

A Comparative Policy Analysis of End-of-Life Vehicle (ELV) Management: Examining the Regulatory Drivers behind Divergent Performance between Malaysia and Japan

*Analisis Perbandingan Polisi Pengurusan Kenderaan-Akhir-Hayat (ELV): Penelitian Terhadap
Faktor Pendorong Kawal Selia di Sebalik Perbezaan Prestasi antara Malaysia dan Jepun*

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ABSTRACT

This paper presents a comparative policy analysis of End-of-Life Vehicle (ELV) management frameworks in Malaysia and Japan, examining the interplay between legislation, economic instruments, and Authorized Automotive Treatment Facility (AATF) operations. Employing a qualitative comparative case study design, the research triangulates document analysis, immersive site visits, and semi-structured focus group discussions at benchmark facilities of Carmedic Sdn Bhd (Malaysia) and Kaiho Sangyo Co. Ltd (Japan). Thematic analysis of interview transcripts, observational data, and policy documents reveals five critical regulatory drivers underpinning divergent performance. Japan's 95% recycling success derives from institutional coherence: (1) binding Extended Producer Responsibility (EPR) with last-owner liability; (2) a secured pre-paid recycling fund (JARC) ensuring recycler viability; (3) synergistic economic disincentives (shaken, progressive taxation, and high operating costs) that engineer predictable ELV supply; (4) effective marginalization of informal operators through mandated deregistration; and (5) stable secondary material markets sustaining investment. In contrast, Malaysia's framework, while progressive on paper, lacks stringent enforcement, effective economic drivers, and a cohesive system for integrating informal actors. The paper concludes that Malaysia's path to ELV management success requires a holistic policy transplant that extends beyond EPR legislation to include powerful market-creating and market-correcting mechanisms, as exemplified by the Japanese model.

Keywords: End-of-Life Vehicle (ELV), Extended Producer Responsibility (EPR), Authorized Automotive Treatment Facility (AATF), Circular Economy, Sustainable Development Goals (SDGs)

ABSTRAK

Kertas ini membentangkan analisis dasar perbandingan rangka kerja pengurusan Kenderaan Tamat Hayat (ELV) di Malaysia dan Jepun dengan meneliti tindak balas antara aspek perundangan, instrumen ekonomi dan operasi di Pusat Kemudahan Rawatan Automotif Berlesen (AATF). Kajian ini menggunakan reka bentuk perbandingan kualitatif, melibatkan analisis triangulasi terhadap dokumen, lawatan tapak dan perbincangan kumpulan fokus separa berstruktur Carmedic Sdn Bhd (Malaysia) dan Kaiho Sangyo Co. Ltd (Jepun). Analisis tematik terhadap transkrip temu bual, data pemerhatian dan dokumen dasar mendedahkan lima faktor kawal selia kritikal yang mempengaruhi perbezaan prestasi kedua-dua negara. Kejayaan kitar semula di Jepun (95%) adalah berpunca daripada strategi koherens institusi iaitu adanya: (1) Tanggungjawab Pengeluar Lanjutan (EPR) yang mengikat bersama liabiliti pemilik terakhir melupuskan kenderaan; (2) kewujudan dana kitar semula pra-bayar menerusi JARC yang menjamin penerusan kitar semula; (3) dasar disinsentif ekonomi yang sinergistik (shaken, percukaian progresif dan kos operasi yang tinggi) membolehkan bekalan ELV diramal; (4) kawalselia berkesan terhadap pengendali ELV tidak formal; dan (5) pasaran bahan sekunder yang stabil bagi mengekalkan pelaburan industri kitar semula. Sebaliknya, rangka kerja Malaysia, walaupun secara polisi adalah progresif, namun lemah dari segi penguatkuasaan selain ketiadaan pamacu ekonomi yang berkesan dan sistem yang sepadu untuk menarik penglibatan pengendali tidak formal. Kertas ini menyimpulkan bahawa laluan Malaysia ke arah kejayaan pengurusan ELV yang berkesan memerlukan anjakan dasar secara holistik, melangkaui perundangan EPR, serta dapat merangkumkan mekanisme penciptaan dan pembetulan pasaran yang kukuh dan saling berinteraksi seperti model Jepun.

Katakunci: Kenderaan-Tamat-Hayat (ELV), Tanggungjawab Pengeluar Lanjutan (EPR), Kemudahan Rawatan Automotif Berlesen (AATF), Ekonomi Kitaran, Matlamat Pembangunan Mampan (SDGs)

INTRODUCTION

The global automotive industry faces a monumental waste management challenge with over 80 million unit vehicles reaching their end-of-life annually (Karagoz, Aydin & Simic, 2020; WRME, 2014). The management of End-of-Life Vehicles (ELVs) is a critical component of the circular economy because it directly impacts environmental sustainability, resource security, and public health (Vermeulen et al., 2011). Each ELVs represents a complex amalgam of valuable materials like ferrous and non-ferrous metals, engineering plastics, and glass; also, hazardous substances, including lead, mercury, and refrigerant gases, which, if improperly handled, leach into soil and degrade air quality (Zambri et al., 2021). Globally, the automotive industry has recognized the importance of sustainable ELV management, aiming to reduce waste and improve material recovery. Vehicles that have reached their end of life naturally or unnaturally should be disposed of properly to ensure all toxic and harmful substances are not exposed to the earth (Zambri et.al, 2021).

The disparity in ELV management efficacy between developed and developing nations is stark. While both Malaysia and Japan have formal commitments to the United Nations Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production), their operationalization in the ELV sector differs vastly. Japan stands as a global benchmark, achieving a 95% reuse and recovery rate as mandated by its landmark Automobile Recycling Law (Ministry of the Environment of Japan, 2022). In contrast, Malaysia, despite introducing an ELV policy in 2019, grapples with low collection rates, a pervasive informal sector, and inadequate recycling infrastructure (Tat et al., 2021). The visible consequence is an estimated 60,000 vehicles abandoned nationwide (Nor Ain, 2018), representing both a public nuisance and a source of environmental contamination. This gap is epitomized by the contrasting trajectories of Japan and Malaysia, offering a critical case study in the political economy of circularity.

Comparative studies consistently place Malaysia far behind Japan and regional peers like China, Singapore, and Thailand in regulatory maturity and implementation efficacy (Kamaruddin & Rahim, 2022; Hassan et al., 2021). Researchers have effectively diagnosed weaknesses in Malaysia's approach to Extended Producer Responsibility (EPR) and catalogued barriers such as informal sector dominance and weak enforcement. However, a significant gap remains. Although many studies highlight Malaysia's legislative shortcomings in EPR, research that specifically delineates the practical impact of this policy framework on involved industries, particularly how they struggle within a constrained and unviable operational cycle remains scarce. There is a paucity of research that moves from macro-level policy critique to a granular analysis of how these regulatory frameworks directly shape, and often cripple the daily operational viability, strategic decision-making, and investment calculus of the formal recycling enterprises tasked with implementing them. Existing literature provides foundational insights but leaves critical dimensions unexplored. The core problem is the significant gap between policy intent and practical outcomes and experiences in ELV management.

This paper posits that Japan's successful End-of-Life Vehicle (ELV) management is not serendipitous but the result of a meticulously designed, multi-faceted regulatory and economic ecosystem that is currently absent in Malaysia. Consequently, the primary objectives are twofold: first, to critically compare the legal architecture governing ELVs and Authorized Automotive Treatment Facilities (AATFs) in both nations; and second, to identify the specific policy mechanisms that underpin Japan's superior performance. Through case studies of Carmedic Sdn Bhd (Malaysia) and Kaiho Sangyo Co. Ltd (Japan), this paper examines how national policy

ecosystems translate into operational outcomes, focusing on the critical factors of feedstock security, financial models, and technological investment within AATFs.

LITERATURE REVIEW

The global End-of-Life Vehicle (ELV) challenge involves managing hazardous waste and valuable material recovery (Vermeulen et al., 2011). The dominant policy response is Extended Producer Responsibility (EPR), shifting post-consumer product responsibility to producers (OECD, 2016). The European Union's ELV Directive (2000/53/EC) is the seminal EPR model, imposing legally binding recovery targets of 85% recycling by 2006, escalating to 95% by 2015, and obligating manufacturers to establish free take-back systems (European Parliament and Council, 2000; Vermeulen et al., 2011). Article 4 of the directive restricts hazardous substances and integrating "design for recycling" principles (Cossu & Lai, 2015). As non-European nations, neither Malaysia nor Japan transposes this directive, yet its influence is pervasive. Japan's Automobile Recycling Law (2002) adopts the Directive's core 95% recovery ambition and producer responsibility for problematic fractions like shredder residue, though through a distinct last-owner deposit fee managed by the Japan Automobile Recycling Promotion Centre (Gerstberger & Yaneva, 2020; Yano et al., 2016). Significantly, Japan's system continues to evolve; the April 2026 implementation of a "Resource Recovery Incentive System" is designed to financially reward dismantlers for removing plastics and glass pre-shredding, responding to international pressure for material circularity rather than thermal recovery (JARC, 2025; Kitagawa, 2025). Malaysia's ELV Management Policy Framework explicitly anchors itself in EPR principles and mirrors the EU's cascading targets but lacks equivalent legally binding enforcement (Kamaruddin & Rahim, 2022). Thus, both nations engage in strategic policy diffusion, adapting the EU's EPR tenets to their socio-economic contexts.

Scholarly work contrasts Japan's integrated model with Malaysia's nascent framework. Research identifies key Malaysian barriers. Among are informal sector dominance, lack of consumer awareness, and insufficient economic incentives (Tat et al., 2021). While the National Automotive Policy (NAP) 2020 and the KASA policy represent progress, they lack the stringent, legally binding force and integrated economic drivers of the Japanese system (Mamat et al., 2022). Malaysia lacks a comprehensive regulatory structure compared to the EU or Japan (Jia et al., 2022; Zambri et al., 2021; Agamuthu & Mehran, 2019), indicating slow ELVs development. Recent research by Economic Research Institute for ASEAN and East Asia (ERIA) highlights Malaysia's progress in establishing Authorized Automotive Treatment Facilities (AATFs) and the e-Dereg system, while acknowledging informal sector dominance remains unresolved (ERIA, 2025). The December 2025 launch of the RM4,000 vehicle scrappage incentive under Budget 2026 represents Malaysia's first substantial fiscal commitment to fleet renewal, though such schemes require parallel public transport improvements to succeed (Transport Policy Review, 2025). Current development indicate that Malaysia's policy context has recently shifted, with government statements indicating no immediate plans to implement mandatory ELV regulations due to public opposition and inadequate public transport alternatives in rural areas (Loke, 2025).

Scholars note a general lack of discussion on standard remanufacturing practices for sustainable development (Jia et al., 2022), urging Malaysia to adopt feasible practices and learn from successful international models in Japan, China, Qatar, and Turkey that feature clear stakeholder roles (Karagoz, Aydin & Simic, 2020; Arora, Bakshi & Bhattacharjya, 2019; Che Rose

et al., 2024). For instance, Qatar and China employ closed-loop supply chain (CLSC) strategies integrated with circular economy models (Zhou et al., 2019; Al-Quradaghi, Kucukvar & Onat, 2018; Ozceylan et al., 2017). India has proposed a shared responsibility framework for robust stakeholder engagement (Arora et al., 2019), while Turkey mandates manufacturer-led free ELV collection, spurring dedicated CLSC networks (Al-Quradaghi et al., 2018). However, existing scholars rarely interrogates the transferability of these models to Malaysia's distinct political economy, characterized by entrenched informal actors, fuel subsidies, and car-dependent mobility patterns. The recent ERIA-MARii seminar explicitly called for greater collaboration amongst government, industry, and academia to build a sustainable automotive ecosystem (ERIA-MARii, 2025). This comparative analysis underscores the value of strategic policy adaptation and stakeholder-centric governance, yet critical questions remain about which elements are transferable and under what conditions.

Despite substantial Malaysian ELV research, including comparative analyses (Tat et al., 2021; Kamaruddin & Rahim, 2022), a significant gap remains. Prevailing studies focus on top-down policy frameworks (KASA, 2020), regulatory comparisons (Mamat et al., 2022), technological challenges (Hassan et al., 2021), and path for effective ELV management (Che Rose et al., 2024). This macro-level, quantitative focus prioritizes system design over implementation realities (Howlett, 2019), creating a critical deficit in qualitative research investigating the on-the-ground operational realities of licensed industry actors. While understanding the informal-formal sector interface is key to waste management success (Wilson et al., 2006; Vermeulen et al., 2011), few apply this lens to licensed AATFs as struggling entities. Consequently, this study addresses this lacuna, building on calls for granular, actor-centered analyses. It pivots to an industry-centric, qualitative examination to elicit firsthand perspectives from licensed AATFs in Malaysia and Japan. By foregrounding industry voices, the research illuminates the regulatory drivers, and their absence that determine operational performance and viability, thereby bridging the gap between legislative intent and practical outcome identified in policy transfer literature (Dolowitz & Marsh, 2000).

Crucially, this study's genuine contribution lies in demonstrating that Malaysia's ELV dysfunction stems from incomplete policy transfer, wherein operational knowledge was successfully transmitted, but the enabling institutional architecture including mandatory financing, last-owner liability, and synergistic economic instruments was not. This insight, grounded in policy transfer theory (Dolowitz & Marsh, 2000), explains why technically capable facilities remain commercially unviable and provides an evidence-based foundation for context-sensitive policy design aligned with Malaysia's political and economic realities.

THEORETICAL FRAMEWORK

This study is anchored in two complementary theoretical perspectives: Institutional Theory (Ostrom, 2005) and Policy Transfer Theory (Dolowitz & Marsh, 2000) which together provide an analytical lens for examining the divergent performance of ELV management systems in Malaysia and Japan.

Institutional theory, as articulated by Ostrom (2005), posits that the performance of any governance system is determined by the interplay between three interconnected elements: formal rules (laws, regulations, policies), informal norms (practices, conventions, cultural expectations), and supporting institutions (market structures, fiscal mechanisms, enforcement bodies). According

to this framework, systems achieve functional coherence when these elements are aligned and mutually reinforcing. System failure occurs when formal rules clash with informal norms, or are undermined by contradictory supporting institutions (Ostrom, 2005). This framework is particularly relevant to comparative ELV policy analysis because it directs attention beyond the mere presence of legislation to the broader institutional ecosystem within which that legislation operates. It provides conceptual tools for diagnosing why similar policy designs may produce divergent outcomes across different national contexts. For this study, institutional theory will be employed to examine the degree of alignment or misalignment between Malaysia's formal ELV policy, the informal practices that govern vehicle disposal, and the supporting fiscal and transportation institutions that shape owner behavior. The theory sensitizes the analysis to how contradictory institutional signals can systematically undermine formal policy objectives, a dynamic that existing literature suggests may be central to Malaysia's implementation challenges (Varman et al., 2021; Tat et al., 2021).

Policy transfer theory, pioneered by Dolowitz and Marsh (2000), provides a complementary framework for understanding how policies, administrative arrangements, and ideas move from one political system to another. The theory distinguishes between different degrees of transfer such as copying (complete adoption), emulation (adoption of the ideas behind a policy), combinations (mixtures of policies from different sources), and inspiration (where policy in another jurisdiction inspires novel change but does not directly draw upon it) (Dolowitz & Marsh, 2000). Crucially, the theory identifies conditions under which policy transfer can be failed: (a) uninformed transfer (where the borrowing country has insufficient information about the policy and its operation), (b) incomplete transfer (where crucial elements that made the policy successful in the originating country are not transferred), and (c) inappropriate transfer (where insufficient attention is paid to differences in economic, social, political, or ideological contexts between lender and borrower) (Dolowitz & Marsh, 2000). Policy transfer theory will guide the analysis in examining which elements of the Japanese system were adopted, which were omitted, and whether the transfer process adequately accounted for contextual differences between the two nations.

The integration of two theoretical perspectives offers a robust foundation for the empirical analysis. Policy transfer theory will be used to examine the nature and completeness of Malaysia's adoption of Japanese ELV policy elements, identifying what was transferred, what was omitted, and how contextual factors may have been overlooked. Institutional theory will then provide the analytical tools to examine how the resulting policy configuration interacts with Malaysia's existing institutional landscape (i.e. informal norms, market structures, and contradictory fiscal policies) to produce the observed outcomes.

METHODOLOGY

This study employs a qualitative comparative case study design to investigate the regulatory and operational ecosystems of ELV management in Malaysia and Japan. According to Yin (2018), the comparative case study approach is appropriate for examining how contextual factors shape policy implementation outcomes across different national settings. Methodological triangulation that is combining of document analysis, site observations, and focus group discussions enhances analytical rigor and validity. Two benchmark facilities were purposively selected, Carmedic Sdn Bhd (Malaysia) and Kaiho Sangyo Co. Ltd (Japan). Carmedic Sdn Bhd is one of only five designated AATFs in Malaysia and is widely regarded as among the largest and most

technologically advanced (KASA, 2026), having received direct technical training from Kaiho Sangyo Co Ltd. Kaiho Sangyo is a leading AATF in Japan, recognized for its advanced ASR processing capabilities. While the sample size of one facility per country is an acknowledged limitation, the depth of qualitative inquiry at these benchmark sites provides rich, contextualized insights into the mechanisms driving performance (Flyvbjerg, 2006).

Data collection proceeded in three phases. *First*, comprehensive document analysis examined national policy frameworks (Malaysia's ELV Management Policy, Japan's Automobile Recycling Law) and reports from JARC and KASA. *Second*, site visits were conducted at Carmedic (12 June 2025, and 20 January 2026) and Kaiho Sangyo (24–25 November 2025). Non-participant observation focused on operational workflows, technology deployment, and material handling. *Third*, semi-structured Focus Group Discussions (FGDs) were conducted. At Carmedic, the discussion engaged a company director (CM1). At Kaiho Sangyo, two managerial informants (KS1, KS2) and one operational specialist (KS3) took part. The FGD protocol explored component recycling workflows, the impact of national laws, labor dynamics, technological capabilities, and operational constraints. Data were captured via audio-visual recordings and field notes, supplemented by photographic documentation.

All recordings were transcribed verbatim. Analysis followed thematic analysis (Braun & Clarke, 2006), beginning with familiarization with transcripts and secondary documents. Initial codes were generated inductively (e.g., "feedstock insecurity") and deductively (e.g., "EPR implementation") from literature. Codes were collated into themes such as regulatory enforcement, economic viability, technological adoption which captured divergent manifestations across national contexts. Triangulation was achieved by systematically comparing findings across the three data sources. Several limitations warrant acknowledgement. First, the single-company-per-country sample limits generalizability, though the facilities selected are acknowledged leaders in their respective national contexts. Second, the shorter duration of visit restricted observational depth, partially mitigated by two separate engagements. Third, reliance on self-reporting in FGDs introduces potential social desirability bias, addressed by triangulating with observational and documentary evidence. Fourth, language barriers during Japanese site visits required interpretation, which may have introduced subtle meaning distortions despite efforts to verify translations with informants. Finally, the study's qualitative design prioritizes depth over breadth; findings should be complemented by future quantitative research examining sector-wide patterns.

FINDINGS & DISCUSSION

GENERAL INFORMATION ON ELV PERFORMANCE: MALAYSIA vs. JAPAN

Table 1 reveals a systemic chasm explaining the divergent ELV outcomes. Japan's larger vehicle population yields a massive, predictable annual stream of over 3 million ELVs, enabled by its Shaken inspection system. This scale sustains its extensive network of over 6,500 certified facilities. Conversely, Malaysia's smaller fleet generates an estimated 550,000 ELVs annually, but the flow is erratic due to the absence of a mandatory retirement trigger. This uncertainty stifles investment, evidenced by only four designated formal AATFs. Critically, Japan's finance-backed regulatory framework has rendered the informal sector negligible, ensuring total control. Malaysia exhibits the opposite, a tiny formal sector (4 AATFs + 207 non AATF formal processors) coexists with a vast informal network capturing 70-80% of ELVs, outcompeting and starving formal infrastructure through immediate cash transactions and minimal overhead.

In Japan, the formal collection rate crystallizes the outcome of these structural differences. Japan's near-perfect rate is a function of systemic design where the ELV is legally and financially channeled into formal pathways. In contrast, Malaysia's 20-30% rate is a symptom of systemic failure, where voluntary policy cannot compete with the informal cash economy. The divergence highlights that the core challenge is not vehicle volume but governance. Japan's policy ecosystem engineers for a compliance of a larger fleet, while Malaysia's smaller problem remains intractable as its policy is merely a recommendation in a differently governed market. Bridging this gap requires moving beyond establishing AATFs to fundamentally restructuring the economic incentives for the final vehicle owner and integrating (rather than ignoring) informal sector.

TABLE 1. Comparative Analysis of Vehicle Population and ELV Management Infrastructure:
Malaysia vs. Japan (2025 Estimates)

Parameter	Malaysia	Japan	Sources
Total Registered Vehicles (2025)	~ 33.2 million	~ 78.5 million	Malaysia: JPJ Annual Report Projection. Japan: MLIT Statistics.
Estimated Annual ELVs Generated	~ 550,000	~ 3.2 million	Malaysia: KASA & Industry Estimate (1.6% of fleet). Japan: JARC Historical Rate (4% of fleet).
Formal AATF / ASR Processing Facilities	4 Designated AATFs (+ 207 non AATF formal processors under MARAA)	~ 6,500 JARC-Certified Facilities	Malaysia: Ministry of Environment & Water (KASA); Malaysian Automotive Recyclers Association (MARAA). Japan: JARC Registry.
Estimated Informal / Unregulated Dismantlers	1,500 - 3,000+ entities	Negligible (effectively marginalized)	Malaysia: Scholarly estimates (Sidek et al., 2023) & industry intelligence. Japan: Enforced regulation;
Formal ELV Collection Rate	20% - 30% (of estimated ELVs)	> 99% (via mandatory system)	Malaysia: Industry & academic estimates (Tat et al., 2021). Japan: JARC Performance Data.

REGULATORY DRIVERS BEHIND DIFFERENT PERFORMANCES: JAPAN VS. MALAYSIA

Information triangulated from Focus Group Discussions (FGDs), on-site observations, and secondary sources reveal five critical regulatory drivers underpinning the divergent ELV management performance between Japan and Malaysia.

REGULATORY FRAMEWORKS: MANDATORY RESPONSIBILITY VS. VOLUNTARY GUIDANCE

The legal character of the governing framework creates fundamentally different operating realities in both nations. Japan's Automobile Recycling Law explicitly assigns responsibility under Article 4, mandating that the registered owner ensures proper recycling. This legal obligation is operationalized through a mandatory pre-paid Recycling Fee, creating an unbreakable financial and administrative chain from last owner to certified recycler. While the law itself does not mandate recycling within 10 years, its economic and regulatory ecosystem creates this *de facto* outcome. The key informant revealed how this regulatory frameworks creates operational certainty:

...here [*in Japan*], to ensure safety of road vehicles and to promote the good environment, no automobiles shall be operated unless they conform to the safety regulations. To us, the law is the circuit breaker. When an owner wants to deregister their car within 5-10 years, the system automatically directs them to a certified recycler like us.

(Informant KS1)

The safety regulation explained by the informant KS1 is generally refers to Articles 40- 42, Article 44, and Article 45 of the Japan Road Vehicles Law (2002). The Law prescribes the registration of all vehicles such as automobiles, motor bikes and light-weight vehicles (Chapter II), the standards for safety of road vehicles and prevention of environmental pollution (Chapter III), the inspection and maintenance of road vehicles (Chapter IV), the check-ups (Chapter V) and the automobile maintenance business in implementation of these inspections (Chapter VI). In term of prepaid recycle fund, the Informant KS2 asserted that: "...users have already paid the fee to JARC during vehicle registration, so there is no financial negotiation cost of recycle. Our role is to process the ELV to follow legal standard, and report to JARC, and receive payment. The transaction is not about the scrap value, we paid users only if there any profit surplus from recycled components; so this is about fulfilling a legal and environmental contract".

The above "environmental contract" that fundamental to Japan's success is absent in Malaysia. Informant CM1 described a landscape of "*voluntary choice*" and "*direct competition*", emphasizing that owners choose between "immediate, untraceable cash from informal scrapyards or a lower, formal offer". In term of framework regulation and certainty of recycling feedstock, Informant CM1 emphasized that:

...the policy says they should use an AATF, but there is no 'must'. Yet, no specific law approved for this formal recycle under MOT or KASA. So we are not in the law but outside it, and we are trying to compete in a market that operates on completely different rules compare to other developed country like Japan.
 (Informant CM1)

Observations at the yards confirmed this systemic disparity. At Kaiho Sangyo, a consistent flow of complete, relatively young vehicles (5-10 years old) array via organized logistics, each tagged with a coded sticker detailing its processing destiny (resale parts, component dismantles or shredded). In contrast, Carmedic's yard received a quite sporadic, often pre-cannibalized vehicles, a condition termed by CMI as "...bald car syndrome", where the informal sector extracts high-value components, leaving the formal AATF with the liability of the stripped shell". This operational reality stems from a foundational regulatory gap: Malaysia's non-binding framework lacks last-owner liability, creating an accountability vacuum that handicaps formal operators (Table 2).

TABLE 2. Comparison of Key Regulatory Elements

No	Parameter	Malaysia	Japan
1	Legal Status	Voluntary Policy (Under Review). No specific law on ELV.	Enacted (ELV Recycling Law, No. 87 of 2002)
2	Core Principle	Aspirational EPR (Producer-focused)	Strict EPR with Last Owner Liability
3	Financial Mechanism	Proposed but not implemented	Pre-paid, Mandatory Recycling Fee
4	Targets	Stated, but non-binding	Legally Binding (95% recovery)

Sources: Fieldwork, 2025; related documents (NAP 2020; Japan Automobile Recycle Law, 2002)

Japan's system, codified in enacted law (No. 87 of 2002), establishes strict EPR with explicit last-owner liability, a secured pre-paid recycling fee that decouples revenue from scrap value, and a legally binding 95% recovery target, creating an enforceable performance benchmark. In contrast, Malaysia's approach remains a voluntary, non-binding policy grounded in aspirational EPR principles that fail to place direct obligations on the final owner. Consequently, Malaysia's system is built on discretion, while Japan's is constructed on obligation and secured finance.

THE FINANCIAL MECHANISM: SECURING VIABILITY VS. SUBSIDIZING INFORMALITY

The financing model represents the most critical differentiator underlying the divergent performances in ELV management between the two countries. Japan's system is anchored by a mandatory pre-paid recycling fee (approximately ¥15,000, or RM500) managed by the Japan Automobile Recycling Promotion Center (JARC). This mechanism severs the direct link between an ELV's fluctuating scrap value and the recycler's core revenue, providing economic certainty and de-risking capital investment. This institutionalized financing empowers Japanese AATFs to invest in advanced, capital-intensive processing technologies that essential for achieving high recovery rates.

...because JARC pays us a fixed fee to process the ASR, we can justify investing in eddy-current separators, optical sorters, and other technology to recover ferrous, non-ferrous metals and plastics. We always try our best to ensure our business model is to maximize recovery, to meet the 95% target, because that is what we are paid to do. The value of the recovered materials is a bonus, not the core revenue

(Informant KS1)

Observations at Kaiho Sangyo yards corroborated this operational scale and technological sophistication. The recycling facilities for ferrous, non-ferrous, and plastic materials housed an array of advanced, automated machinery operating in a sequenced material separation line. The process included dedicated systems for recycling rubber and plastic components from vehicle bodies such as bumpers and panels, able to produce granulated rubber and plastic pellets for secondary manufacturing. Further processing lines handled coated conduit materials, wiring, and electrical components to recover copper, other non-ferrous metals, and various grades of alloys and steel scraps. These materials were subsequently processed through specialized recycling machinery, some are compacted into high-density bales for reuse in domestic industries or for export. The operation at Kaiho Sangyo presented not as a waste disposal site, but as a highly efficient urban mine, systematically producing consistent streams of ferrous, non-ferrous, and plastic commodities.

Conversely, Malaysia's financial model is both inverted and precarious. Formal AATFs like Carmedic Sdn Bhd must purchase ELVs outright from owners at market price, placing them in direct, unfair competition with informal dismantlers who operate with minimal overhead and avoid environmental and tax compliance costs. The Informant CM1 detailed the severe operational consequence stating that: "...every ringgit we pay for a car send by customer generally less than our operations, wages, or equipment cost. The informal, have almost no overhead because they don't responsible to environmental controls, therefore they can always outbid us". This flawed financial architecture triggers a systemic failure. Therefore, to remain solvent, Carmedic is "forced" to prioritize quick-stripping high-value parts from scarce vehicles over the systematic, full-material recovery for which it was trained. Despite a significant investment (over than RM3 million) and direct Japanese technical training, the facility's primary constraint remains a chronic ELV feedstock shortage. According to Informant CM1, the "users are economically rational to choose informal agents for "higher, immediate cash payments," rendering manufacturer-led trade-in rebates a positive but "*structurally insufficient*" stimulus". According to informant, success requires "regulated channels, stipulated by a dedicated Act of Parliament" as a prerequisite for a circular automotive transition:

...looking toward the future, I suggest that Malaysia critically requires the establishment of a national recycling fund and a corresponding legal obligation for vehicle owners to dispose of end-of-life vehicles through formal AATF channel.

(Informant CM1)

Observations at Carmedic's yard confirm that the company has made substantial capital investment and fully complies with KASA standards. The facility's technical capacity able to process more than 1,500 vehicles monthly, yet it faces a critical shortage of ELV feedstock due to low voluntary consumer delivery. This shortage stems from the absence of a mandatory consumer-financed recycling fee and ELV law, a foundational element of the Japanese system.

THE BROADER ECONOMIC ECOSYSTEM: *ENGINEERING SUPPLY VS. ENCOURAGING LONGEVITY*

The true robustness of Japan's ELV system emerges from policy integration that extends well beyond the environmental ministry. The compulsory vehicle inspection (*Shaken*), high fuel taxes, age-progressive (weighted) road tax rates, and expensive parking and toll fees collectively render prolonged retention of older vehicles economically irrational. Informant KS2 directly linked this policy synergy to operational viability, explaining that:

...the vehicles received for dismantling or shredding are typically 5–10 years old, as owners generally retain them only until the cost of the next *Shaken* inspection exceeds the vehicle's residual market value.

(Informant KS2)

Field trip in Japan (24–28 November 2025) using rental vehicles (Toyota Prius hybrid 1.5cc, and Alphard ANH20 2.5cc), spanning approximately 3,000 kilometers from Tokyo–Osaka–Kyoto, and encompassing both northern and southern regions, substantiate these economic disincentives. Travel-related costs including tolls, fuel, and parking are substantially much higher than in Malaysia. During trip, the retail price for fuel of equivalent quality RON95 is approximately RM5.80 per liter in Japan compared to the heavily subsidized (BUDI MADANI) rate of RM1.90 per liter in Malaysia. Similarly, parking fees in enclosed urban facilities in Japan average between RM19–38 per hour, in contrast to rates typically ranging from RM1.50–5.00 per hour in Malaysian city centers. Some of the comparative elements regarding vehicles ownership between Malaysia and Japan can be observed in Table 3. According to table, Japan has deliberately engineered a transportation ecosystem where retaining aging vehicles incurs escalating punitive costs. The Total Cost of Ownership (TCO) calculus heavily disincentives vehicle retention beyond ten years, with the *Shaken* inspection fee 80–150 times higher than Malaysia's equivalent, functioning as a primary retirement trigger. This financial pressure is reinforced by operating costs 180–280% higher for fuel and 300–600% higher for urban parking. Conversely, Malaysia's policy framework actively subsidizes prolonged vehicle retention. Fuel prices at roughly one-third of Japan's market rate, coupled with minimal inspection fees, create economic incentives for motorists to maintain vehicles for 15–20 years or more. This generates a fundamental policy contradiction: while environmental authorities advocate ELV recycling through aspirational policies, national fiscal and transportation frameworks provide subsidies, low taxation, and minimal ownership disincentives.

TABLE 3. Comparative Vehicle Ownership Costs (2025)

Parameter	Country		Sources	
	Malaysia	Japan	Malaysia	Japan
Toll Rate (Tokyo-Osaka-Kyoto Loop)	RM 180 - RM 200 (KL-Penang, or equivalent distance)	¥16,000 - ¥18,000 (≈ RM 500 - RM 560)	PLUS Malaysia Berhad (2025) Toll Rates	NEXCO Central (2025) Toll Calculator
Compulsory Vehicle Inspection (<i>Shaken</i>)	RM 30 - RM 100 (Puspakom inspection fee)	¥80,000 - ¥150,000+ (≈ RM 2,500 - RM 4,700) for a 10-year-old mid-size car	Puspakom Sdn Bhd Official Fee Schedule (2025)	Japan Automobile Inspection Association (2025)
Annual Automobile Tax (Weight-Based)	RM 90 - RM 380 for common 1.6L-2.0L engines	¥34,500 - ¥50,500 (≈ RM 1,080 - RM 1,580) for standard sedans	Road Transport Department (JPJ) Malaysia (2025)	Ministry of Internal Affairs & Communications, Japan (2025)
Fuel Price (RON 95 Equivalent)	RM 1.90-2.05/Liter (subsidized)	¥185/Liter (≈ RM 5.80/Liter)	Ministry of Finance Malaysia, Set Price (Jan 2025)	Ministry of Economy, Trade and Industry (METI) Japan, Weekly Average (Jan 2025)
Urban Parking Rate (Per Hour)	RM 1.50 - RM 5.00 in Kuala Lumpur City Centre	¥600 - ¥1,200 (≈ RM 19 - RM 38) in Tokyo/Shibuya wards	DBKL Kuala Lumpur Parking Rates (2025)	Tokyo Metropolitan Government Parking Authority (2025)

Sources: various sources as explained (average exchange rate, 2025)

Japan's ELV pre-eminence thus derives not solely from recycling legislation but from a coordinated suite of economic instruments deliberately designed to disincentives prolonged ownership. Age-progressive taxation, compounded by high operational costs, sharply increases TCO for aging vehicles, engineering a faster turnover cycle (typically 5–10 years). These synergistic pressures systematically drive older vehicles toward retirement and formal recycling channels. Malaysia's approach, conversely, presents a fundamental policy contradiction, while environmental authorities advocate ELV recycling, fiscal and transportation policies subsidize prolonged vehicle lifespans, directly undermining circular economy objectives. The Informant CM1 explained this operational consequence by stating that:

...in many cases, the vehicles we eventually receive for dismantling are often around 15-20 years old, heavily corroded, and have undergone multiple repairs, some with non-original parts. They are more labor-intensive and costly to process, yield lower-quality materials, and offer minimal reusable component value.

(Informant CM1)

The economics are fundamentally challenging because the policy envisions a circular economy, but the broader national economy policies provide every incentive for consumers to retain vehicles within a linear system indefinitely.

THE INFORMAL SECTOR: *DOMINANT VS MARGINALIZED*

The role and regulation of the informal sector fundamentally shape the competitive landscape within each country's ELV management ecosystem. In Japan, stringent certification requirements, coupled with the JARC-managed financial mechanism, have effectively marginalized informal dismantlers. These operators are structurally excluded from accessing the ELV stream without violating the legally mandated vehicle deregistration process, ensuring a level playing field for certified facilities like Kaiho Sangyo. As Informant KS2 explained, "...the informal dismantler in Japan is not a competitor to us, because it is an outlaw." Informant KS1 further elaborated on the systemic barrier:

“...the moment an owner wishes to deregister a vehicle, the system through JARC and the *Shaken* record will directs that vehicle to us. For an informal operator to get that car, they would have to convince the owner to forgo deregistration entirely, which is normally illegal and forfeits any potential future registration”

(Informant KS1)

In Japan, the legal and financial architecture is systematically designed to direct ELVs toward certified recyclers, making formal disposal the default and rational choice. In Malaysia, the dynamic is inverted. As Informant CM1 explained, the informal sector does not merely compete with formal operators, it constitutes the market itself:

...currently, they are not our competitors, but they are actually the market. We are the alternative”. We have to explain to owners why they should choose us on the value proposition of preserving environmental care, proper documentation, but these, for many has no market price.

(Informant CM1)

Field observations at Carmedic revealed that certain salvaged components were displayed with accompanying price lists for generic parts. According to Informant CM1, the company has also established online sales channels, including engagements through social media platforms, in an effort to compete with the informal and aftermarket sectors for component resale. This strategy, however, represents a divergence from their primary mandate as comprehensive recyclers.

1.5. PREDICTABLE STOCK AND MARKET DEMAND: *VAST VS LIMITED*

The high, predictable turnover of vehicles in Japan, driven by the *Shaken* system, provides AATFs companies with a consistent flow of relatively young ELVs (average 5-10 years old). This creates two powerful revenue streams that are unavailable in Malaysia, that is the market for quality used parts ("fresh parts") and a stable, high-volume supply of homogeneous materials for recycling. The market for Japanese used parts is a global industry, driven by the reputation for reliability of brands like Toyota, Honda, and Suzuki, as explained by Informant KS1:

...our dismantling lines are designed for efficiency because we know the models. We receive hundreds of the same Toyota Aqua, or Honda Fit each year. The engines, transmissions, and electronic modules from cars under 10 years old have a very strong market worldwide. We test, certify, and export them globally to Southeast Asia, the Middle East, Africa, even Eastern Europe. This isn't just scrap; it's a global supply business for affordable, reliable parts. This revenue is what funds our deeper investment in material.

(Informant KS1)

Conversely, Malaysia's slow vehicle turnover results in ELVs that are older, more corroded, and often repaired with non-genuine parts. This drastically reduces the quality and value of the salvageable components. While there is domestic demand for local Proton and Perodua parts, the international market for these brands is limited, confining the potential revenue from parts export. This creates a "scavenger economy" for Malaysian AATFs, where they must compete for a small, irregular supply of low-quality feedstock with limited revenues for high-value recovery:

...parts sales are our lifeline, but it's a constant struggle. The cars we get are too old. A 20-year-old Proton Wira engine has little value. The market for local parts is hyper-competitive and price-sensitive, dominated by the informal 'half-cut' shops. For export, there is almost no demand for used Proton parts overseas. So, we are stuck in a small, low-margin local market. We cannot predict our parts inventory from month to month because we cannot predict what cars will come in. Without volume and quality, we cannot build a real parts business.

(Informants CM1)

This disparity in market demand creates a self-reinforcing cycle. Japan's system generates a high-quality, predictable parts commodity with global appeal, which in turn finances the technologically intensive recycling of the remaining materials (the "residue"). Malaysia's system yields a low-quality, unpredictable parts commodity with only local appeal, which cannot generate sufficient capital to improve the recycling of the residue. Thus, the "predictable stock and market demand" factor is not a passive condition but an active outcome of the broader policy framework.

CONCLUSION AND POLICY IMPLICATION

The comparative analysis reveals that Japan's superior ELV performance (achieving over 95% recycling) is not solely attributable to technological advantage but to a coherent socio-technical system where institutional alignment eliminates contradictory policy signals. Based on analysis, Japan's success is due to successful integration of stringent regulation (binding EPR with last-owner liability via JARC), powerful economic disincentives (*Shaken*, progressive taxation, high ownership costs), and stable secondary material markets. This alignment of formal rules, informal compliance norms, and synergistic supporting institutions creates what Institutional Theory predicts as a functional governance system (Ostrom, 2005).

In contrast, Malaysia's approach, as documented by Kamaruddin & Rahim (2022); Tat et al. (2021); Che Rose et al. (2024); and Harun et.al (2021) is characterized by a policy-market disconnect. The voluntary ELV Management Policy exists in direct conflict with a national economic framework that subsidizes vehicle ownership through cheap fuel and low taxes, actively encouraging the extended vehicle lifespans that starve formal AATF recyclers. The result, as observed at Carmedic's yards is a condition where a formal sector trapped in a vicious cycle. Without a guaranteed feedstock, mandatory law and payment mechanism, it cannot invest in advanced technology, therefore cannot achieve high-value recovery, profitability, or compete with the informal and non-AATF sectors. This findings aligns with Institutional Theory that predicts system "failure" when formal rules (ELV policy) clash with informal norms (cash-based informal disposal) and contradictory supporting institutions (example: fuel subsidies).

Applying policy transfer theory (Dolowitz & Marsh, 2000) illuminates why Malaysia's institutional misalignment persists despite sustained engagement with Japan's model. Malaysia's adoption of Japanese ELM practices represents a clear case of incomplete and symbolic transfer. While Malaysian personnel received direct technical training and adopted operational elements (e.g. dismantling protocols, facility design, AATF certification), the critical institutional architecture that makes Japanese operations viable was not transferred. The missing elements are precisely those identified by institutional theory as essential for system coherence: (a) the mandatory pre-paid recycling fee managed by a third-party fund (JARC), which severs the link between scrap value and recycler revenue; (b) last-owner legal liability, which creates an enforceable chain of accountability; and (c) the synergistic economic instruments (*Shaken*, progressive taxation, petrol price) that engineer a predictable ELV supply.

Thus, what was transferred was operational knowledge, but this transfer occurred in isolation from the complementary legal and financial mechanisms that give such knowledge practical effect within Japan's functional ecosystem. This incomplete transfer produced symbolic policy adoption: frameworks were articulated, AATFs were designated, and technical capacity was built, but without the accompanying legal and financial commitments necessary to make the system functional. The underlying of market failure, the dominance of the informal sector is

remained untouched, creating an appearance of progress while leaving structural contradictions unresolved. This finding aligns with policy transfer theory's prediction suggesting that incomplete transfer, where crucial elements are omitted, inevitably leads to implementation failure (Dolowitz & Marsh, 2000).

While Japan provides an ideal benchmark, a direct transplantation of its model is socio-politically untenable for Malaysia. Japan's system relies on a high-cost, high-regulation societal contract that trades individual automotive freedom for collective environmental efficiency. Imposing Japan's punitive *Shaken* costs or removing fuel subsidies in Malaysia would be politically catastrophic, perceived as an attack on middle-class affordability in a car-dependent nation with inadequate public transport. As noted by Varman et al. (2021), automotive policy in Malaysia is deeply intertwined with notions of social equity and development. This political sensitivity is underscored by the failure of the 2009 Vehicle Lifespan Policy, which proposed mandatory inspections for older vehicles and met significant public opposition (Azmi et al., 2013). This reality underscores a key insight from policy transfer theory of "inappropriate transfer" where insufficient attention in economic, social, and political contexts between lender and borrower is a primary cause of policy failure (Dolowitz & Marsh, 2000). Malaysia's pathway, therefore, cannot replicate Japan's model but must forge a hybrid approach that adapts core EPR principles to local political, economic, and cultural realities.

Instead of a full Japanese transplant, Malaysia should synthesize lessons from other nations that have successfully formalized their ELV sectors. Among are the Chinese "OEM-Led Formalization" Model (2020) that mandate vehicle manufacturers to establish recycling networks and meet collection targets (Wang et al., 2022). For Malaysia, this could be adapted by legally obliging car producers like Proton, Perodua, and other OEM or importers to establish partnership with AATFs. Incentives could link the mandatory recycling of old vehicles for approvals of importing or manufacturing new units, creating a business-driven push for ELV collection. The EU-Inspired "Green VAT & Incentive" Model also beneficial to follow. Rather than a punitive pre-paid fee, Malaysia could implement a "Circular Economy Rebate" funded by a small, ring-fenced levy on new vehicle sales. The last owner surrendering an ELV to a formal AATF would receive this rebate (e.g., RM 500-800 or higher), making it financially competitive with the informal cash offer. This "carrot" approach, coupled with a strict ban on deregistration without a certificate of proper disposal (the "stick"), aligns with local sentiment by providing a benefit, not a penalty. The "Integrated Informal Sector" Model (inspired by Latin American & Indian Experiments), may also be adopt since attempts to eradicate informal dismantlers will affect backlash to government. Malaysia policy should focus on gradual formalization. This could include a licensing and training program for credible informal dismantlers, who would then gain access to a "Last Owner Rebate" pool when they channel ELVs to partner AATFs for final ASR processing. This measure is appropriate given the current context where only four AATFs are registered in Malaysia under the KASA compared to approximately 7,000 in Japan. By increasing numbers of formal collectors, the objective shifts from futile competition to strategic collaboration, effectively transforming informal operators from market adversaries into a decentralized, incentivized collection arm for the formal recycling chain, thereby closing the critical feedstock gap.

Addressing Malaysia's institutional misalignment requires interventions across all three dimensions of Ostrom's (2005) framework: formal rules, informal norms, and supporting institutions. Malaysia's path is not to replicate Japan *per se*, but to forge a coherent domestic system. A viable roadmap includes: (1) Enacting a Mandatory ELV Act with an Incentive-Based

Fund, financed by a levy on new vehicles to provide a "Citizen Recycling Rebate"; (2) Launching a National Vehicle Renewal Program with domestic OEMs, offering discounts on new vehicles for ELVs processed formally; (3) Catalyzing markets for secondary materials through government procurement mandates for recycled content in public projects, creating a "market-pull" for AATF outputs; and (4) Formalizing the informal sector through licensing and training, integrating dismantlers as a regulated collection network. In conclusion, Malaysia's path to effective ELV management lies not in aping Japan's high-cost, high-control model, but in strategic adaptation. It must craft a uniquely Malaysian solution that respects its political economy, leverages its industrial structure, and transforms its ELV challenge from a persistent environmental failure into a cornerstone of its national circular economy and green industrial strategy.

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