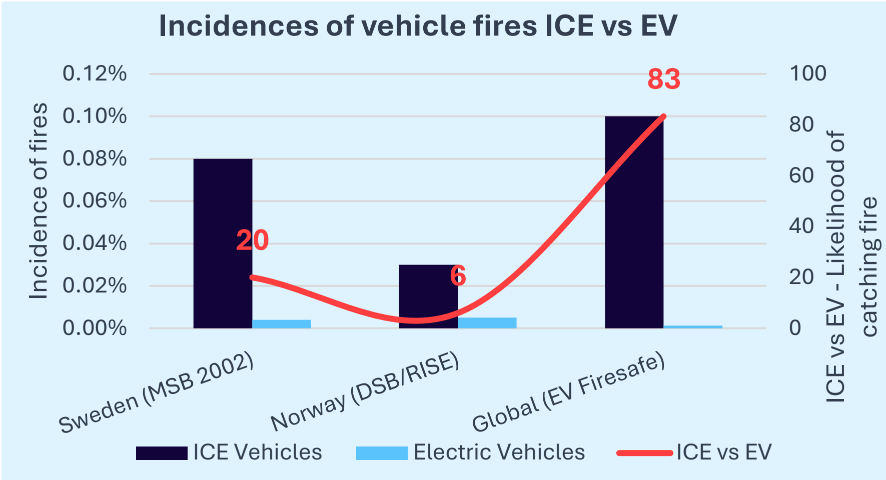
- 24 fires in 611,000 EVs (0.004%)
- 3,400 fires in 4.4 million ICE vehicles (0.08%)
- ICE vehicles were 20× more likely to catch fire.

Similarly, analysis by **RISE (Hynynen & Arvidson, 2024)** using data from the **Norwegian Directorate for Civil Protection (DSB)** showed that EVs accounted for just 2.3% of vehicle fires, despite comprising over 17% of Norway's vehicle fleet. This implies EVs were six to eight times less likely to ignite.

Global data compiled by **EV FireSafe (2023)** estimate a battery-related EV fire probability of 0.0012%, compared with approximately 0.1% for ICE vehicles, suggesting ICE vehicles may be up to 80× more likely to experience a fire.

Modern vehicles, regardless of powertrain, contain large quantities of combustible plastics, polymers and synthetic materials that dominate fire load characteristics. Full-scale testing reviewed by **RISE (2020–2023)** shows that **peak heat-release rates and total heat released** in EV and ICE fires fall within a broadly similar range. The main differences relate to **duration** and the potential for **thermal-runaway-driven re-ignition**, not fire intensity.

It is worth noting that EVs do not have many of the traditional ignition points: hot exhaust systems, turbochargers, combustible fuel systems, and lubricants. These structural differences help to explain why EVs show lower fire-incident rates across the datasets examined.



Region / Study	EV Fire Rate (per 100,000 vehicles)	ICE Fire Rate (per 100,000 vehicles)	Relative Likelihood (ICE: EV)
Sweden (MSB 2022)	4	80	20× more likely
Norway (DSB / RISE)	5	30	6× more likely
Global (EV FireSafe)	1.2	100	83× more likely

Table 2 –Research outputs into the Incidences of fires in EVs and ICE vehicles

1.1 WHY DO EVS CATCH FIRE LESS OFTEN?

The key engineering reasons identified in the MSB and RISE analyses:

- No combustion engine: fewer hot surfaces and mechanical wear points.
- No petrol/diesel system eliminates a major ignition source in ICE fires.
- Active battery management systems: monitor voltage, temperature and current continuously.
- Fewer mechanical components and less mechanical complexity: creating fewer 'points of weakness' or opportunities for a fire to start.

1.2 WHERE DO EV FIRES START?

Contrary to perception, most EV fires do not originate in the traction battery. Data from RISE (2023) and EV FireSafe research shows the majority start in:

- Low-voltage wiring
- Auxiliary electrical components
- Overheated brakes or mechanical components
- Collision damage
- External ignition sources (arson or adjacent vehicles)

The battery tends only to become involved **if heat propagates**, which well-designed suppression systems should be able to prevent.

1.3 PRACTICAL EXPERIENCE IN CAR PARKS

Although concerns are sometimes raised about the suitability of underground or multi-storey car parks for EVs, there is very little evidence that operators are refusing EVs entry on fire-safety grounds. The limited cases that have been reported tend to be temporary and linked to specific circumstances, such as ongoing refurbishment works, upgrades to fire-protection systems or uncertainty during periods of new regulatory guidance. These are isolated events rather than indicative of an emerging industry trend.

Across the sector, EVs are treated as any other vehicle in the context of day-to-day parking. Operators, insurers, and regulators consistently approach the issue on the basis that the presence of EVs does not materially increase risk when the car park is managed in accordance with modern fire-safety principles.

1.4 THE OPERATOR PERSPECTIVE

If EVs posed a unique hazard themselves, whether charging or not, we would expect to see EVs being prohibited from parking in underground car parks. Instead, what we are seeing is:

- Companies such as **NCP** actively promote EV charging in multi-storey and underground car parks.
- Local authorities increasingly roll out EV charging in basement facilities.
- Temporary restrictions (e.g., **Alder Hey Hospital**, parts of **The Houses of Parliament**) were linked to site-specific sprinkler upgrades, not intrinsic EV risk.

It is also interesting to note that the guidance created by The Office for Zero Emission Vehicles (OZEV) and Arup assumes EVs will be parked and charged in covered car parks. The focus of this document is on mitigation, not prohibition.

Taken together, the general consensus among car-park operators is clear: the normal act of parking an EV does not present a disproportionate risk. It is the act of charging – the additional electrical interface – that requires careful design, installation and ongoing management.

SUMMARY – SECTION ONE: FIRE RISKS WITH EVS

- EVs ignite far less often than ICE vehicles.
- Fire severity is similar between EVs and ICE vehicles.
- Most EV fires do not start in the battery.
- Early suppression can prevent battery involvement.
- Operators accept EV parking; concerns are about charging, not parking.

2. DOES THE ACT OF CHARGING AN EV INCREASE THE RISK OF THAT VEHICLE CATCHING FIRE?

When the nervousness amongst some real estate owners is examined, the perception that *“charging equals danger”* is at the heart of this nervousness. This is understandable given the coverage in some parts of the media of EV charging; however, it is very difficult to find any empirical or evidence to support this fear. A review of incident databases indicates that only around 18–30% of EV fires occur while the vehicle is plugged in or within about an hour of charging. Most EV fires occur while the vehicle is not being charged.

However, applying a reasonable ‘first principles’ approach to this question, charging does introduce additional electrical interfaces: connectors, cables, charging equipment – so it is right, simply on the basis of the change in ‘state’ of the vehicle when charging, to properly examine this. The conclusion that our research led us to was that a focus on the design, specification and workmanship of an installation is very important.

2.1 WHAT HAPPENS WHEN AN EV IS CHARGING?

During the charging process, electrical energy flows from the charging infrastructure through the vehicle's onboard charger (for AC charging) or directly to the battery management system (for DC charging). Throughout this process, the battery temperature rises modestly due to internal resistance and chemical reactions within the cells. However, this temperature increase remains minimal under normal conditions, with active thermal management systems maintaining optimal conditions throughout the charging cycle.

The charging process involves continuous communication between the vehicle and the charging station through protocols such as ISO 15118 or CHAdeMO, ensuring that power delivery matches the vehicle's requirements and current capacity. The Battery Management System continuously monitors individual cell voltages, temperatures, and the overall state of charge, adjusting charging parameters in real-time to maintain safe operation.

TEMPERATURE OPERATING ENVELOPE

Table 3 illustrates the substantial safety margin between normal operating temperatures and critical failure thresholds for both traditional Lithium-Ion batteries and Lithium-Ion Phosphate (LFP) batteries which has become the increasingly popular choice for mainstream EVs:

Temperature Range	LFP (°C)	Lithium-Ion NMC/NCA (°C)	Operational State
Optimal Charging Range	15-35	20-30	Ideal conditions for charging efficiency and battery longevity
Normal Operating Range	0-45	0-45	Safe charging with BMS monitoring
Rapid Charging Peak	40-50	40-50	Typical maximum during rapid charging
BMS Intervention Threshold	55-60	55-60	Charging rate reduced or suspended
Accelerated Degradation	60-80	60-80	Battery stress increases but no immediate danger
Critical Temperature Zone	200-230	80-150	Approaching thermal instability
Thermal Runaway Initiation	>500	160-260	Self-sustaining thermal event possible

Table 3 - Temperature Comparison - LFP vs Traditional Lithium-Ion (NMC/NCA) Batteries

The temperature differential between rapid charging peak temperatures and thermal runaway initiation of between 110°C (traditional Lithium Ion) and 440°C (LFP) show a substantial safety buffer that, combined with multiple active and passive safety systems, makes uncontrolled thermal events during normal charging extremely unlikely.

2.2 BATTERY CHEMISTRY, HEAT GENERATION AND THERMAL STABILITY

Battery chemistry influences heat generation, temperature tolerance and susceptibility to thermal runaway. Modern EVs predominantly use two families of lithium-ion chemistry: Nickel Manganese Cobalt (NMC/NCA) and Lithium Iron Phosphate (LFP). Both operate safely within wide temperature limits, but their thermal characteristics differ.

LFP batteries typically offer:

- Higher thermal-runaway initiation thresholds (often >450–500°C).
- Excellent thermal stability and strong performance under repeated charging cycles.

- Lower energy density but substantially longer cycle life.
- Increasing adoption in mainstream vehicles, such as Tesla Model 3/Y RWD, BYD models and many European entry-segment EVs.

NMC/NCA batteries typically provide:

- Higher energy density and greater performance capability.
- Lower thermal-runaway onset thresholds (**140–250°C**), although still safely above normal operating temperatures.
- Greater heat generation under high charging loads, which is mitigated by active cooling.

Across all chemistries, **thermal-management systems** (liquid cooling loops, refrigeration-based systems, heat pumps, fans and cell-level monitoring) ensure batteries operate within optimal temperature ranges. Charge rate falls automatically when temperatures rise, keeping cells far from thermal-stress thresholds.

These mechanisms mean that uncontrolled temperature rise during compliant charging is exceptionally rare and usually linked to external damage or non-compliant equipment rather than inherent battery behaviour.

2.3 FAST AC CHARGING TEMPERATURE BEHAVIOUR

Charging systems installed in underground and multi-storey car parks typically operate at **7 kW single-phase AC** or **22 kW three-phase AC**. Many 22 kW units function as dual-output chargers, sharing capacity across two connectors. As a result, the actual per-vehicle charging load is modest and well within the limits anticipated by modern EV battery-management systems.

7KW AC CHARGING (MOST COMMON)

- Low current and slow charging rate.
- Minimal heat generation within the battery.
- Battery temperature increase is typically **very small (often <3–5°C)**.
- Thermal-management systems operate intermittently or not at all.
- This mode of charging is inherently stable and ideal for enclosed car parks.

22KW AC CHARGING

- Faster charging, although many vehicles cannot draw the full 22 kW due to onboard charger limitations (commonly capped at 11 kW).
- Even at full output, temperature rise remains modest, with charge rates tapering automatically as temperatures increase.
- In dual-output units, actual power per vehicle is often significantly lower than the rated 22 kW.

WHY AC CHARGING LIMITS THERMAL RISK

- The onboard charger regulates charging current, preventing overheating.
- Battery management systems reduce charge rates as temperatures rise.
- Liquid cooling systems and heat pumps intervene well before any temperature approaches potentially hazardous levels.

Global incident data shows that **fires originating during compliant AC charging are extremely rare**. Events that do occur usually involve:

- Non-compliant or damaged EVSE
- Improvised charging (extension leads or domestic sockets)
- External wiring faults
- Pre-existing battery damage

There is **no evidence** that AC charging at 7–22 kW in underground car parks is a known ignition pathway when infrastructure is correctly designed and maintained.

2.4 STANDARD SAFETY FEATURES IN MODERN ELECTRIC VEHICLES

Contemporary electric vehicles incorporate multiple layers of safety systems that work in concert to prevent thermal events. These systems represent industry-standard technology present in all vehicles from major manufacturers:

- ***Battery Management System (BMS)*** The BMS serves as the primary safety guardian, continuously monitoring cell voltages, temperatures, current flow, and state of charge. It maintains cell balance, prevents overcharging or deep discharge, and can instantly disconnect the battery from charging if any parameter exceeds safe thresholds.
- ***Active Thermal Management Liquid cooling systems*** (or advanced air cooling in some models) maintain optimal battery temperature during charging and operation. These systems pre-condition batteries before fast charging and can dissipate heat more effectively than passive cooling, maintaining temperatures well below critical thresholds even during rapid charging sessions.
- ***Cell-Level Monitoring*** Individual cell voltage and temperature monitoring allows the BMS to identify and isolate problematic cells before they affect neighbouring cells, preventing cascade failures that could lead to thermal propagation.
- ***Charging Rate Modulation*** Dynamic adjustment of charging speed based on battery temperature, state of charge, and ambient conditions ensures that heat generation never exceeds the cooling system's capacity to dissipate it.
- ***Physical Cell Separation and Thermal Barriers*** Fire-resistant barriers between cell groups prevent thermal propagation, while cell spacing and module design facilitate heat dissipation and contain any individual cell failures.
- ***Pressure Relief Mechanisms*** Designed venting systems safely direct any gases away from the passenger compartment in the unlikely event of cell venting, preventing pressure buildup that could lead to rupture.
- ***Electrical Isolation and Ground Fault Detection*** High-voltage systems are fully isolated from the vehicle chassis, with continuous monitoring for ground faults that could create safety hazards or fire risks.
- ***Multi-Level Communication Protocols*** Vehicle-to-charger communication ensures appropriate power delivery, while internal communication networks allow instant response to any detected anomalies.
- ***Redundant Temperature Sensors*** Multiple temperature sensors throughout the battery pack provide redundant monitoring, ensuring that no hot spots go undetected during the charging process.
- ***Emergency Disconnection Systems*** Both automated and manual emergency disconnection systems can instantly isolate the battery in case of detected faults, crashes, or emergency situations.

The convergence of these safety systems creates a robust defensive architecture that maintains battery temperatures at levels far below those associated with thermal runaway risks. The normal charging process, particularly in the controlled environment of an underground car park with stable ambient temperatures, represents one of the safest operational modes for an electric vehicle. The multiple independent safety systems, combined with the significant temperature margin between normal operation and critical failure points, ensures that EV charging in underground facilities poses no greater risk than conventional vehicle operations in the same space.

2.5 REGULATORY POSITION ON EV CHARGING IN CAR PARKS

The regulatory and guidance framework in the UK and Europe treats EV charging in underground car parks as acceptable, provided certain design and management controls are in place.

- *UK building and electrical standards* – The IET *Code of Practice for Electric Vehicle Charging Equipment Installation* and BS 7671:2018+A2:2022 (Section 722) set out requirements for electrical safety, earthing, fault protection, and environmental conditions for EV charge points. Guidance from the IET stresses that installers must also consider location and fire safety when siting EVCPs, not just electrical compliance.
- *Fire-safety specific guidance (RC59)* – The Fire Protection Association's RC59: Recommendations for fire safety when charging electric vehicles has been produced on behalf of major UK insurers. It focuses on fire hazards and risk-control measures for EV charging, including siting, separation distances, structural protection, detection, emergency procedures and management arrangements – this guidance is clear that is *assumes* that EV charging will occur, and frames the issue as one of *control*, not prohibition.
- *OZEV / Arup covered car-park guidance* – The UK Government's Covered car parks: fire safety guidance for electric vehicles explicitly addresses parking and charging EVs in covered and underground car parks. It recommends risk assessment, suitable siting of charge points, consideration of suppression and smoke control, and operational controls. Crucially, it does not advise banning charging in underground car parks; instead, it provides a framework for doing it safely.
- *EU Sustainable Transport Forum guidance* – EU-level guidance on fire safety for EVs and charging infrastructure in covered parking spaces similarly focuses on prevention, detection, evacuation, propagation control and firefighting, and explicitly states that EVs do not inherently pose a higher fire risk than ICE vehicles when appropriate measures are in place.

Taken together, these documents show a clear regulatory stance: EV charging in covered and underground car parks is acceptable in principle but must be supported by appropriate design and management.

2.6 FIRE SUPPRESSION AND EXTINGUISHMENT CONSIDERATIONS

EV fires are uncommon, but when they do occur the extinguishing process can differ slightly from fires involving internal combustion engine vehicles. This does not mean that EV fires are more severe. Instead, the methods used by fire services reflect the way heat can behave within a battery pack.

BATTERY INVOLVEMENT AND DURATION

If a traction battery enters thermal runaway, which is rare and generally the result of significant mechanical damage, the fire may burn for a longer period and require extended cooling. This is because heat can travel between cells within the battery pack. If not cooled sufficiently, some cells may re-ignite.

FIRE SERVICE APPROACH

Fire and Rescue Services in the UK increasingly use established EV response tactics which include:

- applying large volumes of water to cool the battery pack
- using water mist or fog for compartment cooling
- monitoring the vehicle for re-ignition risk

- using specialist equipment such as fire blankets or, in limited scenarios, immersion quenching

These methods differ from traditional vehicle fire response, but they are well established and part of national operational learning. Importantly, EV fires do not usually require more water than a large diesel or commercial vehicle fire.

IMPLICATIONS FOR UNDERGROUND CAR PARKS

Fire safety organisations, including RISE and the Fire Protection Association, note that the challenges associated with extinguishing an EV fire do not mean that EVs pose a greater ignition risk. Instead, they underline the importance of measures that are already common in modern car parks. These include:

- effective detection and alarm systems
- working smoke extraction and ventilation
- clear access routes for attending crews
- suitable spacing between parking bays
- suppression systems, where installed, that are designed for the fire load of modern vehicles rather than battery involvement alone.

Full-scale testing reviewed by RISE confirms that peak heat-release rates for EV and ICE vehicles are broadly similar. The main difference relates to the potential duration of an incident, not the intensity of the fire.

CONTEXT AND PROPORTIONALITY

The perception that EV fires are difficult to extinguish often arises from media reporting rather than operational reality. The challenge is usually related to accessing the battery pack rather than the fire being uncontrollable. Once the battery is adequately cooled, the vehicle can be removed and monitored in a safe area. Fire services globally now train specifically for EV incidents, and their guidance is aligned with the view that EVs in underground car parks do not require a fundamentally different fire safety strategy.

Taken together, the evidence shows that EV fires, while sometimes requiring longer cooling times, remain entirely manageable within established fire safety frameworks for covered and underground car parks.

2.7 EV CHARGING EQUIPMENT AND INSTALLATION PRACTICE

EV charging equipment (EVSE) adds a second layer of protection outside the vehicle. Modern EVSE is designed to:

- Monitor current, fault currents and insulation resistance.
- Communicate with the vehicle to agree charging rates and disconnect safely.
- Interrupt supply automatically if faults, ground leakage, or overheating are detected.

Guidance from the Fire Protection Association (RC59), risk-management advisers and the IET emphasises several **practical risk-control measures** for car parks:

- *Siting and layout* – locate charge points away from primary escape routes, critical structural elements and obvious ignition hazards; provide adequate spacing between bays to reduce fire spread potential.
- *Protection and detection* – provide appropriate electrical protection, fire detection and, where feasible, suppression (e.g. sprinklers) in charging zones within covered or underground car parks.
- *Management controls* – prohibit the use of domestic extension leads and improvised connections, enforce maintenance and inspection regimes, and integrate charging policies into wider fire-risk assessments.

Incident data suggest that when EV fires do occur, **only a minority are directly associated with active charging**, and many of those involve defective or non-compliant equipment rather than type-approved EVSE. This is broadly comparable to experience with other high-load electrical equipment: the risk is manageable when appropriate standards and controls are applied.

SUMMARY - SECTION TWO (A): BATTERY CHEMISTRY, THERMAL BEHAVIOUR, AND CHARGING RISK

- LFP and NMC/NCA batteries have different properties, but all incorporate robust thermal-management systems.
- Temperature rise during 7–22 kW AC charging in underground car parks is minimal.
- Vehicle battery-management systems taper charge rates automatically to prevent overheating.
- Modern EVSE provides multiple layers of electrical protection and automatic disconnection.
- Charging-related incidents are rare and usually linked to non-compliant or damaged equipment rather than type-approved installations.
- EV fires may take longer to cool, but they are fully manageable within existing fire-safety frameworks for underground car parks.

SECTION TWO (B): REGULATORY POSITION & INDUSTRY GUIDANCE

- UK and EU regulations permit EV charging in covered and underground car parks with proportionate safety controls.
- BS 7671, the IET Code of Practice and insurer-led RC59 set clear expectations for safe electrical installation and fire-risk mitigation.
- OZEV and Arup guidance focuses on safe design, siting and management rather than restricting EVs.
- European guidance similarly states that EVs do not present higher inherent fire risk than ICE vehicles when appropriate measures are applied.
- The regulatory approach is consistent: controlled installation and management, not prohibition.

3. COMMERCIAL AND OPERATIONAL CONSIDERATIONS FOR LANDLORDS

The technical and regulatory evidence makes clear that EVs and EV charging can be accommodated safely in underground car parks when installations are properly designed and managed. The remaining question for most landlords is therefore not one of safety, but one of **practical implementation**: how EV charging should be funded, operated and integrated into the management of the building.

EV charging is increasingly being viewed as a standard part of building infrastructure, much like lifts, lighting, air conditioning or security systems. As uptake grows, occupiers expect reliable charging provision, and landlords are expected to plan for it as part of long-term asset management. This means thinking not only about the physical installation, but also about **tariffs**, **service-charge treatment**, **utilisation patterns** and **operational responsibilities**.

3.1 DEPLOYMENT STRATEGY

Every building will have different objectives for introducing EV charging. In some cases, the aim is simply to offer a convenient service to residents or staff. In others, the priority may be cost recovery, futureproofing the asset, achieving ESG commitments or supporting a wider mobility strategy. The landlord's "strategic intent" will shape all deployment decisions: the scale of installation, the tariff structure, maintenance arrangements and the financial model.

For portfolio owners and institutional landlords, EV charging is also increasingly tied to leasing strategy. It can influence tenant retention, marketability and even asset valuation, particularly in urban areas where reliable charging access is rare.

3.2 FUNDING MODELS AND TARIFF APPROACHES

There is no single "correct" commercial model; several are used across the UK depending on the nature of the building and the expectations of occupiers.

In residential buildings, fairness and cost transparency tend to be the primary considerations. Many landlords adopt a "cost-recovery approach", where the tariff simply covers electricity consumption, maintenance and back-office fees. In other developments, installation costs may be recovered gradually through the service charge, with EV users repaying the investment over time. This approach tends to minimise disputes where non-EV residents are concerned about cross-subsidising infrastructure they do not use.

In commercial or mixed-use buildings, a more flexible approach is common. Landlords may choose to operate charging on a "breakeven basis", or they may set tariffs on "commercial basis" to offset wider service charge costs. In some high turnover locations, particularly those with visitor or retail demand, a small revenue surplus can be generated without undermining the attractiveness of the service. Conversely, some employers and corporate campuses opt for "subsidised charging" as an ESG initiative to encourage staff adoption through private energy contracts with providers.

Public rapid charging networks in cities now regularly exceed **70-80p/kWh**, especially where drivers rely on on-street charging. By contrast, AC charging installed in private car parks typically falls within a more stable range of approximately **40–60p/kWh**, depending on energy contracts and operational aims. For many buildings, the objective is not to compete with public rapid charging, but to offer a predictable and well-managed alternative at a sensible rate.

3.3 CAPEX, SERVICE CHARGE AND OPERATIONAL RESPONSIBILITY

A key question for landlords is how capital expenditure should be treated. In single let buildings, the tenant may choose to fund installation directly as part of its occupational requirements. In multi let commercial buildings, the landlord typically funds the infrastructure and recovers costs either through the service charge or through tariff revenue. The nature of the lease and service charge provisions will determine which approach is appropriate.

In residential blocks, service charge rules and resident engagement are particularly important. Where EV charging is considered a communal facility, installation and long-term maintenance can be added into the service charge, provided residents understand why, and that tariff structures fairly allocate running costs to users.

Regardless of funding structure, landlords must also consider operational responsibilities. Charging systems require periodic inspection, software updates, metering accuracy checks, and in some cases load management oversight. Clarity about who performs these functions - the landlord, managing agent or a third-party operator - is essential for ensuring reliability and compliance.

3.4 HOW BUILDING TYPE INFLUENCES THE COMMERCIAL APPROACH

The appropriate model will vary depending on the nature of the asset.

In multi-family residential buildings, the priority is ease of use and cost neutrality. Residents value predictability, and tariff structures that recover costs without generating profit tend to be the most acceptable. In multi let offices, the landlord often retains control of the car park and can adopt a more flexible model, balancing cost recovery with operational efficiency. In single let offices, tenants may fund their own provision and manage it internally. Retail and mixed-use environments, where dwell times are shorter, tend to support more commercial tariffs.

What unifies these settings is the need for a **clear understanding and rationale** behind the chosen approach. Occupiers increasingly expect transparency around tariff setting, service charge treatment and the long-term reliability of the system.

3.5 A STRUCTURED APPROACH TO DECISION MAKING

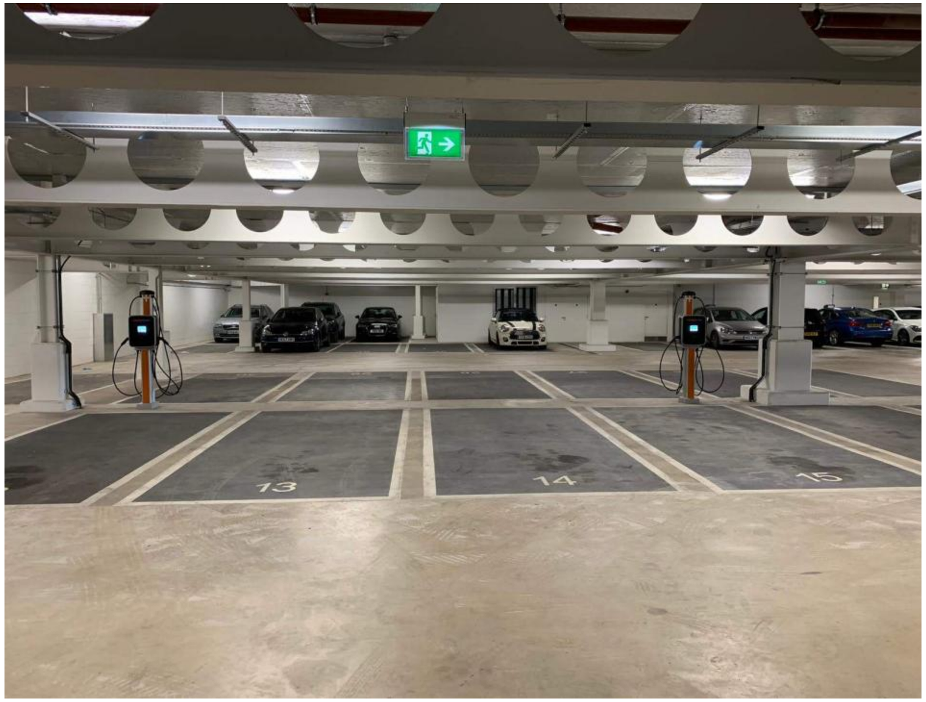
While each site is unique, most landlords benefit from working through a structured set of questions before committing to an installation:

- What is the purpose of offering EV charging, and how does it fit into the broader asset strategy?
- Who will be using the chargers, and what are their likely charging patterns?
- What electrical capacity is available, and how many chargers are required initially and in future?
- Should the landlord fund installation directly, or should costs be recovered through the service charge?
- What tariff approach best reflects the building's objectives and user expectations?
- How will ongoing maintenance, monitoring and emergency procedures be managed?

This process ensures that decisions are transparent, commercially justified and aligned with the long-term operation of the building.

SUMMARY - SECTION THREE: COMMERCIAL & OPERATIONAL CONSIDERATIONS

- Landlords must be clear on their objective for installing EV charging- amenity, compliance, ESG or commercial return.
- Tariff structures range from cost-recovery to revenue-generating, depending on building type and user needs.
- CAPEX treatment varies across residential, multi-let and single-let buildings and must align with lease structures.
- Operational responsibility must be clearly defined to ensure ongoing safety, maintenance, and user management.
- A structured decision-making process supports safe, commercially effective deployment.



4. IMPLICATIONS FOR REAL ESTATE OWNERS: BEST PRACTICE, RISK MANAGEMENT AND STRATEGIC ACTION

Electric vehicles and EV charging infrastructure are no longer optional amenities. EV charging is a **core requirement** for modern commercial and residential real estate. The evidence shows that EVs can be safely accommodated in underground car parks with appropriate design, mitigation, and management. The strategic question for owners is therefore not *whether* to provide underground EV charging, but *how* to implement it in a way that is safe, insurable, futureproof, and commercially advantageous.

This section brings together the **technical best practice** and the strategic implications for asset owners.

4.1 EV CHARGING IS NOW ESSENTIAL CORE INFRASTRUCTURE

EV charging is rapidly becoming an expected building service; indeed, it is a planning requirement for most new developments. By 2035, all new UK vehicles sold will be zero-emission. Without sufficient EV charging:

- Buildings risk becoming obsolete or less competitive.
- Tenants may choose alternative assets with better charging provision.
- Institutional investors may view poor EV provision as a deficiency in ESG and future readiness.

Looking at two specific real estate sectors, multi-family (built-to-rent) residential and offices – where underground parking is a common feature – tenants increasingly regard on-site charging as essential. In offices, workplace charging also supports commuting patterns and corporate sustainability commitments.

EV charging is no longer a nice-to-have - it is fundamental to maintaining asset value.

Where underground car parks are present, landlords must assume that EV charging will be required *unless* sufficient external surface capacity exists to meet long-term demand.

4.2 DESIGN AND RETROFIT: TECHNICAL BEST PRACTICE

SUPPRESSION (SPRINKLERS AND ALTERNATIVES)

Although not legally mandated in all underground car parks, sprinklers are increasingly seen as best practice, especially where multiple vehicles and charging infrastructure are present. For owners, key points are:

- New-build car parks: seriously consider designing in a sprinkler system from the outset. It is often a modest incremental cost compared to the overall structure and can materially reduce future insurance costs and business-interruption risk.
- Existing car parks: where retrofitting full sprinklers is not immediately feasible, explore:
- Targeted suppression or enhanced protection in high-risk areas (e.g. EV charging zones).
- Upgrading smoke and heat ventilation systems and fire detection.
- Phased investment plans to work towards full suppression over time.

Sprinklers remain one of the most effective tools for limiting fire spread between vehicles, protecting structural elements and providing a safer environment for fire and rescue services.

DETECTION, VENTILATION AND COMPARTMENTATION

EVs do not fundamentally change the core duties around detection and smoke/heat management; they reinforce them:

- Detection: provide appropriate fire detection in underground and enclosed car parks, with clear alarm and response procedures.
- Ventilation: ensure mechanical smoke and heat ventilation systems are designed (or upgraded) for modern vehicle fire loads, whether EV or ICE.
- Compartmentation: where possible, use layout, fire-resisting construction, and separation distances to reduce the likelihood of multi-vehicle fires and to protect escape routes.

SITING AND LAYOUT OF EV CHARGING INFRASTRUCTURE

Charging points should be treated as important but manageable assets within the car park layout. Good practice includes:

- Locating charge points away from main escape routes, protected stair cores, and key structural elements.
- Avoiding tight clusters of chargers in locations where a single fire could easily involve many vehicles.
- Providing adequate spacing between bays, particularly in dedicated charging areas, to reduce the risk of rapid fire spread.
- Considering how fire and rescue services would access a vehicle at a charge point in the event of a fire.

These measures are aligned with the expectations set out in RC59, the IET Code of Practice and government guidance on covered car parks.

ELECTRICAL DESIGN AND COMPLIANCE

Owners should satisfy themselves that all EV charging infrastructure is:

- Designed and installed by competent contractors in accordance with BS 7671 and the IET Code of Practice.
- Supported by appropriate protective devices (RCDs, overcurrent protection, isolation, surge protection as required).
- Commissioned and tested before being put into service, with clear documentation retained.

In many cases, owners will not design the systems themselves, but they remain responsible for ensuring that competent parties have done so and that records exist to demonstrate compliance.

4.3 OPERATIONAL MANAGEMENT AND PROCEDURES

Technical measures are only effective if supported by sensible day-to-day management. For underground car parks with EV charging, owners should consider:

- ***Charging policies:*** prohibit the use of domestic extension leads, multi-way adaptors and improvised connections. Require users to use only the installed EVSE and manufacturer-approved cables.
- ***Inspection and maintenance:*** establish routine inspection of chargers, cabling, signage, and associated systems; act quickly on damage, faults or misuse.
- ***Fire risk assessment:*** explicitly include EV parking and charging within the formal fire risk assessment, documenting assumptions and control measures.
- ***Emergency procedures:*** ensure that incident response plans account for the possibility of an EV fire, including isolation of power to charging circuits and liaison with local fire and rescue services.
- ***Record-keeping*** maintain up-to-date records of installations, inspections, incidents and remedial actions. These support both compliance and discussions with insurers.

The aim is to integrate EV charging into existing safety management systems rather than treat it as an entirely separate discipline. These steps make EV charging a routine managed activity rather than a perceived risk anomaly.

4.4 WORKING WITH INSURERS AND OTHER STAKEHOLDERS

Insurers are key stakeholders in the evolution of EV charging in underground car parks. Their concern is primarily about severity and uncertainty, not about day-to-day operations when equipment and management are sound.

Real estate owners can improve outcomes by:

- ***Engaging early:*** discuss proposed EV charging schemes with insurers before implementation. Share design information, risk assessments and planned control measures.

- ***Aligning with recognised guidance:*** referencing documents such as RC59, the IET Code of Practice and OZEV/Arup guidance helps demonstrate that the scheme reflects current best practice.
- ***Highlighting mitigation:*** emphasise any sprinklers, enhanced detection, ventilation improvements or management controls that reduce risk.
- ***Reviewing terms regularly:*** use renewal discussions as an opportunity to update insurers on improvements and to seek more favourable terms over time.

Engagement should not be a one-off event at installation, but an ongoing dialogue as technology, guidance and the asset itself evolves.

4.5 COMMUNICATION WITH OCCUPIERS AND USERS

Finally, owners should not underestimate the importance of clear communication with occupiers, residents and users of the car park. Media coverage of EV fires has, in some cases, created an exaggerated perception of risk.

Good practice includes:

- ***Providing concise, information*** about how EVs and charging are managed safely on site.
- ***Explaining any house rules*** (e.g. no extension leads, reporting damage, adhering to marked EV bays).
- ***Reassuring users*** that the design and management of the car park reflect current guidance and insurance expectations.
- This helps to build confidence and reduce the likelihood of ad-hoc restrictions being imposed in response to individual concerns.

4.6 FINANCING AND SERVICE CHARGE RECOVERY

Many safety and charging-related investments may be recoverable under service charge provisions, including:

- Fire-safety upgrades (sprinklers, detection, ventilation improvements).
- Electrical infrastructure supporting EVSE.
- Works required to comply with guidance or maintain insurability.

Owners should seek legal advice on a building-specific basis, but in many cases, these investments can be treated as essential plant or safety measures.

Futureproofing measures (e.g., spare ducting, risers, containment) should also be considered; installing them early reduces future retrofit costs significantly.

SUMMARY – SECTION FOUR: IMPLICATIONS FOR OWNERS

- Many safety and charging related investments may be recoverable under service charge provisions, including:
- Fire safety upgrades (sprinklers, detection, ventilation improvements).
- Electrical infrastructure supporting EVSE.
- Works required to comply with guidance or maintain insurability.
- Owners should seek legal advice on a building specific basis, but in many cases, these investments can be treated as essential plant or safety measures.
- Futureproofing measures (e.g., spare ducting, risers, containment) should also be considered; installing them early reduces future retrofit costs significantly.

5. DEPLOYMENT ROADMAP FOR EV CHARGING IN UNDERGROUND CAR PARKS

Introducing EV charging into an underground car park is most effective when approached as a structured process. Having considered the regulatory, technical and commercial context for EV charging in underground car parks, the final step is understanding how these principles are applied in practice.

The following roadmap sets out a structured approach that landlords and managing agents can use to plan, design and deliver safe and reliable EV charging infrastructure within their buildings. It draws together the evidence and considerations outlined earlier and translates them into a clear, practical sequence of actions.

5.1 FEASIBILITY AND INITIAL ASSESSMENT

The first stage is to understand the practical limitations of the site. This includes reviewing the available electrical capacity, the condition of existing wiring, the fire strategy for the car park, ventilation arrangements and any structural constraints that may influence charger placement.

5.2 RISK ASSESSMENTS

A compliant installation will typically require:

- an updated Fire Risk Assessment (FRA),
- an assessment of electrical capacity or a DNO enquiry,
- and, where necessary, an electrical-installation condition report.

These assessments ensure that the installation meets safety obligations and that the proposed infrastructure is compatible with the building's broader risk-management framework.

5.3 DESIGN AND SPECIFICATION

Once assessments have been conducted, the design phase determines the type, number and positioning of chargers, cable routing, containment, signage and the integration with fire-safety systems. Early consideration should also be given to access controls, payment systems, load management and future expansion.

5.4 COMMERCIAL PLANNING

The design stage should proceed in parallel with commercial modelling. Tariff structures, service charge treatment, utilisation forecasts and CAPEX funding routes all influence the scale and nature of the installation. Making these decisions early ensures clarity for occupiers and enables the project to be delivered efficiently.

5.5 INSTALLATION AND COMMISSIONING

Installation should be carried out by competent contractors familiar with EV charging systems and underground environments. Upon completion, the system must be tested, commissioned and certified in accordance with relevant manufacturer requirements. Back-office systems, billing and monitoring mechanisms should be configured at this stage.

5.6 ONGOING OPERATION AND MANAGEMENT

Once installed, the charging system becomes part of the building's operational infrastructure. Routine inspections, maintenance, firmware updates and performance monitoring are essential. Clear processes should be in place for user support, fault reporting and emergency procedures to ensure long-term reliability and safety.

By approaching EV charging deployment in this structured way, building owners can manage safety, commercial performance and operational reliability properly. The roadmap demonstrates that providing charging in underground car parks is not a high-risk project, but a manageable process when carried out in accordance with recognised standards and modern fire-safety principles.

SUMMARY – SECTION FIVE: DEPLOYMENT ROADMAP

- A successful installation begins with feasibility and fire-risk assessments.
- Design must consider charger type, siting, containment, detection, load management and future capacity.
- Installation and commissioning must follow recognised standards and competent practice.
- Operational arrangements - maintenance, monitoring, software updates and user procedures - are critical to long-term reliability.
- EV charging in underground car parks is a manageable process when approached methodically.

6. SUMMARY AND RECOMMENDATIONS

The evidence reviewed in this paper leads to a clear overall conclusion:

- EVs are less likely to catch fire than ICE vehicles.
- When EV fires occur, their severity is broadly comparable to modern ICE vehicle fires.
- Most EV fires do not start in the battery, and many are unrelated to charging.
- The key differences in EV fires - longer duration and potential re-ignition - are manageable within modern fire-engineering practice.

From a real estate owner's perspective, the implications are practical rather than theoretical. The presence of EVs and EV charging in underground car parks does not require a fundamental rethink of fire safety, but it does strengthen the case for:

1) Investing in robust core protection

- Strongly consider sprinklers or other suppression systems, especially in new-build car parks and EV charging zones.
- Ensure detection, alarm and ventilation systems are modern, maintained and suitable for today's vehicle fire loads.

2) Designing and operating EV charging infrastructure carefully.

- Follow recognised standards (BS 7671, IET Code of Practice, RC59) and government guidance for covered car parks.
- Pay close attention to siting, spacing, structural protection and emergency access.

3) Embedding EV risks into existing management systems

- Incorporate EV parking and charging explicitly into fire risk assessments, policies and procedures.
- Implement clear rules for users and robust inspection and maintenance regimes for charging equipment.

4) Working constructively with insurers and regulators

- Use guidance and evidence to support a rational, proportionate approach to EV risk.
- Present improvements and control measures clearly in renewal and planning discussions.

In short, the right question for owners is not, "Should we allow EVs or EV charging in underground car parks?" but rather:

"How do we design, operate and insure our underground car parks so that EVs and charging are safely integrated into normal practice?"

Handled in this way, EVs are not a new, existential threat to underground car parks but an important catalyst for raising overall standards of fire safety, resilience and asset management.

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