ARTICLE IN PRESS

Engineering xxx (xxxx) xxx

Contents lists available at ScienceDirect

Engineering

journal homepage: www.elsevier.com/locate/eng

Research
Energy Transition's Technical Pathways, Risks, and Equity—Perspective

The Urgency to Regulate Informal EV Battery Recycling in China

Hetong Wang [a], Peng Wang [b], Jiashuo Li [c], Laixiang Sun [d], Kuishuang Feng [e,f,*]

[a] Institute of Climate Change and Energy Sustainable Development, Qingdao University of Science and Technology, Qingdao 266061, China
[b] Key Lab of Urban Environment and Health, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen 361021, China
[c] Institute of Blue and Green Development, Shandong University, Weihai 264209, China
[d] Department of Geographical Sciences, University of Maryland, College Park, MD 20742, USA
[e] Department of Geography, The University of Hong Kong, Hong Kong 999077, China
[f] Institute for Climate and Carbon Neutrality, The University of Hong Kong, Hong Kong 999077, China

ARTICLE INFO

Article history:
Received 23 July 2025
Revised 6 March 2026
Accepted 30 March 2026
Available online xxxx

Keywords:
Electric vehicle battery
Informal recycling
Waste management
Policy regulation

ABSTRACT

China's electric vehicle (EV) boom will generate an unprecedented volume of battery waste, yet over 70% of end-of-life EV batteries currently flow to informal recyclers operating outside regulated channels. Low market entry barriers, high profit margins, and weak regulatory enforcement enable these informal operators to outcompete licensed enterprises, posing a major obstacle to China's sustainable energy transition. By coupling the Global Change Analysis Model with dynamic material flow analysis, we project that retired EV battery volumes will reach 22.39 million tons by 2040 under the carbon neutrality scenario, representing 112-fold increases from the 2020 level. To address this escalating crisis, we urge coordinated actions among all stakeholders, including legislating extended producer responsibility, classifying end-of-life batteries as hazardous waste, raising market entry thresholds, supporting research and development for low-cost recycling technologies, and implementing ownership-based classification of retired batteries.

1. Introduction

The transition toward sustainable transportation is a vital component of China's ambitious plan to achieve carbon neutrality [1]. In 2024 alone, electric vehicle (EV) sales in China reached 11.3 million units, accounting for about 65% of global EV sales (17.3 million units) [2]. Because lithium-ion batteries (LIBs) have a relatively short service life of approximately eight years [3,4], this rapid adoption is poised to generate a massive wave of end-of-life battery waste within the coming decade. Timely and effective strategies are therefore essential to address the impending triple challenge of environmental sustainability, economic viability, and strategic resource management.

However, recent reports reveal that fewer than 30% of end-of-life EV batteries enter formal recycling channels; the vast majority is instead captured by unlicensed, informal operators [5–8]. Although China has issued guidelines prohibiting informal dismantling and modification on safety grounds, these operations persist because informal recyclers can outbid their licensed counterparts by offering substantially higher acquisition prices for waste batteries. The environmental consequences are stark. In a case announced in January 2024 by the Quannan County People's Procuratorate in Jiangxi Province, a single company was found to have improperly dismantled 364.23 tons of waste lithium iron phosphate batteries, causing foliage dieback across 2.43 hectares of forest and killing standing timber totalling 11.94 m^3 through severe contamination [9]. The continued dominance of informal recycling poses a fundamental obstacle to China's low-carbon transition, making effective strategies for EV battery recycling an urgent priority.

In this perspective article, we examine current and emerging trends in informal and formal EV battery recycling in China and assess their environmental and health implications. Through an in-depth comparison of the two recycling pathways, we identify the key factors driving the expansion of the informal sector and the barriers hindering the development of a structured formal market, and we propose targeted policy recommendations to address these challenges. These analyses are essential for understanding the persistent ineffectiveness of existing policies—a problem rooted in uncertainties and structural dynamics within the

* Corresponding author.
E-mail address: kfeng@hku.hk (K. Feng).

https://doi.org/10.1016/j.eng.2026.03.019

recycling industry value chain that has been largely overlooked in prior research. We argue that, although formally authorized enterprises possess the capacity to handle all existing retired EV LIBs, a combination of low market entry barriers, high profitability of informal recycling, conflicts of interest among stakeholders, and inadequate industry governance collectively prevents these enterprises from competing effectively with informal channels. Our coupled Global Change Analysis Model (GCAM) and dynamic material flow analysis (MFA) modelling framework projects that the volume of retired EV batteries in China will surge to 1.69 million tons by 2030 and 22.39 million tons by 2040 under carbon neutrality scenario, representing approximately 8-fold and 112-fold increases over the 2020 level, respectively. Without decisive intervention, the severe challenges confronting the battery recycling industry are poised to intensify. We therefore advocate for coordinated action involving all stakeholders, encompassing the strengthening of the extended producer responsibility (EPR) system through legislation, classification of end-of-life EV LIBs as hazardous waste with corresponding criminal liabilities, elevation of market entry thresholds for battery recycling, support for research and development in standardized battery design and low-cost recycling technologies, and implementation of ownership-based classification management for retired batteries. Collectively, these measures are essential to address the current crisis effectively and to pave the way for a sustainable, low-carbon transition.

2. Escalating challenge: surge in EV battery waste

China is already contending with a rapidly escalating volume of waste EV LIBs. The estimated quantity surged from 70 thousand tons in 2018 to 130 thousand tons in 2019 and then to 200 thousand tons in 2020, corresponding to growth of 76% and 170%, respectively (Fig. 1(a) [5,10–15]). Retirement volumes continued to climb in 2021, reaching 320 thousand tons, an increase of approximately 58% over the 2020 level [10]. By 2023, the annual volume of waste EV LIBs had risen further to 360 thousand tons [10].

Achieving China's carbon neutrality target requires extensive deployment of EVs, which will in turn generate an ever-increasing volume of waste EV LIBs. Using the coupled GCAM and dynamic MFA (Sections S1 and S2 for details in Appendix A), we project that EV adoption will continue to rise and that the resulting volume of waste EV LIBs will surge dramatically, reaching approximately 1.69 million tons by 2030 and 22.39 million tons by 2040. These figures represent approximately 8-fold and 112-fold increases over the 2020 level, respectively (Fig. 1(b)). Compound-

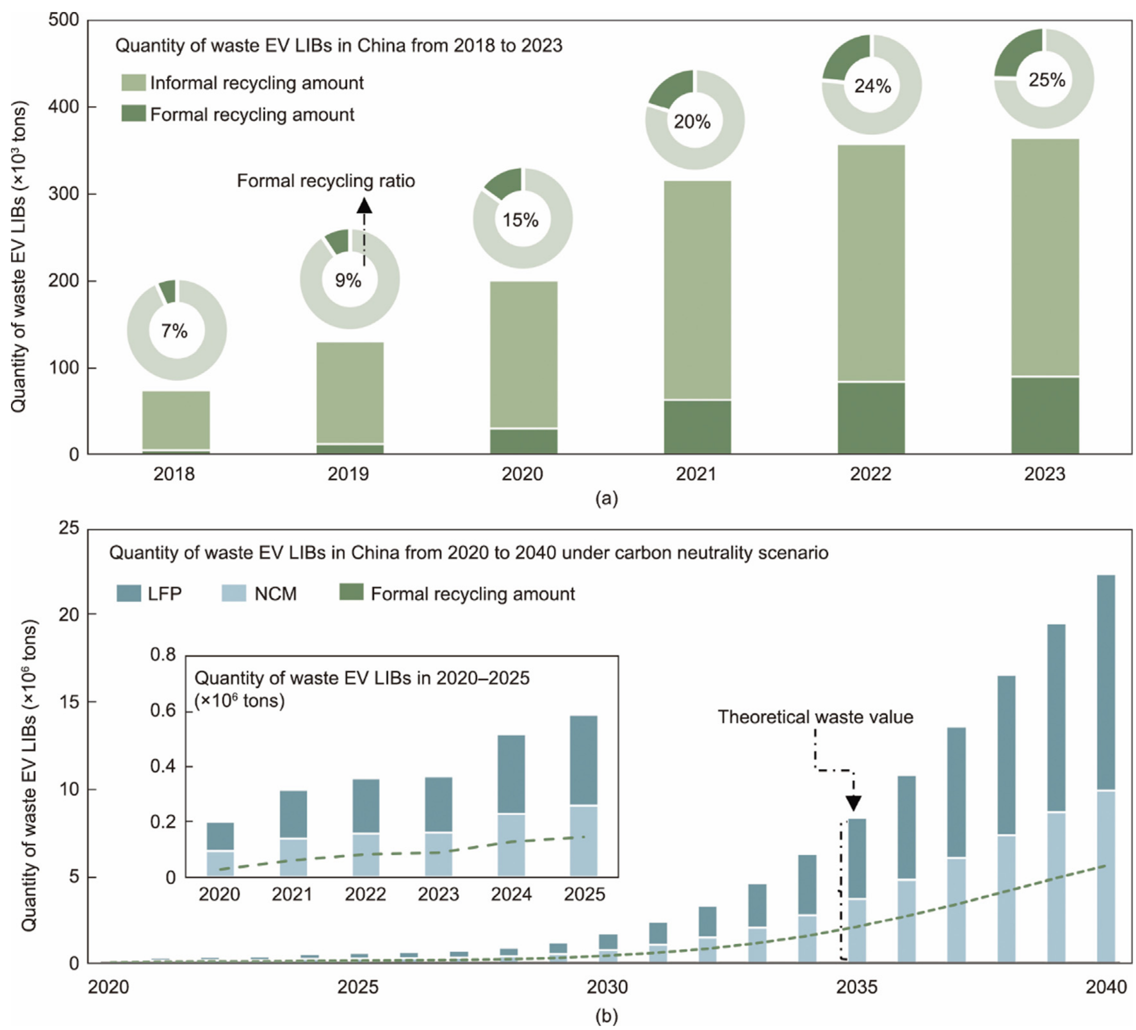

Fig. 1. Quantity of waste EV LIBs in China from 2018 to 2040: (a) from 2018 to 2020 (in thousand tons) [5,10–13], (b) from 2020 to 2040 under the carbon neutrality scenario (in million tons) (derived from this study). NCM: lithium nickel manganese cobalt oxide; LFP: lithium iron phosphate. Due to persistent technical and commercialization barriers for lithium-sulfur batteries, lithium-air batteries, and solid-state batteries in the short to medium term, this analysis does not include them in its scope [14,15].

ing this challenge are the structural complexity and chemical diversity of waste EV LIBs, their high processing costs, and their wide geographic dispersion across China. China's existing recycling infrastructure, moreover, remains fragmented, characterized by incomplete geographic coverage and significant logistical inefficiencies. According to data from the Ministry of Industry and Information Technology of China (MIIT), approximately 10 908 power battery recycling outlets across 31 provinces had been established by the end of August 2025; however, these outlets are predominantly concentrated in eastern coastal and central regions [16]. More critically, not only are many registered outlets effectively nonfunctional owing to company relocations or operational incapacity, but an even larger number are reportedly unaware that they have been designated as authorized recycling facilities [17]. Such information asymmetry hinders coordination among recycling stakeholders and further impedes the effective collection and formal recycling of waste EV batteries [18].

3. Losing battle: formal recycling versus informal recycling

Chinese policymakers have increasingly recognized the urgent need to address the escalating challenge of EV battery waste (Sections S3 and S4 in Appendix A). The management of waste EV batteries requires strict adherence to regulated procedures, placing significant demands on recycling enterprises. To promote standardization, the MIIT has published five batches of qualified enterprises, 156 in total, that meet the Industry Specification Conditions for Comprehensive Utilization of Waste Batteries of New Energy Vehicles [19–23]. Collectively referred to as "White List" entities, these enterprises constitute the formal recycling sector.

The first batch of "White List" enterprises, including Huayou Cobalt, Ganzhou Highpower Technology Co., Ltd., Green Eco-Manufacture (GEM), Brunp Recycling, and Ghtech, possesses a combined designed recycling capacity exceeding 600 000 tons of LIBs, approximately three times the volume of waste EV LIBs generated in 2020 and nearly equivalent to the projected total for 2025. Among them, GEM has a total designed capacity of 215 000 tons per year for resource recycling and 100 000 tons per year for second use, sufficient to recycle nearly all current waste EV LIBs [24]. By 2023, certified "White List" enterprises had achieved an actual recycling capacity (i.e., realized installed capacity) of 623 000 tons [25], approximately 1.7 times the theoretical retirement volume for that year. With ongoing technological upgrades, the processing capacity of formal enterprises continues to expand. In this context, the MIIT issued a notice in 2024 instructing local departments to suspend acceptance of new applications for battery comprehensive utilization qualifications. This measure aims to enhance the market valuation and competitiveness of existing "White List" enterprises, prioritizing operational quality over quantitative expansion.

However, the formal sector continues to face severe challenges in acquiring waste EV LIBs. Reports indicate that only 0.005 million tons (7%), 0.012 million tons (9%), and 0.03 million tons (15%) of waste EV LIBs were channelled into the formal recycling process in 2018, 2019, and 2020, respectively (Fig. 1(a)). Despite the growing volume of waste EV LIBs, only 0.06, 0.08, and 0.09 million tons flowed into formal recycling channels in 2021, 2022, and 2023, respectively, representing only about 20%, 24%, and 25% of the total waste volume [5,10–13]. Without decisive intervention, these challenges are projected to worsen. Under the carbon neutrality scenario, 1.26 million and 16.79 million tons of EV LIB waste are expected to flow into informal channels by 2030 and 2040, respectively, approximately 7 and 99 times the 2020 level (Fig. 1(b)). This stark contrast highlights a critical structural imbalance: despite possessing the capacity to process all EV LIB waste, authorized formal channels continue to lose ground in battery collection, while unregulated informal channels capture the overwhelming majority.

4. Severe environmental and health impacts of informal recycling

The widespread informal recycling of waste EV batteries poses substantial risks to the environment, human health, and the orderly functioning of the recycling market (Figs. 2(a) and (b) [26]). Formal recycling enterprises operate in fully enclosed facilities and comply with national environmental and safety regulations [27]. Informal recyclers, by contrast, routinely disregard these regulations, illegally discharging hazardous wastes. They may also sell batteries for use in low-speed EVs or convert them into smaller rechargeable battery packs without adequate safety checks [28].

Informal recycling also poses direct safety hazards. Non-compliant storage and handling practices render waste batteries prone to spontaneous combustion or explosion [29]. In October 2024, for instance, the People's Government of Hengyang reported an explosion at Hunan Jinkai Recycling Technology Co., Ltd. in Leiyang City, Hunan Province [30], attributed to the absence of physical barriers and insulation between the waste battery storage area and the operational zone. Although no injuries occurred, the explosion caused direct economic losses of approximately 150 000 RMB. Workers in the informal sector also face significant occupational health risks, as they frequently disassemble batteries by hand without protective equipment, exposing themselves to toxic substances [31]. Non-compliant transportation practices compound these dangers. In July 2025, a semi-trailer carrying 50 tons of LIBs (exceeding its rated capacity of 32 tons by 56%) rear-ended a delivery truck stopped in traffic. The collision caused the battery packs to short-circuit under compression, triggering an explosion and fire that killed 3 people and injured 12 [32].

Beyond these safety hazards, informal recycling poses significant environmental threats. Improper disposal of electrolyte, separator film, and waste liquid can cause freshwater and terrestrial acidification, heavy metal contamination, dust and fluorine emissions, and organic pollution [33]. For example, metallic contaminants such as lithium, cobalt, nickel, and copper can leach from LIBs that are landfilled without proper treatment, contaminating surrounding soil and groundwater [34]. Toxic additives, including ionic compounds and volatile organic electrolytes, may similarly migrate into soil and groundwater during non-compliant recycling operations, compounding the environmental damage [35]. Electrolytes can also react with water to generate toxic gases, contributing to localized air pollution and posing serious health risks to unprotected workers [36].

On the economic front, informal recyclers avoid environmental compliance costs, enabling them to offer higher acquisition prices for waste batteries and thereby outbid formal operators. This dynamic triggers a "Gresham's Law" effect within the industry, distorting market price signals as substandard practices displace compliant ones [37]. As formal enterprises lose access to feedstock, their capacity utilization declines, driving up average per-unit processing costs and further weakening their price competitiveness. Over time, this vicious cycle risks eroding trust in the recycling system among key participants such as automakers and battery manufacturers, pushing the recycling market toward heightened volatility, reduced transparency, and growing disorder.

5. Driving forces of informal battery recycling

The waste LIB recycling market is characterized by low entry barriers, high profit margins, and relatively weak regulatory over-

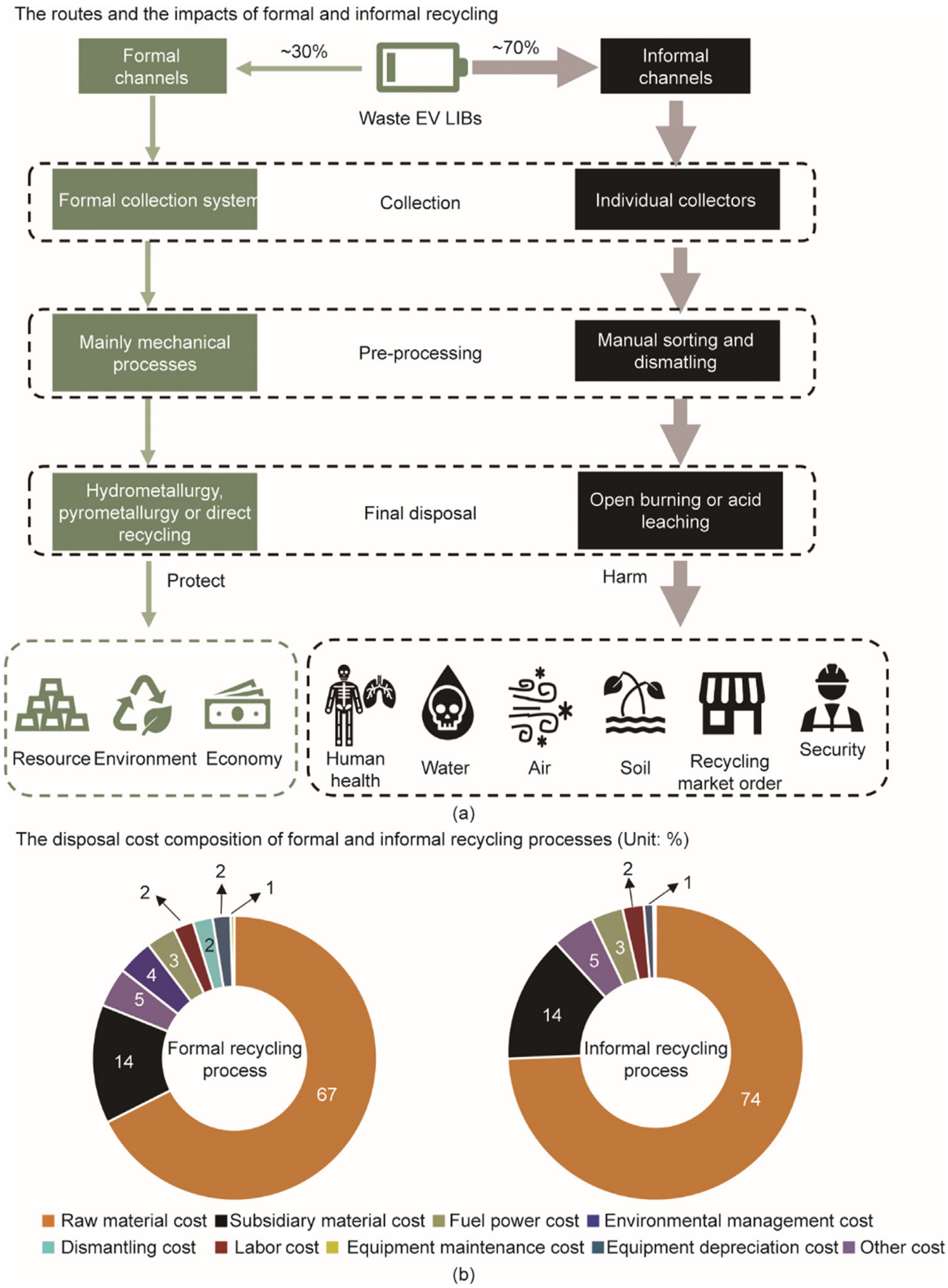

Fig. 2. Contrast between formal and informal recycling processes: (a) routes and impacts, (b) cost structure [26].

sight, making it particularly attractive to informal operators compared with other high-value waste streams [38]. Profitability is the primary draw. Price volatility in high-value metals such as cobalt and lithium enables the sector to generate substantial short-term margins; in 2022, for example, the price of lithium carbonate surged to 600 000 RMB per ton, multiplying the profit from recycling a single ton of lithium iron phosphate batteries severalfold [39]. Ease of operation reinforces this appeal: compared with other categories of high-value electronic waste, waste EV LIBs are relatively easy to collect and dismantle manually [38]. Weak regulation further lowers the threshold for entry. Because the LIB recycling industry remains in a transitional phase, enforcement is limited [40]. This regulatory gap affords informal operators' considerable freedom and profit opportunities that are largely unavailable to their compliance-bound formal counterparts.

The dominance of informal recycling is further reinforced by the lack of a coordinated governance framework that aligns the stakeholder interests within the formal recycling supply chain. A significant cost disparity lies at the heart of this structural weakness: because informal recyclers are unburdened by environmental compliance costs, they can offer far more competitive purchase prices [13], consistently outbidding formal operators [41]. Their decentralized and flexible operations amplify this advantage. Informal recyclers frequently position themselves near 4S dealerships and auto repair shops, directly approaching vehicle owners at the point of scrappage and offering prices that formal channels cannot match [42]. For nickel-cobalt-manganese battery waste, informal purchase prices are typically 50%–150% higher than those offered by formal recyclers [43]. Consequently, EV owners, particularly those with limited environmental awareness, gravitate toward informal buyers for the higher financial returns, perpetuating a cycle in which non-compliant practices crowd out regulated ones [44].

Beyond market dynamics, however, the root cause of widespread informal recycling lies in the sector's inadequate governance system. Retired EV battery recycling involves diverse stakeholders, including governments, recyclers, automobile manufacturers, and consumers [41], yet the delineation of rights and responsibilities among them remains vague, and no coordinated policy framework has been established. Although the Chinese government has been formulating specialized battery recycling policies since 2016, advocating for implementation of the EPR system and certification requirements for comprehensive utilization enterprises [20,45,46], these policies lack binding legal mandates and fail to address information asymmetries among stakeholders. Notably, they do not define clear consumer responsibilities. Local governments have implemented targeted subsidies for battery recycling enterprises, automakers, battery material producers, and retail entities to encourage formal recycling [47–50], but these measures have proven insufficient in the absence of key safeguards such as mandatory traceability mechanisms, coordinated enforcement actions, and blacklist-based penalties. Compounding the problem, many registered recycling service outlets do not engage in actual recycling operations because of low profit margins [51].

Recognizing these challenges, major industry players have begun to take collective action. On July 16, 2021, nine leading new energy vehicle and battery manufacturers issued a joint statement calling for a boycott of informal recycling operations [52]. Although such efforts signal growing industry awareness and the potential for coordinated governance, they remain nascent and insufficient to achieve systemic transformation. Curbing the dominance of the informal sector and establishing a truly circular and sustainable EV battery recycling system will require substantial, broad-based collaboration among all stakeholders.

6. Potential solutions

As noted in Section 5, the effectiveness of existing battery recycling policies has fallen short of expectations [20,45,46]. To effectively address the challenges of pervasive informal recycling, coordinated stakeholder action is urgently needed, focusing on five key measures.

First, the government should establish a coordinated policy framework to govern stakeholder responsibilities, anchored in the legislative strengthening of the EPR system. As the entities bearing primary recycling responsibility under EPR, manufacturers should be mandated to create battery identification codes and maintain comprehensive digital lifecycle records. A deposit-refund mechanism could incentivize consumer returns, while a government-led blockchain-based traceability platform, integrating data from production to recycling and synchronized with financial regulatory systems, would ensure transparency and accountability.

Second, legislation should be enacted to classify retired EV LIBs as hazardous waste, establishing corresponding criminal liabilities to deter informal activity. At present, waste EV LIBs in China are managed as general solid waste [53], and their mishandling therefore lacks the stringent legal repercussions applied to hazardous waste violations [54,55]. Reclassifying these batteries as hazardous waste, consistent with international best practices like Australia's classification of EV LIBs exceeding 5 kg as hazardous waste [56], would provide the legal foundation for criminal enforcement.

Third, raising market entry barriers is a practical means of strengthening formal recycling. Transactions involving retired EV batteries should be restricted to certified formal enterprises only, with strengthened supervision over online trading platforms that facilitate informal deals. Standardized definitions of key terms and procedures are needed to ensure consistent enforcement.

Fourth, advancing standardized battery designs and investing in low-cost, high-efficiency recycling technologies can substantially enhance the economic competitiveness of formal recycling. Subsidies and policy incentives should support technological innovation, particularly in non-destructive testing and high-value resource recovery. Publishing a catalog of proven technologies and equipment would further promote their adoption.

Finally, a differentiated approach based on ownership classification is recommended. Retired batteries from fleet and commercial vehicles, such as public buses, should be subject to mandatory centralized recycling through agreements signed at purchase. For the more dispersed batteries from private vehicles, a model combining consumer incentives, robust traceability, and regulatory oversight is necessary to channel them into formal recycling pathways.

CRediT authorship contribution statement

Hetong Wang: Writing – original draft, Software, Methodology, Investigation, Data curation, Conceptualization. **Peng Wang:** Writing – original draft, Supervision, Data curation. **Jiashuo Li:** Supervision, Investigation. **Laixiang Sun:** Writing – review & editing, Supervision, Formal analysis, Conceptualization. **Kuishuang Feng:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This work was sponsored by National Natural Science Foundation of China (72504153) and Shandong Province Natural Science Foundation (ZR2025QC1946Z). We acknowledge all reviewers for their insightful recommendations in the development of this perspective article.

Appendix A. Supplementary data

The supplementary materials include a method for estimating the EV retired battery volumes in China using the Global Change Analysis Model and dynamic material flow analysis, an overview of China's policies on the EV retired battery recycling, and a literature review on the EV retired battery recycling. Supplementary data to this article can be found online at https://doi.org/10.1016/j.eng.2026.03.019.

References

[1] Normile D. China's bold climate pledge earns praise—but is it feasible? Science 2020;370(6512):17–8.
[2] Global electric car sales, 2014–2024. Report. Paris: International Energy Agency; 2025.
[3] Xu C, Dai Q, Gaines L, Hu M, Tukker A, Steubing B. Future material demand for automotive lithium-based batteries. Commun Mater 2020;1(1):1–10.
[4] Tao Y, Rahn CD, Archer LA, You F. Second life and recycling: energy and environmental sustainability perspectives for high-performance lithium-ion batteries. Sci Adv 2021;7(45):eabi7633.
[5] Wang Z. Annual report on the big data of new energy vehicle in China (2021). Beijing: China Machine Press; 2021.
[6] Niu Y. How can China address its EV battery-recycling challenge? Report. London: Dialogue Earth; 2023.
[7] Market prospect analysis of lithium-ion battery recycling in China in 2020. Report. Guangzhou: Green Globe International Inc.; 2020. Chinese.

[8] White paper on the development of China's waste lithium-ion battery recycling, dismantling and echelon utilization industry (2023). Report. Beijing: EVTank; 2023. Chinese.
[9] Ye C, Tao W. Quan Nan Procuratorate: addressing environmental pollution through the rule of law [Internet]. Nanchang: Jiangxi Provincial CPC Committee Political and Legal Affairs Commission; 2024 Jun 10 [cited 2025 Jul 23]. Available from: https://www.jxzfw.gov.cn/2024/0710/2024071058441.html. Chinese.
[10] Tian X, Peng F, Chen X, Wei G, Gan Y, Zhang Z, et al. Management of spent power batteries in China: progress, policies, and challenges. Renew Sustain Energy Rev 2025;219:115797.
[11] China lithium battery recycling and reuse market prospects analysis report in 2022. Report. Guangzhou: Green Globe International Inc.; 2022. Chinese.
[12] Implementing the spirit of the State Council executive meeting to promote high-quality development of the new energy vehicle industry [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2023 Jun 21 [cited 2025 Jul 23]. Available from: https://www.miit.gov.cn/xwdt/gxdt/ldhd/art/2023/art_643c641ae55849eabd329f8311bc964d.html. Chinese.
[13] He W, Zhu M, Fan Z, Wu W, Zhao S, Cheng H. New energy vehicle power battery recycling difficulties need to be cracked. Report. Beijing: Development Research Center of the State Council; 2023. Chinese.
[14] Liu M, Liu W, Zhang M, Pan X, Zhang Q, Zhang M, et al. Analysis of the potential resource, environmental and economic impacts of EV battery and waste battery regulations on China's lithium-ion battery industry. Resour Conserv Recycl 2025;219:108314.
[15] Zeng A, Chen W, Rasmussen K, Zhu X, Lundhaug M, Müller D, et al. Battery technology and recycling alone will not save the electric mobility transition from future cobalt shortages. Nat Commun 2022;12:1.
[16] Information of EV battery collection service outlets [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; [cited 2025 Jul 23]. Available from: https://wap.miit.gov.cn/datainfo/zysjk/xnyqcdlxdchsfwwdxx/index.html. Chinese.
[17] The chaos of power battery recycling: how hidden small workshops compete against mainstream players [Internet]. Fuzhou: Fujian Provincial Department of Ministry of Industry and Information Technology; 2024 Jul 4 [cited 2025 Jul 23]. Available from: https://gxt.fujian.gov.cn/zwgk/xw/hydt/xydt/202407/t20240704_6478914.htm. Chinese.
[18] Wang Y, Fan R, Chen R, Xie X, Ke C. Exploring the coevolution dynamics of residents and recyclers in electric vehicle battery recycling decisions on the two-layer heterogeneous complex networks. Appl Energy 2025;382:125235.
[19] List of enterprises in line with the industrial standards for comprehensive utilization of scrap steel, waste paper, waste plastics, waste tires, waste power batteries of new energy vehicles in 2022 [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2022 Dec 7 [cited 2025 Jul 23]. Available from: https://www.miit.gov.cn/zwgk/zcwj/wjfb/gg/art/2022/art_751a83c5cae9443087ecfc5cb16e3be5.html. Chinese.
[20] List of enterprises in line with industry standards for comprehensive utilization of waste power batteries of new energy vehicles (the first batch) [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2018 Sep 3 [cited 2025 Jul 23]. Available from: https://www.miit.gov.cn/jgsj/jns/wjfb/art/2020/art_4301180723a44035b23dcb19b6637330.html. Chinese.
[21] List of enterprises in line with the industry standard for comprehensive utilization of scrap iron and steel, waste plastics, waste tires and waste power batteries of new energy vehicles to be announced. Report. Beijing: China Association of Automobile Manufacturers; 2020. Chinese.
[22] Announcement No.40, 2021 of the Ministry of Industry and Information Technology of the People's Republic of China [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2021 Dec 6 [cited 2025 Jul 23]. Available from: https://www.miit.gov.cn/jgsj/jns/zyjy/art/2021/art_dc43c3657da9414b86faa15735885941.html. Chinese.
[23] List of enterprises in line with the industry specification conditions for comprehensive utilization of waste batteries of new energy vehicles. Report. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2023. Chinese.
[24] Power battery life cycle value chain business. Report. Shenzhen: GEM Co., Ltd.; 2021. Chinese.
[25] China lithium-ion battery industry development white paper. Report. Beijing: EVTank; 2024. Chinese.
[26] Liu Z. Battery recycling series (part II): cost and profit breakdown model for battery recycling. Report. Beijing: CINDA Securities; 2022. Chinese.
[27] Morse I. A dead battery dilemma. Science 2021;372(6544):781–3.
[28] Who's driving it? An orgy of illegal power battery recycling. Report. Beijing: D1EV; 2020. Chinese.
[29] Feng X, Ouyang M, Liu X, Lu L, Xia Y, He X. Thermal runaway mechanism of lithium ion battery for electric vehicles: a review. Energy Storage Mater 2018;10:246–67.
[30] Investigation Report on the October 18 Used Battery Explosion Incident at Hunan Jinkai Recycling Technology Co., Ltd., Leiyang City. Report. Hengyang: People's Government of Hengyang; 2024. Chinese.
[31] Lebedeva NP, Boon-Brett L. Considerations on the chemical toxicity of contemporary Li-ion battery electrolytes and their components. J Electrochem Soc 2016;163(6):A821.
[32] Major rear-end collision on Beijing–Shanghai expressway in Huai'an: why have new energy transport vehicles become moving bombs? [Internet]. Fujian: SOHU; 2025 Jul 17 [cited 2025 Jul 23]. Available from: https://roll.sohu.com/a/914909753_122456338. Chinese.
[33] Wang S, Yu J. A comparative life cycle assessment on lithium-ion battery: case study on electric vehicle battery in China considering battery evolution. Waste Manag Res 2021;39(1):156–64.
[34] Chan KH, Anawati J, Malik M, Azimi G. Closed-loop recycling of lithium, cobalt, nickel, and manganese from waste lithium-ion batteries of electric vehicles. ACS Sustain Chem Eng 2021;9(12):4398–410.
[35] Christensen PA, Anderson PA, Harper GD, Lambert SM, Mrozik W, Rajaeifar MA, et al. Risk management over the life cycle of lithium-ion batteries in electric vehicles. Renew Sustain Energy Rev 2021;148:111240.
[36] Amusa HK, Sadiq M, Alam G, Alam R, Siefan A, Ibrahim H, et al. Electric vehicle batteries waste management and recycling challenges: a comprehensive review of green technologies and future prospects. J Mater Cycle Waste Manag 2024;26(4):1959–78.
[37] Tian X, Peng F, Xie J, Liu Y. Agent-based modeling for an end-of-life power battery cross-regional recycling system and subregional policy analysis: a case study in China. J Clean Prod 2024;441:141054.
[38] Parviziomran E, Elliot V. Barriers to circular economy: insights from a small electric vehicle battery manufacturer. J Purch Suppl Manag 2024;30(2):100905.
[39] Lin C. Lithium carbonate prices continue to fall: manufacturers are selling at low prices, and distributors no longer hoard the commodity. Report. Shanghai: Yicai; 2023. Chinese.
[40] Chigbu BI, Umejesi I. Unlocking economic and environmental gains through lithium-ion battery recycling for electric vehicles. Resources 2024;13(12):163.
[41] He L, Sun B. Exploring the EPR system for power battery recycling from a supply-side perspective: an evolutionary game analysis. Waste Manag 2022;140:204–12.
[42] Tracking of the chaos in the disposal of end-of-life vehicles. Report. Beijing: Workers' Daily; 2026. Chinese.
[43] Prices change every day! CATL/BYD/Gotion and other competing for 100 billion market. Report. Beijing: SINA Corporation; 2022. Chinese.
[44] Tang Y, Zhang Q, Liu B, Li Y, Ni R, Wang Y. What influences residents' intention to participate in the electric vehicle battery recycling? Evidence from China. Energy 2023;276:127563.
[45] Interim measures for the administration of recycling and utilization of power batteries of new energy vehicles (draft for soliciting opinions). Report. Beijing: China Association of Circular Economy; 2016. Chinese.
[46] Interim provisions on traceability management for recycling and utilization of new energy vehicle power battery [Internet]. Beijing: Ministry of Industry and Information Technology of the People's Republic of China; 2018 Jul 2 [cited 2025 Jul 23]. Available from: https://wap.miit.gov.cn/jgsj/jns/wjfb/art/2020/art_b56b23d884934687aca9b346cafecbc4.html. Chinese.
[47] Jingmen City to support the new energy vehicle waste power battery comprehensive utilization of industrial high-quality development policy measures [Internet]. Jingmen: Jingmen Municipal People's Government; 2023 Nov 6 [cited 2025 Jul 23]. Available from: https://www.jingmen.gov.cn/art/2023/11/6/art_6607_15891.html. Chinese.
[48] Hangzhou new energy vehicle industry policy compilation. Report. Hangzhou: Hangzhou Municipal Bureau of Economy and Informatization; 2023. Chinese.
[49] Guangxi Zhuang Autonomous Region new energy vehicle promotion and application three-year action financial subsidy implementation rules notice. Report. Nanning: Guangxi Zhuang Autonomous Region Development and Reform Commission; 2022. Chinese.
[50] Hefei Municipal People's Government Office on the issuance of a number of policies to promote the high-quality development of new energy vehicles to help win the battle to defend the blue sky notice. Report. Hefei: Hefei Municipal Finance Bureau; 2021. Chinese.
[51] Large-scale decommissioning of power batteries, recycling industry chain standardization and development to be a breakthrough. Report. Shenzhen: Shenzhen Securities Times Co., Ltd.; 2022. Chinese.
[52] Zhou J. Nine enterprises jointly voice "boycott of informal workshops", the first sample of closed-loop battery recycling on the ground. Report. Beijing: EEO; 2021. Chinese.
[53] National hazardous waste list [Internet]. Beijing: Ministry of Justice of the People's Republic of China.; 2026 Sep 21 [cited 2025 Jul 23]. Available from: http://www.moj.gov.cn/pub/sfbgw/flfggz/flfggzbmgz/201609/t20160921_374188.html. Chinese.
[54] Solid waste pollution prevention and control law of People's Republic of China [Internet]. Beijing: Ministry of Ecology and Environment of the People's Republic of China; 2020 Apr 30 [cited 2025 Jul 23]. Available from: https://www.mee.gov.cn/ywgz/fgbz/fl/202004/t20200430_777580.shtml. Chinese.
[55] Regulations on the safe management of hazardous chemicals [Internet]. Beijing: Ministry of Public Security of the People's Republic of China; 2014 Jun 23 [cited 2025 Jul 23]. Available from: https://www.mps.gov.cn/n2255079/n4242954/n4500645/n4500649/c4504321/content.html. Chinese.
[56] Sun M, Yang X, Huisingh D, Wang R, Wang Y. Consumer behavior and perspectives concerning spent household battery collection and recycling in China: a case study. J Clean Prod 2015;107:775–85.