



**TURNING THE USED VEHICLE TRADE FROM
BURDEN TO OPPORTUNITY**
A PROPOSAL FOR AN INDUSTRY-LED WORK
PROGRAMME

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EXECUTIVE SUMMARY

Over just three years, from 2015 to 2018, ca. 14 million used light-duty vehicles (LDVs) were exported from Europe, the USA and Japan to low- and middle-income countries (LMICs). (1) Many have poor safety and emissions standards, contributing to air pollution and road accidents in the LMICs. **This trade is inhibiting efforts to support sustainable development and combat climate change.**

There are three critical areas to address the issue:

Curbing exports of poor-quality end-of-life vehicle (ELVs);

Repairing and upgrading vehicles that fail to meet minimum import requirements;

Ensuring vehicle lifetime extension and end-of-life management in importing countries.

Numerous international organisations are striving to tackle these challenges. Current work programmes and actions focus on filling data and policy gaps to enhance the existing state of the used vehicle trade. The review shows that three gaps remain in the current work on used vehicles:

Assessment of profit pools: Current work programmes do not sufficiently assess the economic and business value around the used vehicle trade.

Assessment of solution pathways to scale industrialised circular processes: Future research must assess how the necessary technologies and solutions can be commercialised and scaled.

Proof of concept of circular business models in importing countries: It is important to develop an on-the-ground proof of concept that tests the business case for vehicle recycling in importing countries.

A gap exists around industry action and developing profitable business models that help make the used vehicle trade fair and equitable. Mobilising the private sector will complement and support policy efforts to regulate the global vehicle trade and develop clear business cases for circular automotive levers.

This whitepaper proposes a work programme that enables industry action in addressing the critical challenges of the used vehicle trade and which complements existing efforts by international organisations. Its approach is based on two approaches, consisting of top-down and bottom-up actions:

The first approach seeks to develop an industry-wide perspective on transitioning to a circular used vehicle trade, evaluating profit pools of circular business models, pinpointing solution pathways, and rallying industry support for international initiatives

The second approach concentrates on establishing an on-the-ground proof of concept for end-of-life vehicle (ELV) management and recycling in LMICs while identifying policy, technology, and investment gaps essential for scaling circular business models

Drawing inspiration from the Mission Possible Partnership (2) and Project STOP (3), this programme seeks to **assemble stakeholders from the automotive value chain, financiers, and other industry actors for strategy formation and implementation.** In the coming months, **the work programme will be refined** in collaboration with industry leaders, OEMs, policymakers and other key stakeholders **to launch an industry-validated and backed work programme on the used vehicle trade.**



1 CONTEXT AND APPROACH FOR THE WHITEPAPER DEVELOPMENT

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This section provides a short overview of the study's motivation and the approach taken to develop this whitepaper.

1.1 MOTIVATION FOR THE STUDY

The global trade of used vehicles currently leads to burdens in importing countries. With new dynamics ranging from the phase-out of petrol vehicles in lead markets and large volumes of used cars starting to enter China, action against illicit trade must be re-hashed. The ongoing EU End of Life Vehicle Directive review is a timely opportunity. Efforts of international organisations, most notably the Used Vehicles Workplan by the UN Environmental Programme, establish a valuable connecting tissue for global action.

The hypothesis underlying this whitepaper is that there is a gap around catalysing industry action to address the issues around the used vehicle trade. Specifically, it is believed that a comprehensive work programme that also activates industry with a view on business opportunities could considerably accelerate and raise chances of success.

This work was made possible through the Climate Compatible Growth Programme (CCG), funded by the UK's Foreign, Commonwealth and Development Office (FCDO). It aims to further detail, validate, and plan the approach, align with the critical actors mentioned above and initiate fundraising to allow this programme to become actionable.

1.2 METHOD

The content of this whitepaper was derived through desk-based research, a series of expert interviews, and a workshop with key organisations working on this issue. The project was carried out between February and March 2023.

Desk-based research: Desk research into the issue was carried out to identify existing activities, relevant governance frameworks (national/regional and international), economic and impact opportunities.

Expert Interviews: 15 interviews were conducted to understand the business opportunity around a circular global vehicle trade. This included experts from key international organisations and actors along the automotive value chain (i.e. automotive steel & plastics suppliers; OEMs; aftermarket players; recyclers).

Validation workshop: An online workshop with key experts from international organisations and industry associations was conducted to present, validate, and help refine the initial findings. The represented organisations were: African Association of Automotive Manufacturers, African Automotive Data Network, CCG, European Commission, German Association of the Automotive Industry (VDA), GIZ, International Energy Agency (IEA), International Council on Clean Transportation (ICCT), International Transport Forum (ITF)/ OECD, Transport & Environment (T&E), United Nations, United Nations Environmental

Programme, UK Department for Energy Security & Net-Zero, UK BEIS ZEVTC, World Business Council on Sustainable Development (WBCSD), World Economic Forum.

1.3 WHERE WE STAND NOW

Section 4 of this whitepaper introduces an initial plan for a work programme to develop industry-led solutions to the challenges of the used vehicle trade. As indicated in the last section of this whitepaper, this is intended to be merely a first proposal for an industry-led work programme and still requires further validation and elaboration with stakeholders.



2 THE CURRENT USED VEHICLES TRADE IS HIGHLY PROBLEMATIC

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This section aims to describe the status quo of the used vehicles trade, outlining the overall volumes and flows and the key sustainability-related concerns.

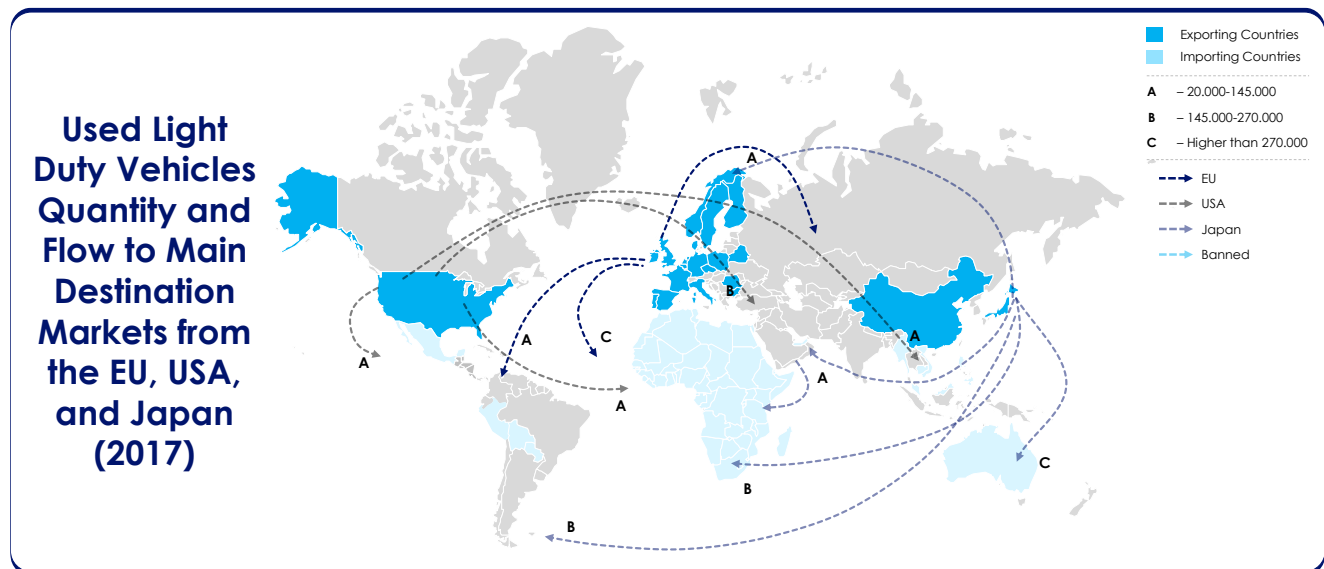


Figure 1 - Overview of the current light-duty vehicle trade (1)

2.1 GLOBAL USED VEHICLE TRADE HAS BEEN GROWING SIGNIFICANTLY

Millions of used cars exported from Europe, the USA and Japan to low- and middle-income countries (LMICs) are inhibiting efforts to support sustainable development and combat climate change. Many have poor safety and emissions standards, contributing to air pollution and road accidents in the LMICs.

The vast majority of used light-duty vehicles (LDVs) originate from three primary exporting nations: the European Union (EU), Japan, and the United States (USA). (1) **Between 2015 and 2018, these nations exported 14 million used LDVs globally,** with the EU accounting for 54% of the total, followed by Japan (27%) and the USA (18%). (1) The EU's primary export destinations are West and North Africa, while Japan primarily exports to Asia, East and Southern Africa, and the USA to the Middle East and Central America. (1)

Seventy per cent of exported LDVs are destined for low- and medium-income countries. (1) Africa imported the largest share (40%) during the studied period, followed by Eastern Europe (24%), Asia-Pacific (15%), the Middle East (12%), and Latin America (9%). In Africa, over 60% of vehicles added to the fleet are imported. (1) In some countries, the reliance is even higher – more than 90% of vehicle needs are met through imported vehicles in Kenya and Nigeria. (1)

Various factors contribute to the export of used vehicles from their countries of origin. (4) These may include prohibitive repair or maintenance costs relative to their value, non-compliance with safety or environmental regulations, or increased demand for older vehicles in the importing country due to market distortions caused by high import tariffs on vehicles, as is common in many LMICs. (4)

2.2 THERE ARE THREE ACTION AREAS FOR INCREASING THE SUSTAINABILITY OF THE USED VEHICLE TRADE

Many used vehicles imported to low- and middle-income countries fail to comply with the existing safety and emissions standards. This significantly exacerbates air pollution and road accident rates in these nations, while hindering the global transition towards net-zero emissions in the transport sector. There are three action areas for increasing the sustainability of the used vehicle trade:

2.2.1 PREVENTING THE EXPORT OF END-OF-LIFE VEHICLES

Many exported vehicles are unfit for road use and contribute to pollution, climate emissions, and decreased road safety in the receiving countries. In Europe, approximately 6 million ELVs are disposed of each year, as per Eurostat statistics. (5) However, **an additional 3.4 to 4.7 million deregistered vehicles remain unaccounted for annually.** (5) A significant portion of these untraceable vehicles are exported, often to Africa. The illicit dismantling and export of ELVs are primarily driven by profits from the sale of spare parts and metals, frequently bypassing proper de-pollution measures to avoid additional costs.

A study conducted by the Dutch government discovered that the quality of **many used cars exported to West Africa resemble the group of end-of-life vehicles** in terms of age, Euro emission class, and mileage. (6) **Approximately 50% of the vehicles exported to African countries were not roadworthy**, and about **80% would not meet stricter import requirements**, such as the minimum Euro 4/IV emission standard in East Africa. (6)

The export of end-of-life vehicles poses a challenge for exporting nations, as it competes with recycling. In the Netherlands, for instance, a recycling fee has already been paid for these vehicles; however, **only about one in three ELVs ultimately reaches a recycling company**, where they are dismantled under controlled conditions and with a high rate of material reuse. (6) In light of the battery electric vehicle (BEV) transition, concerns about raw material supply will increase the importance of closing material loops.

There are increasing pressures by policymakers in exporting countries to secure access to materials contained in ELV, particularly critical raw materials, by leveraging recycling. For example, the proposed EU Critical Raw Materials Act and the new EU Battery Regulation introduce targets for the recycling of battery materials. The EU Critical Raw Materials Act introduces a target that 15% of the EU's 2030 critical raw material need should be met through domestic recycling capacities, while the EU Battery Regulation sets recycled content targets. (7) For lithium, for example, the regulation sets recycled content targets of 6% by 2031 and 12% by 2036. (8) Similar pressures were introduced in the US with the US Inflation Reduction Act. (9) Given these concerns around developing domestic raw materials supply for BEV production, there will likely be an increased focus on recycling ELVs as the EV transition progresses.

2.2.2 REPAIRING / UPGRADING VEHICLES THAT DO NOT MEET MINIMUM IMPORT REQUIREMENTS

The second issue pertains to the export of vehicles that have not yet reached their end-of-life but fail to meet required standards due to certain deficiencies. Potential problems can range

from **deficient or missing catalytic converters or diesel particulate filters** to minor deficiencies such as malfunctioning doors, bonnets, airbags, missing mirrors, and rust issues. (6) Depending on the severity of these deficiencies, these **vehicles could be repaired or upgraded before export**, offering safe and cost-effective mobility in importing countries.

The importance of repairing and upgrading substandard vehicles becomes even more critical in the battery electric vehicle (BEV) roll-out context. Repair and disassembly of EV batteries present greater challenges due to design choices and proprietary system hardware and software implemented by original equipment manufacturers (OEMs). Vehicle manufacturers are heavily investing in providing technical support throughout a vehicle's lifetime, potentially seeking to outcompete independent aftermarket service providers. It is crucial to ensure that EVs, particularly EV batteries, are designed for disassembly and that data and information regarding repairs and upgrades are made accessible across the value chain.

To ensure that products are kept at the highest utility and value, facilitating service and repair are critical for both ICEVs and BEVs. For example, many OEMs have not designed batteries for repair, requiring entire packs to be scrapped if a single module is broken or having limited repair and service access to their own dealer and service networks. (10) Battery Passports, as mandated for all BEV batteries in the future by the incoming EU Battery Regulation, are meant to help address this by closing existing data gaps that would allow more economical handling of ELV batteries. (11) Nevertheless, concerns over viability may limit the scalability of this opportunity, unless repair / upgrading costs can be significantly reduced.

2.2.3 ENSURING VEHICLE LIFETIME EXTENSION AND END-OF-LIFE MANAGEMENT IN IMPORTING COUNTRIES

Lastly, environmental and social concerns arise when a used vehicle reaches importing countries. As motorisation rates rise in these nations, it becomes imperative to establish effective maintenance, repair, and ELV management systems. (12) Inevitably, all vehicles will reach their end-of-life, resulting in the need to develop a formalised recycling infrastructure that can economically recover materials and minimise adverse environmental and social effects. This will become increasingly important in the coming years as African economies develop further, leading to an increase in vehicles.

Lifetime extension of vehicles in importing countries

Significant value chain challenges exist in effectively repairing used vehicles in importing countries, ranging from lacking a formalised maintenance and repair industry to lacking quality assurance for vehicle parts or modification activities. The BEV transition can potentially alleviate this challenge, since BEVs typically require less maintenance and repairs. By 2035, as many as 2 million second-hand EVs could be destined for second-hand vehicle markets, predominantly in LMICs, with this value exceeding 8 million by 2050. (4) Similar to the situation in exporting countries, the potential for lifetime extension of BEVs ultimately depends on their design for disassembly as well as the information sharing across the value chain, for example, through digital battery passports.

End-of-life vehicle management in importing countries

Many end-of-life vehicle management processes in importing low-to-middle-income countries are either entirely absent or conducted by a lengthy chain of informal, unregulated actors. Many vehicles reaching the end of their life are not disposed of properly, resulting in

environmental pollution and health hazards. While exporting used vehicles in good condition could improve access to affordable EVs globally, it would also shift the burden of EV battery disposal to importing countries, which may lack the infrastructure to manage and recycle them safely. (4)

The prevalence of informal and substandard end-of-life management facilities leads to adverse sustainability impacts and deprives industry of secondary raw materials. It is estimated that current end-of-life management practices in these countries has led to an estimated USD 1 trillion loss in lifetime earnings annually due to childhood lead exposure, according to a 2020 report by UNICEF and Pure Earth. (13) The lack of vehicle recycling infrastructure also means that valuable resources are lost, as materials that could be recycled from used vehicles are often discarded in landfills or left to corrode. This represents a significant loss of potential resources that could be used to create new products, reduce waste, and stimulate local economies.



3 THERE ARE SEVERAL INTERNATIONAL ORGANISATIONS TRYING TO SOLVE THIS ISSUE, BUT GAPS REMAIN



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Numerous organisations are working to tackle the challenges posed by the used vehicle trade. These include the United Nations Environmental Programme (UNEP), the International Transport Forum (ITF), the World Bank, the International Council on Clean Transportation (ICCT), and the Dutch government, among others. This section examines the work plans and seminal publications related to the sustainability issues outlined in the previous section to identify gaps in the current work on the used vehicle trade.

3.1 FILLING DATA GAPS ON THE USED VEHICLES TRADE

One primary concern regarding data gaps is the limited insight into the quantity and quality of used vehicle flows. Concerning the quantity of flows, **UNEP's 2020 and 2021 reports provided the first assessment** of global light-duty used vehicle flows, with a heavy-duty vehicle report added in 2023. (1) In its 2023 work programme, the **ITF announced a project to study the implications of the EV transition** on second-hand vehicle flows in emerging markets. This project aims to build upon UNEP's work by exploring future scenarios around EV adoption, such as assessing the speed at which EVs are expected to enter emerging economies. **The ICCT has also conducted similar work**, publishing a report in 2021 on the future development of the used zero-emissions vehicle market. (14)

In terms of the quality of used vehicle flows, the Dutch Human Environment and Transport Inspectorate has carried out the most comprehensive work to date. (6) Another aspect of this study focused on testing the quality and availability of data on used vehicles and essential components being exported. The findings demonstrated that the condition of used cars exported to West Africa is similar to the quality of cars dismantled in the Netherlands. (6)

Other relevant work on data gaps has been conducted by the International Motor Vehicle Inspection Committee (CITA) in collaboration with the United Nations Economic Commission for Europe (UNECE), UN Road Safety Fund (UNRSF), and Fédération Internationale de l'Automobile (FIA). Overall, while these analyses are important in highlighting the stock and flows of used vehicles, they all lack one dimension: economic and business value assessment. This is needed as a basis for companies and investors to engage the issue as an opportunity, rather than just a problem.

3.2 BOLSTERING POLICIES IN IMPORTING AND EXPORTING COUNTRIES

A focus area for organisations working in this field is addressing the policy gap between exporting and importing markets. UNEP (2020) first identified this as a **crucial factor enabling the trade of obsolete, ageing, unsafe, and polluting used vehicles.** Since recognising these policy gaps, UNEP has engaged with importing countries, developing sub-regional agreements on minimum vehicle standards adopted in East and West Africa, for example.

Furthermore, the **Breakthrough Agenda launched at COP-27**, led by the UK government through the Clean Energy Ministerial, emphasises initiating dialogue between importer and

exporter countries to develop harmonised quality standards for used ICEVs and commitments to support the international trade of second-hand zero-emission vehicles.

Other relevant work includes the World Bank report examining the implications of integrating motorisation management strategies to address policy gaps in developing countries (12), as well as recent research undertaken by the ICCT (14), UNEP (1), and UC Davis (4) to study policy gaps surrounding BEV adoption in low- and medium-income countries.

3.3 CURRENT APPROACHES DO NOT SUFFICIENTLY ADDRESS INDUSTRY INCENTIVES TO TURN THE USED VEHICLE TRADE FROM BURDEN INTO OPPORTUNITY

Current work programmes and actions by international expert organisations concentrate on filling data and policy gaps to enhance the existing state of the used vehicle trade. While this is crucial, there is concern that policy action may be too slow to alleviate the pressures and adverse impacts of the trade.

A gap exists around industry action and the development of profitable business models that help make the used vehicle trade fair and equitable. Considering the need to reduce end-of-life vehicle exports, increase recycling in exporting countries, and strengthen vehicle life-cycle management in importing countries, the circular economy may provide a suitable approach for **developing profitable business models to help address these issues.** The following section will explore how the transition to a circular used vehicle trade could transform the current trade model from burden to opportunity.



4 THE VISION: TURNING THE GLOBAL USED VEHICLE TRADE FROM BURDEN TO OPPORTUNITY

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This section presents the opportunity to address the current challenges through industry action, by transitioning to a circular used vehicle trade. Circular economy is chosen as an approach, since it develops profitable business models around lifetime extension and material circularity. (15)

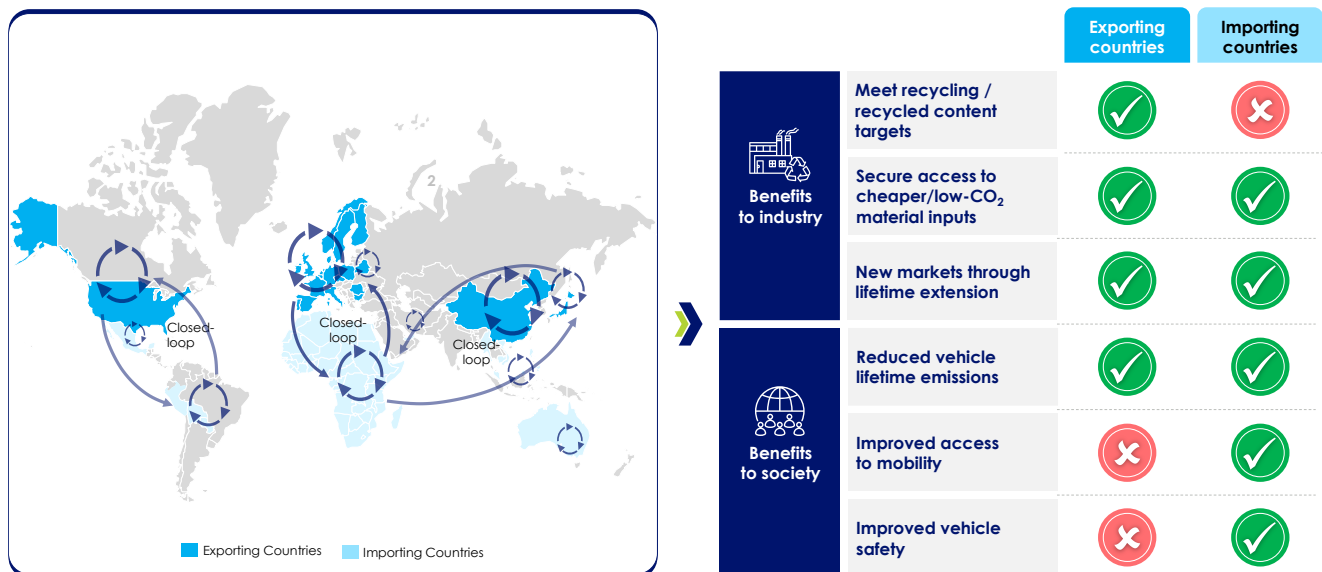


Figure 2 - Concept and benefits of a circular used vehicle trade (own elaboration)

4.1 THE VISION: TURNING TO A CIRCULAR USED VEHICLE TRADE

Figure 2 depicts the concept of a used vehicle trade, including lifetime extension, circular loops and product cascades between exporting and importing countries. In this concept, vehicle lifetimes are extended through maintenance and repair. Depending on the vehicle's state, they will either be recycled (circular loop) or exported to another country (product cascade), where they will be reused, maintained, and ultimately recycled. This ensures that products are kept at highest utility and value throughout their lifetime.

As depicted in Figure 2, the transition to this model can provide significant benefits to industry and society in both exporting and importing countries. For industry, potential benefits include meeting recycling and recycled content targets, securing access to cheaper and low-CO₂ inputs, and building and engaging new markets from vehicles lifetime extension. For society, the transition to a circular vehicle trade can enable total vehicle lifetime emissions, secure mobility access, and improve vehicle and road safety.

4.2 HOW TO ADDRESS THE PROBLEMS OF THE USED VEHICLE TRADE

The concept and potential future state of how a circular vehicle trade could work is described in more detail in Figure 3. It introduces three opportunities that are analogous to the challenges addressed in Section 1.2.

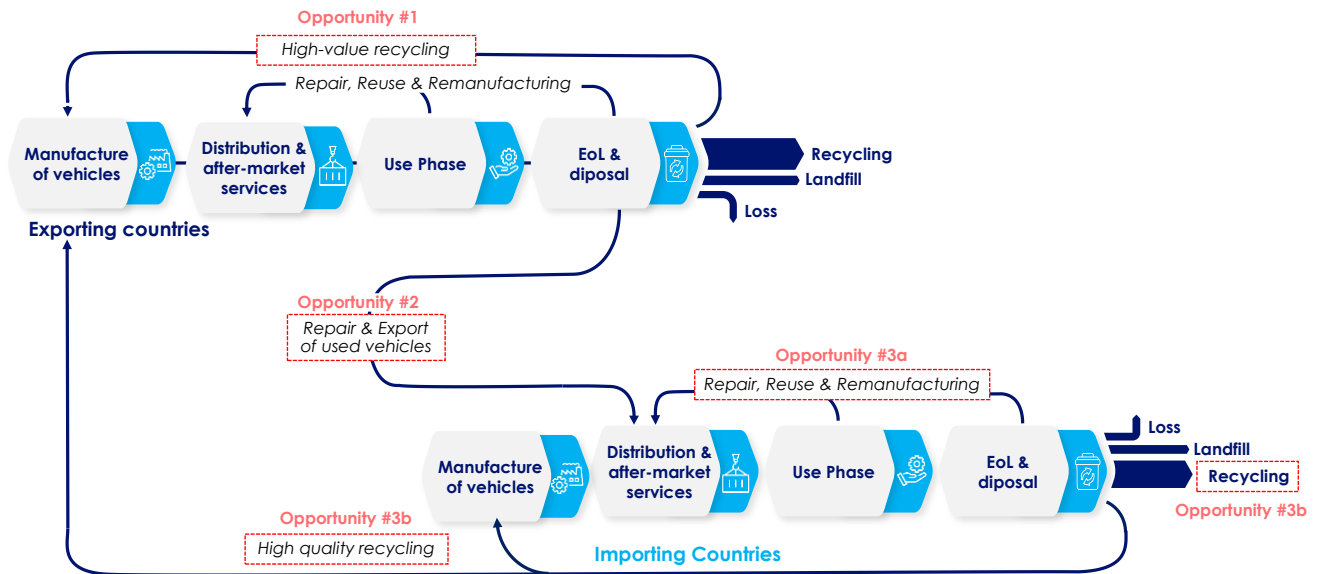


Figure 3 - Value chain perspective of the circular used vehicle trade

4.2.1 OPPORTUNITY #1: REDUCING EXPORTS OF END-OF-LIFE VEHICLES BY SCALING HIGH-QUALITY RECYCLING

In Europe, about a third of ELVs are lost and likely exported per year. (5) Apart from causing safety, health, and emissions problems in importing countries, this also deprives exporting countries of valuable scrap materials. One way to address this is to increase both the quantity and quality of vehicle recycling.

Most ELV vehicles are exported before ever reaching European disassemblers and recyclers due to the low value of recycled materials compared to the high labour and energy costs associated with disassembly and recycling. (16) For example, while more than 88% of the weight of a car's materials are recovered in Europe, disassembly and recycling practices are currently focused on weight and not on value, resulting in most high-value materials being lost or contaminated. (17) Higher secondary raw material prices and demand could incentivise OEMs, recyclers, and material suppliers to increase both the quantity and quality of material recovery, for example by investing in new shredding technology.

There are a number of drivers for OEMs, material suppliers (e.g. steelmakers) and recyclers to increase the quantity and quality of ELV recycling, particularly in Europe. These include:

Pressures to increase supply chain resilience and to near-shore value chains: For example, both the EU and the US passed legislation with the EU Critical Raw Materials Act, the EU Net-Zero Industry Act, and the US Inflation Reduction Act aim to increase domestic capacities for EV battery production and recycling.

Regulatory and voluntary recycling and recycled content targets: Several OEMs are introducing voluntary recycled content targets. BMW, for example, aims to use 50% of recycled and reusable materials. (18) In addition, the new EU Battery Regulation introduces EV battery recycling and recycled content targets. (8) The revision of the ELV Directive, planned for June 2023, is expected to introduce material-specific recycling targets, as well as recycled content targets.

Corporate decarbonisation targets: For example, steelmakers can increase their scrap share to meet short-term emissions reduction targets and to reduce burdens through the EU Emissions Trading Scheme (EU-ETS), especially given the more ambitious GHG reduction targets under the revised EU-ETS. (19)

There are a several challenges to scaling high-value automotive recycling:

Limitations around the scalability and automation of recycling processes: Recycling remains a fragmented and labour-intensive industry, making it difficult to develop industrialised and end-to-end/cross-border solutions.

Profit margins of recyclers are too low: Labour costs and low secondary raw materials result in low-profit margins, making it difficult for recyclers to scale processes, for example by investing in new shredding technology. They ultimately require higher prices for recycled materials to further industrialise their processes. Policymakers and OEMs can, for example, address this through the introduction of recycled content targets, which will increase demand for secondary material and therefore create a stronger business case for high-quality recycling.

4.2.2 OPPORTUNITY #2: REPAIRING USED VEHICLES TO MEET THE MINIMUM IMPORT REQUIREMENTS

The second identified business model centres around repairing and upgrading vehicles that have not yet reached their end-of-life but have a few deficiencies that prevent them from meeting minimum import standards (e.g. missing or broken catalytic converters).

For OEMs, a potential business model is available to extend into the used vehicle market and capture new market segments. The potential attractiveness of such a model is underscored by OEMs such as Renault extending into the retrofitting and refurbishment of used vehicles. By 2030, the group expects to generate up to 1 billion Euros from circular economy-related activities at its "Refactory". (20) Especially with the strict requirements for Euro 7/VII, some OEMs believe that it could be more valuable to complement their new vehicle portfolio with selling used vehicles, especially in smaller vehicle segments where the heightened emissions standards make new vehicles less economically attractive.

There are several challenges for OEMs who want to extend into repair and maintenance:

Lack of developed service networks: OEMs typically do not have the service networks developed to service vehicles that are older than 3 to 4 years. Their dealership networks typically do not have the size and capacity to service so many additional vehicles. The unstructured aftermarket that tends to service most older vehicles is largely disconnected from OEM's activities and system.

Unattractiveness due to low-profit margins: Especially for more premium OEMs, dealers may not be incentivised to service older vehicles due to lower margins. Their focus is on servicing younger fleets with higher margins. Extending into this market would require development of new service structures and additional customer touchpoints. In addition, given the high labour costs in many exporting countries, one option could be to repair vehicles in countries with a lower cost base – yet ensuring high quality and assurance of legitimate activities – before final export.

Difficulty to develop scalable processes: OEMs may find it challenging to develop scalable and industrialised processes around repairing and retrofitting vehicles. This would require significant design for reparability adaptations which may conflict with other design objectives such as price or performance as well as significant capital expenditures, such as Renault's Refactory.

4.2.3 OPPORTUNITY #3: CAPACITY AND INFRASTRUCTURE BUILDING IN IMPORTING COUNTRIES TO SUPPORT LIFETIME EXTENSION AND MATERIAL CIRCULARITY

Finally, increased capacity and infrastructure building in importing countries will be needed to support vehicle lifetime extension and end-of-life treatment and recycling – both short term for ICEV and medium term for BEV. Two potential business models warrant a closer examination:

Opportunity #3a: Maintenance and repair of used vehicles

Once low- and medium-income countries import vehicles they will have to be effectively maintained and repaired to be kept at highest utility and value. Depending on the competitive positioning, this could be a potential business model for some OEMs. This may not be an attractive market for premium OEMs due to the low margins, but (local) low-cost providers may be able to develop scalable solutions in these markets. The overall business case for OEMs could also depend on decisions to localise production in these geographies, which may help create synergistic benefits between production and maintenance/repair activities. In addition, there may be regional aftermarket players who through consolidation or enablement via digital platforms and capacity building could help develop more formalised service networks.

The challenges that actors entering this market will have to face are:

Understanding the potential profit pools that are available and understanding whether a viable business case can be built in these markets;

Developing a suitable service network that can profitably serve customers;

Ensuring access to high-quality spare-parts;

Developing repair and maintenance capacities locally to ensure service quality; particularly for higher-risk BEV repairs.

Opportunity #3b: Improving high-quality recycling of end-of-life used vehicles

Finally, an opportunity exists around the recycling of end-of-life vehicles in importing countries. This is driven by the lack of a formalised recycling industry in many importing countries and the potential value that can be generated from recycling.

This could be a potential business model for regional aftermarket players who could help develop more formalised recycling networks through consolidation and innovation. Apart from selling recycled materials locally, a potential opportunity could be to export recycled materials to countries where vehicle production is localised. For example, end-of-life EV batteries could be recycled into black mass and then exported again to countries with an EV battery production. This could be an interesting proposition given the increased focus of Europe, the US, and others to diversify their sourcing of battery raw materials.

The challenges that actors entering this market will have to face are:

Lack of developed recycling networks and facilities, especially to make transportation of end-of-life vehicles economically feasible;

Lack of recycling technology (e.g., shredding technology) to ensure the safe, efficient, and environmentally sustainable dismantling and processing of end-of-life vehicles;

Lack of skills of workers to safely and sustainably handle and process end-of-life vehicles.

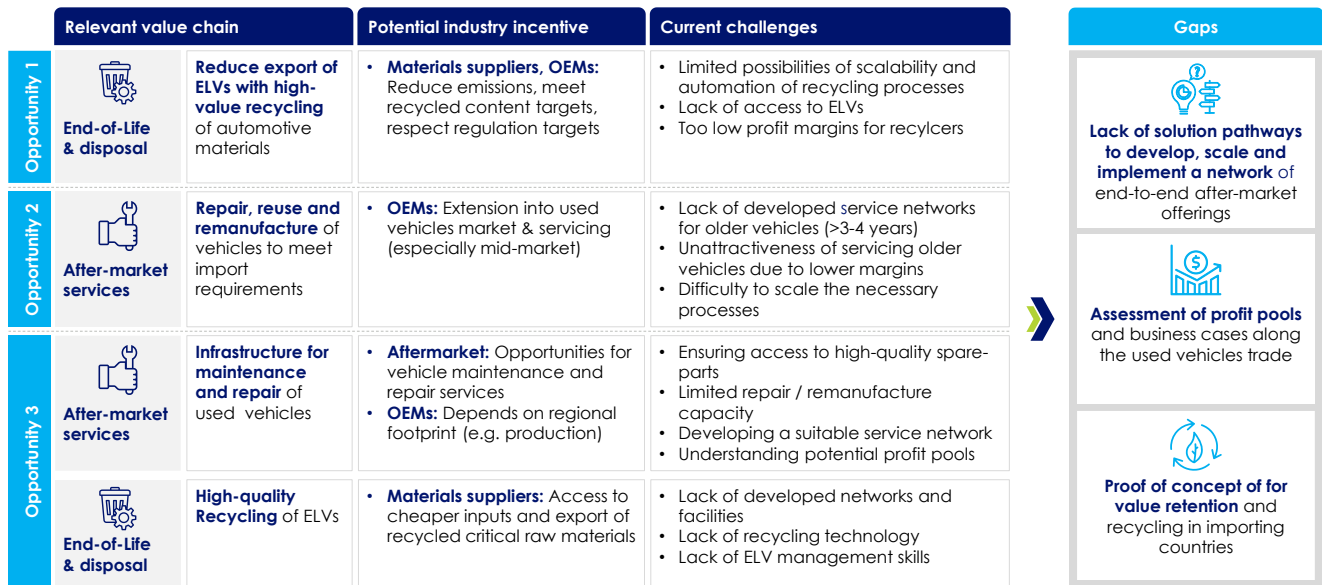


Figure 4 - Overview of industry incentives, challenges and overarching gaps

4.2.4 SYNTHESIS OF GAPS FOR CIRCULAR BUSINESS MODEL IMPLEMENTATION IN THE USED VEHICLES TRADE

Based on the review of potential business opportunities in the circular used vehicle trade, this section derives three remaining gaps inhibiting these business models (see Figure 4). These are:

1. **Assessment of profit pools:** One barrier to transitioning to a global circular used vehicle trade is concerns about the potential attractiveness and profitability of new business models. An in-depth assessment of profit pools and investment needs along the value chain, potentially through agent-based modelling, could help incentivise actors to explore these opportunities further.
2. **Assessment of solution pathways to scale industrialised circular processes:** One concern for both lifetime extension and material circularity is whether industrialised and automated processes can be developed that reduce the labour intensity of current repair and recycling processes. Future research is needed on two things: 1) assessing potential automation technologies and solutions that can be commercialised and scaled; 2) assessing options for the development of novel network archetypes that can service older vehicles.
3. **Proof of concept of circular business models in import countries:** Many importing countries lack the infrastructure and capacity for effective lifetime extension and end-of-life

management. Given the increasing value of recycled materials, particularly in exporting markets, developing an on-the-ground proof of concept that tests the business case for vehicle recycling in importing countries would be important.



5 PROPOSING A WORK PROGRAMME TO DEVELOP INDUSTRY-LED SOLUTIONS TO THE CHALLENGES OF THE USED VEHICLE TRADE

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To close the remaining gaps for industry action and circular business model implementation in the used vehicle trade, a work programme is derived in this section. It aims at enabling industry action to address the three action areas: 1) Preventing the export of end-of-life vehicles; 2) Repairing / upgrading vehicles that do not meet minimum import requirements; 3) Ensuring vehicle lifetime extension and end-of-life management in importing countries.

The proposed work programme will complement other ongoing policy- and data-related initiatives by international organisations, by developing industry-led solutions. It is built around a top-down and a bottom-up approach. The next sections will describe the proposed work programme in more detail.

5.1 TOP-DOWN APPROACH: INDUSTRY STRATEGY SETTING FOR A CIRCULAR USED VEHICLE TRADE

The top-down approach aims to convene industry actors to assess the economic and sustainability opportunity, define solution pathways, endorse ongoing efforts by international organisations, and to support implementation. It will bring together actors from the automotive value chain, financiers, and other industry actors to set strategies for the transition to a circular used vehicle trade.

The approach employed in this approach is modelled after the work of the Mission Possible Partnership (MPP) (2). The [Mission Possible Partnership](#) is an ambitious effort to trigger a net-zero transformation of seven industrial sectors, leveraging world-leading organisations' convening power, talent and expertise on climate action. While the MPP focuses on decarbonising different sectors, its approach in catalysing action from a wide array of actors could address the identified gap. It is described in more detail in the box below.

MISSION POSSIBLE PARTNERSHIP (MPP)



Objective & scope

The [Mission Possible Partnership](#) encompasses seven so-called hard-to-abate sectors (i.e. aluminium, aviation, chemicals, concrete/cement, shipping, steel, and trucking). Supported by an expanding network of nearly 300 partners across corporate, finance, and policy, MPP is empowering high-ambition sector initiatives in these target sectors, which mobilise the full value chain to decarbonise these carbon-intensive industries.

The approach

The MPP uses a replicable, four-step approach that can be tailored to individual sectors:

1. **Convene value chain:** Convene high-ambition industry stakeholders along the used vehicle value chain
2. **Define sector transition strategies:** Develop solution pathways to circular, closed-loop recycling
3. **Jointly commit to action:** Endorse relevant policies and agree on investment areas with 2025-2035 timeframe;
4. **Support implementation:** Develop practical resources and toolkits to help operationalise commitments.

Key achievements to date

Among the biggest achievements to date are the publication of several sector transition strategies that provide an industry-backed roadmap to 1.5°C.

The steel sector transition strategy was endorsed by over a **quarter of the global iron ore market** and over 15% of global steel production excl. China.

The aluminium sector transition strategy was endorsed by **over 60% of global aluminium smelting and 80% of refining capacity** excluding Russian/Chinese companies.

In a first step, it should focus on assessing potential profit pools, sustainability impacts, and investment needs around the circular used vehicle trade. The actions and deliverables are detailed in Table 1.

Table 1 - Overview of actions, deliverables, and stakeholders involved in the top-down approach

ACTION	DELIVERABLE	STAKEHOLDERS INVOLVED
1. Assess potential profit pools, sustainability impacts, and investment needs around the circular used vehicle trade through agent-based modelling (focus on opportunity #1 – high-value recycling in exporting countries)	Analysis of profit pools & scenarios; Open-source code or model.	Industry (materials & component suppliers, OEMs, recyclers, aftermarket players, Financiers, commercial buyers etc.)
2. Define solution pathways and questions to create scalable circular processes	Analysis of different scenarios and technology pathways	
3. Convene industry stakeholders and encourages them to endorse used vehicles work programmes by international organisations	A platform for informed discussions between industry/financiers and buyers/policymakers on how to create a robust investment case for projects Endorsement for circular policy and collective industry action	
4. Support implementation by identifying business cases, and investment areas and enabling the development of strategic end-to-end networks	Portfolio of identified projects	

Note: Bold denotes priority action

5.2 BOTTOM-UP APPROACH: PROOF OF CONCEPT FOR END-OF-LIFE MANAGEMENT IN IMPORTING COUNTRIES

The bottom-up approach aims to implement on-the-ground projects as a proof-of-concept of the commercial viability of circular business models in importing countries.

The approach underlined in the second pillar is modelled by the work of [Project STOP](#) (3), developed by Systemiq and Borealis. Project STOP is a pioneering successful joint operation of industry, governmental organisation and local communities to stop waste leakage in the environment by implementing circular waste management models. Similar to the MPP example, Project STOP is also taken from an adjacent sector. Nevertheless, its approach in bringing together industry and governmental actors to develop waste management efforts in LMICs is analogous to the previously gap identified. It is described in more detail in the box below.

PROJECT STOP



Objective & scope:

[Project STOP](#) was launched in 2017 by Systemiq and Borealis and works with cities and the local communities of different municipalities to create comprehensive, economically sustainable waste management systems in areas of high plastic leakage into the ocean and low waste collection coverage. Indonesia is the second largest contributor to ocean plastics and the local government is committed to reduce the country's plastic levels by 70% by 2025. Project STOP aims to support that commitment.

This Project pursues 3 core objectives:

Achieve zero leakage of waste into the environment;

Increase resource efficiency and recycling of plastic waste streams;

- Support the local community by creating new working opportunities in the waste management system and reducing the impacts of mismanaged waste on health, fisheries and tourism.

The approach:

Project STOP uses a long-term 'system enable' approach to develop effective waste management to prevent environmental plastic leakage:

Scoping: Establish partnerships with national ministries, local and regional government authorities, and local communities;

Preparation & design: Conduct a baseline assessment and leverage government and industry engagement by developing low-cost and scalable waste system designs;

Implementation: Prepare the community to operate its own sustainable waste system, while avoiding disruption of the thriving informal waste sector;

- **Scale-up:** Expand to new regions to scale up the systemic change by applying the learnings from pilot projects.

Key achievements to date:

Amongst the most impactful achievements since its launched in 2017, Project STOP has been successfully implemented in five municipalities:

Pilot projects in Muncar municipality and Banyuwangi in East Java.

In February 2022 the Project STOP Muncar was successfully **handed over to the local government and community**. Active support from Project STOP for the waste management system in Pasuruan Regency, East Java, ended in March 2023, with a similar transition from the active support phase also planned for Jembrana in June 2023.

In the next stage, Project STOP Banyuwangi further scales up this approach, working with regency-level government, to develop a government-owned waste management unit.

The actions and deliverables are detailed in Table 2. Ultimately, this approach aims to:

- Identify practical barriers and opportunities for the implementation and scaling of ELV management infrastructure;
- Create new system level partnerships between local governments and communities, industry leaders, non-governmental organisations.

Table 2 - Overview of actions, deliverables, and stakeholders involved in bottom-up approach

ACTION	DELIVERABLE	STAKEHOLDERS INVOLVED
<p>1. Develop a proof of concept for the business case of ELV management in importing countries</p>	<p>Diagnostic report on select cities/communities</p> <p>Establishment of waste management systems in local communities that also supports job creation for local communities</p>	<p>Industry (OEMs, recyclers, aftermarket players, Financiers, commercial buyers etc.), Local governments & communities, NGOs / IOs and RTOs</p>
<p>2. Lay the foundation for the future implementation and scaling of ELV management recycling solutions and networks in importing countries</p>	<p>Publish a “playbook” for the implementation and scaling of ELV management in low- and medium-income countries</p>	
<p>3. Convene industry and governmental actors to reduce barriers</p>	<p>A platform for informed discussions between industry/financiers and buyers/policymakers on how to create a robust investment case for projects</p> <p>Endorsement for circular policy and collective industry action</p>	

Note: Bold denotes priority action

5.3 NEXT STEPS: FURTHER PROGRAMME DEVELOPMENT

The previous section laid out an initial proposal for a work programme that was developed through desk research, expert interviews, and a stakeholder workshop with leading expert organisations and industry associations.

The proposed work programme is a first proposal that is intended to be further validated and elaborated with stakeholders.

To this end, potential next steps are laid out that could be taken to further develop this work programme. Questions that will need to be addressed are around the overall scoping, funding, stakeholder engagement, and the launch. An example of how this could look is proposed in Figure 5.

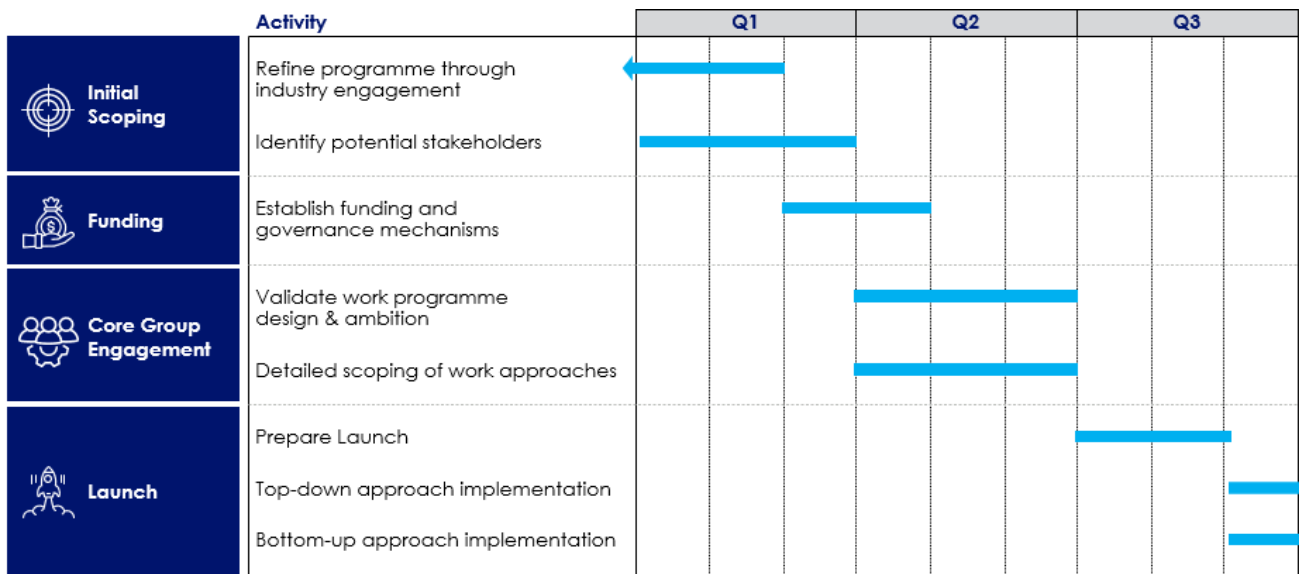


Figure 5 - Proposed timeline for further programme development and launch

This will include the following steps:

Initial scoping: An industry challenger session will be held with actors from across the automotive value chain to present the proposed work programme and to refine the scope and content of the two approaches. The session has three main objectives:

- Refine the specific actions, deliverables and involved stakeholders in the two proposed approaches;
- Identify a set of stakeholders interested to develop this work programme further.

Funding & governance: In close collaboration with industry, international expert organisations, and relevant governmental/philanthropic funding bodies, funding and governance mechanisms for the work programme will be established. Potential decisions that will need to be made are:

- **Funding mechanisms:** Whether the programme will be solely financed by industry or whether a blended approach will be needed that combines industry, philanthropic and civil society organisations, and/or governmental funding to ensure sufficient size of the funding and the neutrality and independence of the process.
- **Governance mechanisms:** Whether decisions and outputs are reached through consent and/or consensus; what types of voting power members have; how to ensure fair representation of higher and lower income countries' actors; how to involve civil society and sciences to validate and legitimise activities.

Core group engagement: Following initial discussions with industry and other stakeholders a core working group of interested actors will need to be established that further refines and validates the programme design and ambition. This will be the engine room of the programme scoping.

Launch of the work programme: The work programme is intended to be launched in close collaboration with other initiatives such as the Clean Energy Ministerial's Breakthrough Agenda. Over a course of three years, the work programme will implement pilot projects within the two identified approaches to develop an overarching industry strategy and

provide an on-the-ground proof of concept for safe and sustainable end-of-life vehicle management in a low- and medium-income context.

REFERENCES

1. **United Nations Environment Programme.** *Used Vehicles and the Environment: A Global Overview of Used Light Duty Vehicles: Flow, Scale and Regulation.* 2020.
2. **MPP.** *Mission Possible Partnership.* 2023.
3. **Project STOP.** *Stop waste. Go circular.* 2023.
4. **United Nations Environment Programme.** *Electric Vehicle Lithium-ion Batteries in Lower- and Middle-income Countries: Life Cycle Impacts and Issues.* 2023.
5. **Umweltbundesamt.** *Illegal treatment of end-of-life vehicles.* 2022.
6. **Netherlands Human Environment and Transport Inspectorate.** *Used vehicles exported to Africa: A study on the quality of used export vehicles.* 2020.
7. **European Commission.** *European Critical Raw Materials Act.* 2023.
8. **Council of the European Union.** *Proposal for a Regulation of the European Parliament and of the Council concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020.* 2023.
9. **US Congress.** *The Inflation Reduction Act.* 2022.
10. **Green Car Reports.** *EV battery repair hurdles may inflate insurance premiums.* 2023.
11. **Battery Pass.** *Battery Passport Content Guidance: Achieving compliance with the EU Battery Regulation and increasing sustainability and circularity.* 2023.
12. **World Bank.** *Motorization Management for Development: An Integrated Approach to Improving Vehicles for Sustainable Mobility.* 2022.
13. **UNICEF & Pure Earth.** *The Toxic Truth: Children's Exposure to Lead Pollution Undermines a Generation of Future Potential.*
14. **Tankou, A.** *Understanding and supporting the used zero-emission vehicle market.* 2021.
15. **WBCSD.** *Driving Ambitions: The Business Case for Circular Economy in the Car Industry.* 2022.
16. **Daehn, K. E., Serrenho, A. C. and Allwood, J.** *Metallurgical and Materials Transactions B.* 2019.
17. **Circular Cars Initiative.** *Paving the Way: EU Policy Action for Automotive Circularity.* 2021.
18. **BMW.** *BMW Group accelerates CO2 reduction and focuses consistently on a circular economy with the Neue Klasse.* 2022.
19. **EURACTIV.** *Steelmakers win concessions in EU carbon market reform talks.* 2022.
20. **Reuters.** *Renault seeks to generate 1 billion euros from 'circular economy' by 2030.* 2021.