Standards & Engagement

The Impact of E-Mobility Battery Fires in NYC

The Economic, Human, and Community Toll

Table of Contents

Introduction

E-mobility has transformed urban transportation in New York City, with e-bike and e-scooter ridership surging in the past five years. The city's dense population, traffic congestion, and the booming delivery market have driven a rapid adoption of these lithium-ion battery-powered vehicles.

However, the proliferation of uncertified devices and inadequate public safety awareness have also led to a sharp increase in e-mobility related battery fires during this timeframe. The frequency and severity of these fires have threatened public safety and are associated with widespread disruptions and economic losses.

To further understand the implications of these fires in New York City, this white paper, designed by UL Standards & Engagement, presents results from ULSE surveys of e-mobility consumer behavior, along with safety science and engineering expertise on lithium-ion batteries and thermal runaway risks from UL Solutions and UL Research Institutes, as well as estimates of e-mobility battery fire incident trends and associated economic costs as calculated by Oxford Economics — a global leader in economic forecasting and quantitative analysis.

Using data on lithium-ion battery fire incidents between 2019 and 2023 from the Fire Department of the City of New York, Oxford Economics estimates that since 2019, e-mobility device-related battery fires in New York City have culminated in as many as 465 e-mobility battery fire incidents.

The Oxford Economics analysis goes on to estimate that between 2019 and 2023, fatalities, injuries, and structural property damage from e-mobility battery fires have conservatively cost New York City up to $518.6 million in damage and loss. Moreover, the economic cost from these incidents has also grown substantially in recent years.

As a result, in 2023, Mayor Eric Adams signed NYC Local Law 39 into law, which prohibits the sale, rental, lease, or distribution of e-mobility devices and storage batteries that don't meet ULSE safety standards. Following this, in July 2024, Governor Katherine Hochul signed a raft of legislation aimed at increasing the safe use of e-bikes and lithium-ion batteries across New York State.[i]

Between 2019 and 2023, it's estimated that there has been:

465
e-mobility battery fire incidents

$518.6 M
in damage & loss

Safety Challenges

Low-cost imports & consumer awareness

Reported increases in lithium-ion battery fires have come in conjunction with a notable increase in imports of relatively low-cost e-mobility devices.

While the promise of affordable e-mobility options is enticing, low-cost lithium-ion batteries often come with a hefty price tag in terms of safety. These batteries, which may be produced in factories with more lax quality control, are frequently made with uncertified materials and lack the essential safety features found in their certified counterparts.

Certified batteries typically undergo rigorous testing to ensure they comply with consensus safety standards developed by experts, which include requirements like short-circuit prevention and safeguards against thermal runaway — a state of uncontrollable heat that can result in fire or explosion if the lithium-ion battery is damaged, overcharged, or defective. Unlike conventional fires, lithium-ion battery fires are intense, fast, and difficult to extinguish.

Low-cost, uncertified batteries may lack these vital safeguards and put consumers in harm's way. Defective wiring, loose connections, and the potential for thermal runaway can lead to fires, explosions, and other serious accidents. Moreover, the use of harmful chemicals in these batteries can pose environmental hazards if misused or not disposed of properly.

In addition to the proliferation of low-cost (often uncertified) devices, inadequate public safety awareness around e-mobility battery safety has likely also contributed to the problem. A May 2024 UL Standards & Engagement report found that more than half of e-bike owners (53%) and e-scooter owners (54%) are unaware that their vehicles are powered by lithium-ion batteries. Not understanding what powers their e-mobility devices leads to not appreciating the risks behind the technology, as 44% of Americans said they were unaware of thermal runaway risks associated with overheating batteries.

Compounding this issue, many users report receiving inadequate information — or little to no information — from manufacturers and retailers regarding battery safety and proper charging practices. A separate UL Standards & Engagement survey of 173 e-mobility users in the NYC metro area between April and August 2024 found that more than two-thirds (67%) leave their e-bikes or e-scooters plugged in even after reaching full charge.

Furthermore, a significant number of New York City e-mobility owners (32%) routinely charge overnight, and nearly one in five (17%) charge them unattended while away from home. Among those who typically charge their e-bikes at home, two-thirds (66%) charge them in a location that blocks easy egress in case of a battery fire — most commonly in the entryway or by the front door, or in hallways. This educational deficit extends to neglecting routine maintenance, another factor that increases the risk of batteries going into thermal runaway.

These risky charging practices and lack of safety awareness have led to a disproportionate impact on specific urban areas. The boroughs of Brooklyn, Queens, and the Bronx experienced the highest frequency of such incidents in 2021 and 2022, according to *The City* newspaper's analysis of structural fires. The analysis goes on to note that these ZIP codes also tend to be predominantly low-income areas, and that the overwhelming majority of these fires occurred within residential buildings, including NYC Housing Authority public housing properties, multi-family dwellings, and private homes.

The safety standards that UL Standards & Engagement develops for e-mobility vehicles and lithium-ion batteries support consumer safety by minimizing the risks and mitigating hazards. When products comply with a standard, consumers are assured that they can withstand demanding, normal-use conditions without presenting a risk of danger or injury. However, among New York City e-mobility owners, 54% have heard or read little to nothing at all about safety standards for lithium-ion batteries. Similarly, 54% have heard or read little to nothing at all about safety standards for e-bikes and e-scooters.

Among NYC e-mobility owners who typically charge their e-bikes at home, two-thirds (66%) charge them in a location that blocks easy egress in case of a battery fire, most commonly in the entryway or by the front door, or in hallways.

E-Mobility Battery Fires

An 8x increase from 2019 to 2023

Analysis from Oxford Economics shows that the number of e-mobility battery fires has sharply increased in recent years. This increase corresponds with the rise in low-cost e-mobility imports and the overall growth in number of devices in NYC.

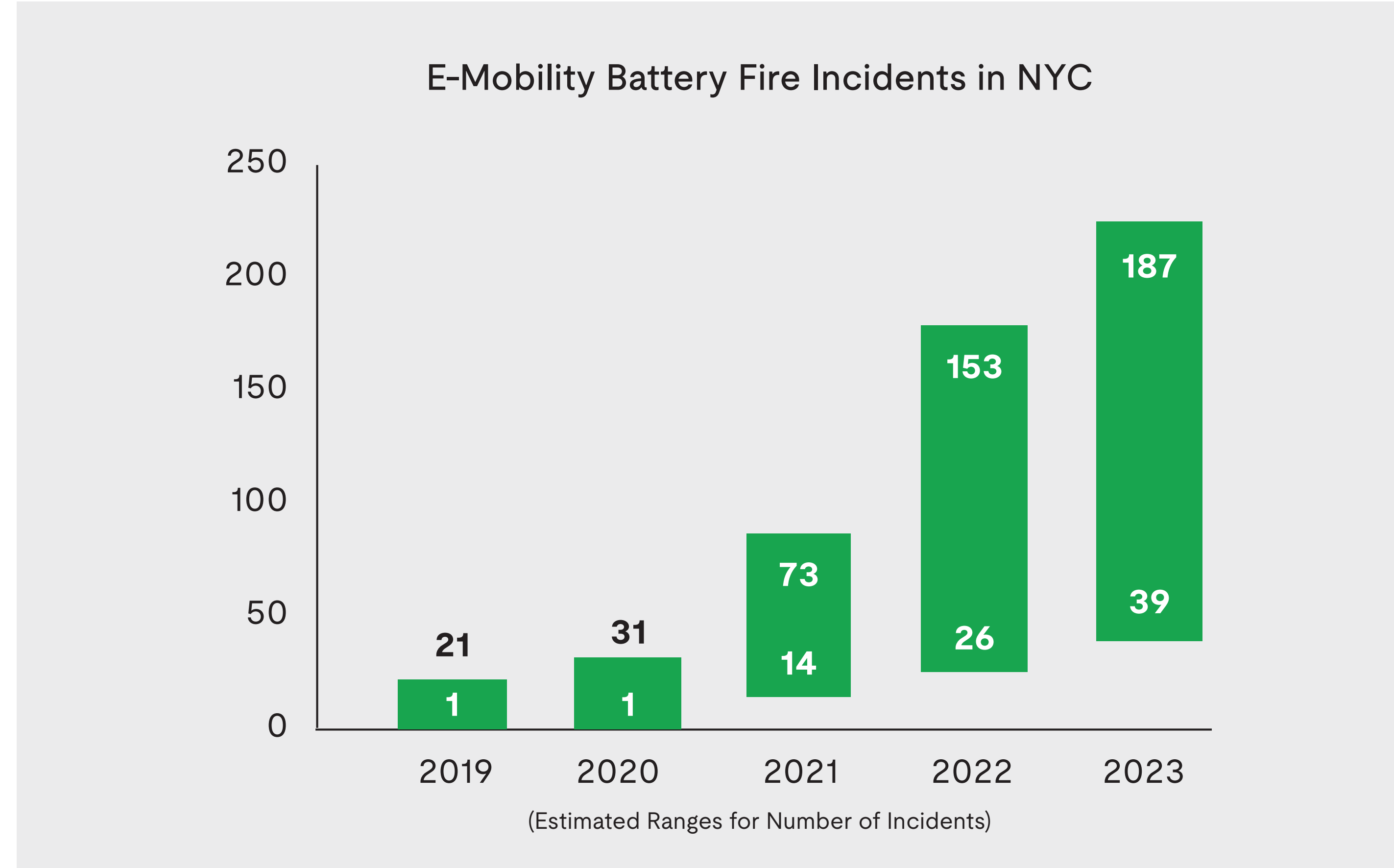
Using incident data collected by the FDNY Bureau of Fire Investigation, the UL Solutions Li-Ion Battery Fire Incident Database, and the U.S. Consumer Product Safety Commission's National Injury Information Clearinghouse, Oxford Economics estimates that in 2019, there were as many as 21 e-mobility battery fires in New York City, and by 2023, that figure had dramatically increased to as high as 187 — a nearly 800% increase.

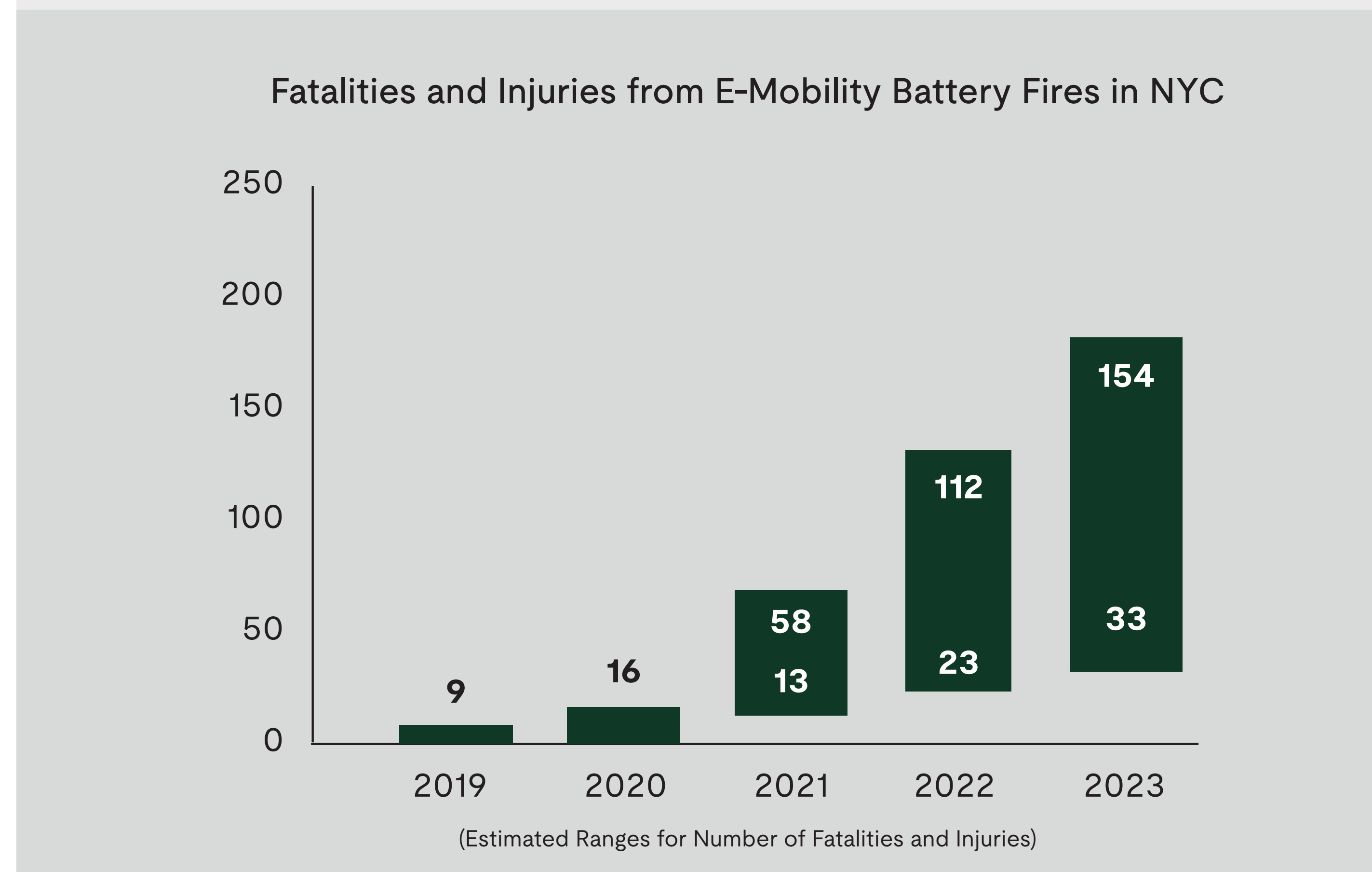
The figure, "E-Mobility Battery Fire Incidents in New NYC," shows Oxford Economics' lower- and upper-bound estimates of e-mobility battery fire incidents in New York City, based on a range of data from available sources. Lower-bound estimates, in general, are from CPSC National Injury Information Clearinghouse and UL Solutions Li-Ion Battery Fire Incident Database, whereas the upper-bound estimates reflect the e-mobility-specific estimates derived using hard counts reported by the FDNY. For complete details on data selection, please see the Methodology section.

The figure, "Fatalities and Injuries from E-Mobility Battery Fires in NYC," shows Oxford Economics' lower- and upper-bound estimates of e-mobility battery fire related fatalities and injuries in New York City. In 2021, there were as many as 58 e-mobility related fatalities and injuries in NYC, and by 2023, that figure is estimated to be as high as 154.

For 2021, the estimated number of fatalities (13 deaths) directly attributed to *e-mobility lithium-ion battery incidents* contrasts with the overall number of fatalities (18 deaths) resulting from *all lithium-ion battery incidents* in New York City. The higher, widely cited figure in news outlets and some government press releases, encompasses a broader scope of lithium-ion battery applications such as rechargeable power tools and cordless vacuum cleaners. Conversely, the more specific count of 13 fatalities focuses predominantly on e-mobility incidents, as in those involving e-bikes and e-scooters.

Oxford Economics estimates that, in 2023, e-mobility battery fires resulted in an estimated 124 incidents of structural property damage, bringing the cumulative total since 2019 to 333 incidents. For additional details on estimates, please see the Methodology section on Oxford Economics approach.





E-Mobility Safety in NYC

A $519 million case

E-mobility battery fires between 2019 and 2023 may have resulted in as many as 25 fatalities, 324 injuries, and 333 incidents of structural property damage — conservatively costing New York City up to $518.6 million in damage and loss.

The Oxford Economics analysis estimates the overall economic costs of e-mobility battery fires in NYC[ii] as a sum of these three main elements and provides a conservative estimate of the overall impact:

1. The number of lives lost due to e-mobility battery fires
2. The number and extent of injuries sustained from e-mobility battery fires
3. The number of properties damaged due to e-mobility battery fires

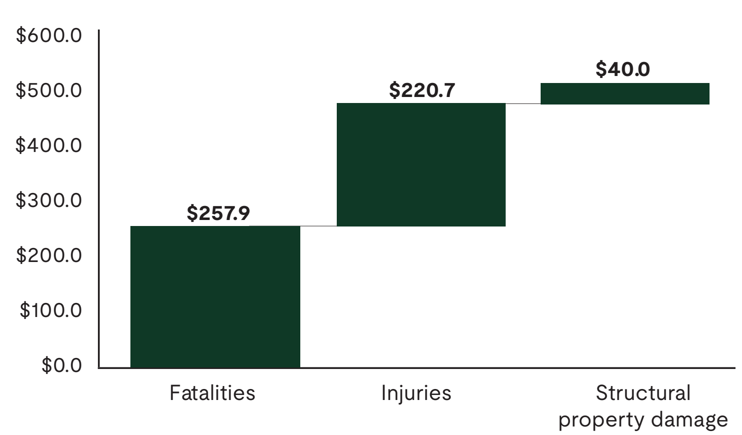
Additionally, the analysis does not account for the cost of damage associated with non-structural fires due to the lack of reliable data on both the exact type of these fires (i.e., location, type of materials involved) and their associated unit costs.[iii]

For 2023, Oxford Economics estimates fatalities and reported injuries from e-mobility battery fire incidents registered costs between $200.3 million to $245.1 million, as well as $6.9 million to $13.2 million for structural property damages from those fires. The overall economic costs of e-mobility battery fires in NYC last year were as high as $258.3 million in damage and loss — a marked increase from 2019's $8.1 million estimate.

The Oxford Economics analysis reveals a dramatic increase in the frequency and severity of e-mobility battery fires in New York City since 2019, with associated economic costs also growing substantially. Due to limited data on the nature of e-mobility battery fire incidents, such as the types of injuries, details around who sustains these injuries, and extent of structural property damage they cause, Oxford Economics made conservative assumptions that likely understate true costs.

Despite Oxford Economics' conservative approach, the estimated costs of these fires, including property damage, injuries, and fatalities, range from $376.4 million to $518.6 million between 2019 and 2023. Given underreporting and the conservative assumptions reflected in Oxford Economics' estimates, these costs may be much larger.

Economic Cost of E-Mobility Battery Fires in NYC 2019-2023, $ Millions



Source: FDNY, Oxford Economics

Costs Associated with E-Mobility Battery Fire Events (2019-2023), $ Millions

All costs are in 2023 prices, unless otherwise stated. Source: Oxford Economics

Year	Fatalities Cost	Injuries Cost	Structural Property Damage Cost	Total Cost
2019	0.0	3.0 - 6.7	0.5 - 1.3	3.5 - 8.1
2020	0.0	5.3 - 11.9	0.8 - 2.2	6.1 - 14.0
2021	36.8	18.2 - 31.4	7.0 - 9.3	62.0 - 77.5
2022	55.3	33.8 - 91.4	8.5 - 14.0	97.6 - 160.7
2023	165.8	34.5 - 79.3	6.9 - 13.2	207.2 - 258.3

Oxford Economics' Estimation Process

Estimating cost of fatalities

To estimate the cost of loss of life, Oxford Economics multiplied the FDNY's count of the number of fatalities resulting from e-mobility battery fires by the U.S. Department of Transportation's "Value of a Statistical Life," a measure used by the U.S. DoT to quantify the monetary value of preventing a fatality.[iv] The VSL, with 2023 as a base year, is an estimated $13.2 million for each life.[v]

Estimating cost of injuries

Unlike fatalities, injuries vary widely in severity, leading to a range of impacts on quality of life, including pain, suffering, and lost income. As such, the costs associated with non-fatal injuries are subject to variation — and therefore, uncertainty. In line with U.S. DoT and U.S. Office of Management and Budget guidance, Oxford Economics calculated a range for injury costs as fractions of the VSL, depending on the severity of injuries.

Estimating cost of structural property damage

To estimate a cost range for property damage caused by e-mobility battery fires, Oxford Economics multiplied the number of structural fires related to e-mobility batteries from FDNY data by a range of property damage costs, including data from the National Fire Protection Association and the Insurance Information Institute. The analysis considered structural fires of New York City Housing Association properties (broken out in the FDNY reporting) separately to all other structural fires.[vi]

For detailed estimate construction, see Methodology for Economic Cost Analysis of Battery Fires in NYC

Conclusion & Recommendations

The rapid proliferation of e-bikes and e-scooters in New York City has transformed urban transportation. E-bike trips on the city's shared e-bike system are at all-time highs,[vii] and tens of thousands of delivery workers rely on electric bikes and mopeds for their livelihoods.

This growth has also come with significant risks. The surge in incidents involving lithium-ion battery fires, particularly those associated with uncertified e-mobility devices, has posed a serious threat to public safety and inflicted substantial economic costs on the city.

Recent regulations enacted by New York City and New York State are a positive step in laying a foundation for improved safety, but more comprehensive efforts are required. ULSE's ongoing advocacy, partnership, and research efforts on the topic indicate a critical need for a multifaceted approach to address challenges posed by e-mobility adoption. To bridge the gap between current efforts and a comprehensive safety framework, ULSE proposes the following recommendations:

1. **Strengthened enforcement:** Rigorous enforcement of safety standards for e-mobility devices and the batteries that power them is crucial to prevent the sale and distribution of unsafe and uncertified devices that have led to the recent spate of fires.
2. **Public education campaigns:** Increased awareness of e-mobility battery safety among consumers is essential. This includes educating users about proper charging practices, maintenance, and the risks associated with uncertified devices.
3. **Targeted initiatives for delivery workers:** Increasing participation in trade-in programs intended to remove unsafe and uncertified devices off the street is essential in reducing harm to New Yorkers and potential fires in the future. Other initiatives, such as battery swap programs and public charging stations for delivery workers, can be equally important.
4. **Strengthen and enhance data collection:** Implementing a standardized incident reporting framework for e-mobility battery fires will provide crucial insights on injury types, affected individuals, and property damage extent. These efforts would enable more accurate risk assessments and help inform targeted safety interventions.

Potential Drivers of the Rising Economic Burden:

Low-cost, uncertified devices:
The influx of relatively low-cost e-mobility devices has contributed to the problem. These devices are rarely certified to recognized industry safety standards and often come with substandard batteries that lack essential safety features.

Inadequate public safety awareness:
Many e-mobility users are unaware of the risks associated with lithium-ion batteries, including the potential for thermal runaway. This lack of knowledge has led to unsafe charging practices and a neglect of routine maintenance.

Methodology for economic cost analysis of battery fires in NYC

The modelling and results presented here are based on information provided by third parties, upon which **Oxford Economics** has relied in producing its report and estimates in good faith. Any subsequent revision or update of those data will affect the assessments and projections shown.

To derive ranges for estimates of fire incidents and associated costs, Oxford Economics considered several indicators collected by FDNY, CPSC, NII Clearinghouse, and the UL Solutions Li-Ion Battery Fire Incident Database, including: number of e-mobility-related lithium-ion battery fire incidents; number of fatalities associated with such incidents; number and severity of injuries associated with such incidents; and number of such incidents that involve structural property damage, including NYCHA properties. Note that Oxford Economics does not account for the cost of damage associated with non-structural fires due to a lack of data.

Summary of Data Sources Used in the Oxford Economics Analysis

Variable Used	Time Period
FDNY	
Count of lithium-ion fire investigations	2019-2023
Count of lithium-ion fire injuries	2019-2023
Count of lithium-ion fire fatalities	2019-2023
Count of structural lithium-ion fires	2019-2023
Count of non-structural lithium-ion fires	2019-2023
Count of lithium-ion fires in NYCHA properties	2019-2023
Count of e-mobility device related lithium-ion battery fires	2023
UL Solutions Li-Ion Battery Fire Incident Database	
Count of lithium-ion fire incidents	2019-2023
Count of lithium-ion fire injuries	2019-2023
Count of lithium-ion fire fatalities	2019-2023
CPSC Clearinghouse	
Severity of injuries associated with batteries/e-systems of e-bikes	2021-2023

Overall, limited detailed data exists on e-mobility-related fires in New York City, as well as more generally around the United States. The primary sources available for the analysis are described below:

The Fire Department of the City of New York
FDNY, which tracks information collected as part of its investigations. Where available, the Oxford Economics analysis prioritizes data from the FDNY given its greater reliability and representativeness. For example, all key counts — of incidents, injuries, fatalities, etc. — which underpin cost estimates, are from the FDNY.

All counts used in the Oxford Economics analysis are specific to e-mobility device lithium-ion battery fires. While the count of e-mobility device lithium-ion battery fires is available for 2023, all other FDNY data is related to lithium-ion battery fires more generally.

To derive figures specific to e-mobility device battery fires, Oxford Economics assumed that the proportion of all lithium-ion battery fires involving e-mobility devices in 2019-2022 is the same as that observed in 2023. This assumption extends to the number of fatalities, injuries, and fires involving property in 2019-2023.

Oxford Economics supplemented FDNY data with additional detail from other data sources. For example, the firm exploits Clearinghouse information on the distribution of injury severity to estimate injury costs. While FDNY is subject to accountability standards as a public agency, this data has some limitations. For example, to the extent that not all e-mobility-related battery fires are reported to the FDNY, it may underestimate the true frequency of incidents.

UL Solutions
The UL Solutions Li-Ion Battery Fire Incident Database[viii] is a global database of fire-related incidents involving lithium-ion batteries maintained by UL Solutions and compiled from publicly available data sources, news articles, and fire department reports (including FDNY reports). Publicly available data sources used to source data at the time of this assessment include the following (this list is not exhaustive):

- Federal Aviation Administration Lithium Battery Air Incidents
- Consumer Product Safety Commission SaferProducts
- National Electronic Injury Surveillance System
- Department of Transportation Pipeline and Hazardous Materials Safety Administration
- FDNY Communications

The incidents are manually reviewed, spurious results not directly relating to Li-Ion battery incidents and duplicate cases are removed, and the relevant data points are entered into a spreadsheet. Any relevant identifying numbers, such as case numbers, are also linked to the incident in the database so future users can find the original report. A copy of the piece is archived for future reference.

Summary Statistics

Year	Incidents	Fatalities	Injuries	Incidents Involving Property
2019	1-21	0	0-9	16
2020	1-31	0	0-16	26
2021	14-73	1-3	12-55	54
2022	26-153	4-9	19-103	113
2023	39-187	4-13	29-141	124

Source: FDNY, UL Solutions, CPSC NII Clearinghouse, Oxford Economics

The data points collected for each incident are as follows:

- Date (Day, Month, Year)
- Location (City, Country, Region)
- Product information
- Event type – Fire, explosion, venting of gas, swelling of battery, or overheating of battery
- Battery status at the time of event – charging, stored, impact, under repair, or unknown
- Source of data – news, transportation agency database, product safety agency database, etc.
- The total number of injuries and/or fatalities

The UL Solutions database was selected as the source of data for the outcome measures due to the availability of e-bike-related lithium-ion battery incident data at a level of detail sufficient to measure the occurrence of incidents, resulting injuries, and fatalities by month. This is not a capability available in the data provided by the FDNY.

Media articles incorporated into the UL Solutions Lithium-Ion Battery Incident Database are found through Google Alerts. This may be subject to incomplete information or bias due to the use of Google Alerts to source media articles relying on certain search terms.

Consumer Product Safety Commission
The CPSC National Injury Information Clearinghouse dataset, which reflects information collated by the CPSC from three independent sources: official death certificates, Medical Examiner and Coroner reports from MECAPS;[ix] and Injury/Potential Injury Incident files.[x] Data is extracted from these sources on cases related to mopeds or power-assisted cycles[xi] and all injury types arising from hazards associated with batteries of electrical systems of e-bikes. The MECAPS data may be subject to reporting bias or incompleteness since relying on participating Medical Examiners and Coroners choosing to report. Incidents may be under-represented if not all relevant incidents are reported. In addition, IPII files contain data from a range of sources which may vary in their accuracy and verification standards. For example, some data is extracted through press and media coverage and therefore potentially subject to bias.

The table, "Summary Statistics," shows Oxford Economics' lower- and upper-bound estimates of

e-mobility battery fire incidents in New York City, based on a range of data from available sources. Lower-bound estimates in general are from UL Solutions and CPSC Clearinghouse sources, whereas the upper-bound estimates typically reflect the e-mobility-specific estimates derived using hard counts reported by FDNY.

Estimating cost of fatalities
To estimate the cost of loss of life, FDNY's count of the number of fatalities resulting from e-mobility battery fires was multiplied by the U.S. Department of Transportation's "Value of a Statistical Life," a measure used by the U.S. DoT to quantify the monetary value of preventing a fatality.[xii] The VSL is based on a comprehensive assessment of the monetary value of reducing fatalities, designed for use in analyses that assesses the economic benefits of preventing fatalities. The Department of Transportation has estimated the VSL to be $13.2 million for each life with 2023 as a base year.[xiii] The U.S. OMB's guidance on regulatory analysis also recommends a willingness to pay for the prevention of a fatality approach (such as VSL) for monetizing fatality risks.[xiv]

VSL Fractions Applicable to Injuries by Severity Level

Injury Severity Level	Fraction of VSL
Minor	0.003
Moderate	0.047
Serious	0.105
Severe	0.266
Critical	0.593
Unsurvivable	1.000

Source: U.S. Department of Transportation, Oxford Economics

Estimating cost of injuries
While fatalities have uniform cost estimates in the context of regulatory analysis, the costs associated with non-fatal injuries are subject to more variation — and therefore, uncertainty. This is primarily because injuries vary widely in severity, leading to a range of impacts on quality of life, including pain, suffering, and lost income. Given the data's lack of detail on the severity of battery-fire related injuries, Oxford Economics provides a range of cost estimates which depend on assumptions around severity. In line with U.S. DoT and U.S. OMB guidance, they calculated injury costs as fractions of the VSL — with the fractions depending on the severity of injuries. The U.S. DoT recommends specific VSL fractions for six levels of injury severity, as shown in table below. These correspond with the six categories of injury severity on the Maximum Abbreviated Injury Scale, a standardized medical scale commonly used to assess and categorize injury severity.

Oxford Economics obtained the number of injuries each year, which forms the basis of its estimates, from the FDNY data. Without detailed information on the severity of each injury in the Oxford Economics analysis, the firm makes the following conservative assumptions (i.e., these assumptions tend to minimize associated severities and, thus, costs):

> For lower-bound estimate, Oxford Economics assumes that half of all non-fatal injuries each year are "Minor" and half are "Moderate", the two least serious injury severity categories in the DoT's categorization. Oxford Economics calculates the cost of these injuries using the corresponding VSL fractions.

> For upper-bound estimate, Oxford Economics exploits data on the severity distribution of injuries from the CPSC Clearinghouse statistics.[xv] Specifically, Oxford Economics assumes the FDNY count of injuries has a severity distribution like the Clearinghouse data. Oxford Economics then estimates the cost of injuries as the relevant fraction of VSL according to their severity.

Estimating cost of structural property damage
To estimate a cost range for property damage caused by e-mobility battery fires, Oxford Economics first derived the number of structural fires related to e-mobility batteries from FDNY data. It then multiplied this by a range of property damage costs. Oxford Economics considered structural fires of New York City Housing Association properties (broken out in the FDNY reporting) separately to all other structural fires.[xvi] For NYCHA properties, the property damage cost is based on NYCHA's Physical Needs Assessment.[xvii] For all other structural fires, Oxford Economics used property damage costs from two sources: the lower-bound per-property cost estimate comes from National Fire Protection Association research,[xviii] and the upper-bound cost comes from appropriate property damage loss statistics reported by the Insurance Information Institute.[xix] These estimates are conservative since the unit costs in these two sources are based on national property damage data. Oxford Economics expects the property damage costs to be higher in NYC given the higher average property costs.

Additionally, the Oxford Economics analysis did not account for the cost of damage associated with non-structural fires due to the lack of reliable data on both the exact type of these fires (in which type of location they occurred/the type of materials involved) and their associated unit costs.[xx]

Methodology for ULSE insights surveys of NYC metro e-mobility owners

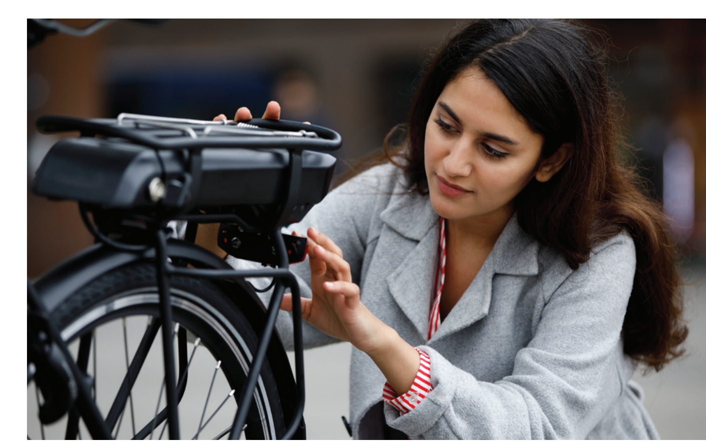
The results are taken from two separate ULSE Insights surveys conducted April 12-21, 2024, and August 20-September 2, 2024. E-mobility owners from the New York Metropolitan Area were oversampled in order to provide more precise estimates of their opinions and experiences.

Precise data on the number of adults in the New York Metropolitan Area who own e-bikes or e-scooters is currently unavailable or limited. As such, estimating an exact margin of sampling error is not feasible. In this scenario, at a 95% confidence level, we assume a p value or estimated proportion value of 0.5 (this is common practice when population size is unknown, as this maximizes the margin). The margin of sampling error for a sample of n=173 is estimated at +/- 7.45%.

As with any survey, sampling error is only one source of possible error. While non-sampling error cannot be accurately calculated, precautionary steps were taken in all phases of the survey design and the collection and processing of the data to minimize its influence.

All studies were designed and formulated by UL Standards & Engagement. Surveys were administered online by BV Insights. As a member of the Insights Association and ESOMAR (the European Society for Opinion and Marketing Research), BV Insights adheres to industry ethics and best practices, including maintaining the anonymity of respondents.

Note: All numbers are percentages unless otherwise noted. Figures may not total 100% due to rounding.



WHITE PAPER

[i] "Governor Hochul Signs Legislation to Encourage the Safe Use of E-Bikes and Lithium-Ion Batteries and Protect New Yorkers," July 11, 2024. https://www.governor.ny.gov/news/governor-hochul-signs-legislation-encourage-safe-use-e-bikes-and-lithium-ion-batteries-and

[ii] Due to a lack of reliable data, we do not account for the cost of non-structural damage caused by these fires, or the cost of damage to the devices themselves, among other things. In addition, it is likely that reported counts of the number of fires is partial.

[iii] FDNY data indicates that the number of non-structural fires (such as brush fires, auto fires, and transit system fires) related to e-mobility device batteries has risen substantially in recent years: from five in 2019 to 63 in 2023.

[iv] VSL is defined as the additional cost that an individual would be willing to pay for improvements in safety that, in the aggregate, reduce the expected number of fatalities by one.

[v] U.S. Department of Transportation, "Departmental Guidance on Valuation of a Statistical Life in Economic Analysis," Effective Date: Tuesday, May 7, 2024, Issued Date: Tuesday, March 23, 2021, https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis

[vi] Notably, we consider only structural fires (those involving some type of property/building). The cost of damage by non-structural fires (e.g. brush fires, auto fires, transit system fires etc.) is not accounted for due to a lack of reliable data.

[vii] NYC, "NYC DOT, Lyft Unveil New York City's First Electrified Citi Bike Charging Stations," May 20, 2024. https://www.nyc.gov/html/dot/html/pr2024/first-electrified-citibike-charging-stations.shtml

[viii] To demonstrate the validity of the UL Solutions Lithium-Ion Battery Incident Database, UL Standards & Engagement analysis compared FDNY data on all lithium-Ion battery fires occurring annually between 2021 and 2023 to UL Solutions data on all lithium-Ion battery fires in NYC during the same time frame. Results indicate a high degree of accuracy of the UL Solutions Lithium-Ion Battery Incident Database compared to the FDNY data. Details of this validity check are available upon request.

[ix] MECAPS is a quick-alert system designed to collect timely information on deaths involving consumer products.

[x] IPII files contain data extracted from CPSC Hotline and SaferProducts.gov reports, product-related newspaper accounts regarding incidents involving consumer products, summaries of reports from other Federal agencies, Health Care Professionals, and Public Safety entities of investigations into events surrounding product-related injuries or incidents.

[xi] Product code 3215.

[xii] VSL is defined as the additional cost that an individual would be willing to pay for improvements in safety that, in the aggregate, reduce the expected number of fatalities by one.

[xiii] U.S. Department of Transportation, "Departmental Guidance on Valuation of a Statistical Life in Economic Analysis," Effective Date: Tuesday, May 7, 2024, Issued Date: Tuesday, March 23, 2021, https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis

[xiv] OMB, "Circular No. A-4," November 9, 2023, https://www.whitehouse.gov/wp-content/uploads/2023/11/CircularA-4.pdf . "Since agencies often design health and safety regulations to reduce risks to life, evaluation of these benefits can be the key part of the analysis. A good analysis must present these benefits clearly and show their importance. Applying WTP is the best approach to use when monetizing reductions in fatality risk... agencies typically utilize central estimates of VSL between $10 million to $12 million as of 2022, and regularly update these values to reflect inflation and real income growth."

[xv] While the injuries reported in this database are much fewer in number than the FDNY data, the dataset includes a narrative description and categorization of injuries sustained. Although the severity categories provided by Clearinghouse do not map exactly to U.S. DoT categories, we (conservatively) assign Clearinghouse categories to one of the lowest three U.S. DoT categories (Minor, Moderate, Serious). Broadly, Oxford Economics categorization involves allocating injuries that require some unknown level of care as "Minor," those involving some other defined treatment as "Moderate," and those involving hospital admission as "Serious." Injury severity distributions are only available for 2021-2023 in Clearinghouse data. For 2019 and 2020, we assume injury severity is distributed similarly to how injuries are distributed on average in the CPSC Clearinghouse data across 2021 to 2023.

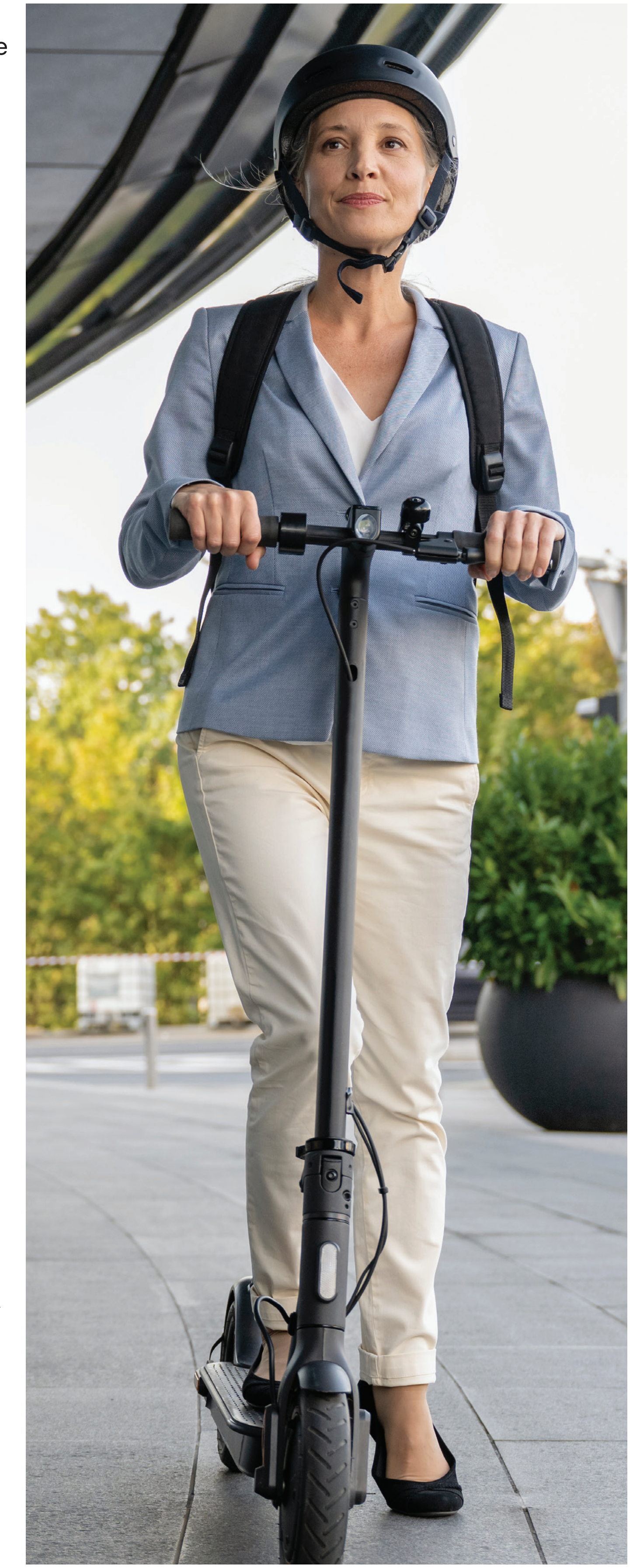
[xvi] Notably, we consider only structural fires (those involving some type of property/building). The cost of damage by non-structural fires (e.g. brush fires, auto fires, transit system fires etc.) is not accounted for due to a lack of reliable data.

[xvii] NYCHA, "Physical Needs Assessment (PNA) Technical Report," June 22, 2023. 2023-PNA-Report-Physical-Needs-Assessment-NYCHA.pdf. Summary available at: Physical Needs Assessment (nyc.gov). The NYCHA property damage cost estimate used is $485,378. This is based on the PNA estimate of the total projected cost to remediate and replace NYCHA apartments over the next 20 years ($78.34bn, 2023 prices), averaged over the appropriate number of NYCHA apartments (161,400).

[xviii] National Fire Protection Association (NFPA), "Fire loss in the United States," November 1, 2023. Fire loss in the United States | NFPA Research. The lower-bound property damage cost estimate used is $29,941. This is derived from NFPA's estimate of total property loss ($15.024bn) caused by structure fires (including residential and non-residential structure fires) in 2022, averaged across all NFPA-reported structure fires (522,500) in that period. These figures are based on NFPA's survey of fire departments for the U.S. fire experience, and surveys of state authorities for large loss and catastrophic multiple-death fires. We convert this to 2023 prices using an appropriate CPI (CPIAUCSL).

[xix] Insurance Information Institute (III), "Facts + Statistics: Homeowners and renters insurance," Accessed July 10, 2024. Facts + Statistics: Homeowners and renters insurance | III. The upper-bound property damage cost estimate used is $83,991. This is the average homeowner insurance claim for property damage from fire and lightning (weighted average 2018-2022, 2023 prices).

[xx] FDNY data indicates that the number of non-structural fires (such as brush fires, auto fires, and transit system fires) related to e-mobility device batteries has risen substantially in recent years: from five in 2019 to 63 in 2023.



Standards &
Engagement