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The EU-CEAP Impacts on Developing Countries

An Analysis of the Plastic Packaging, Electric Vehicles and Batteries Sectors

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Abstract

The European Union Circular Economy Action Plan (EU-CEAP) is key to transitioning to a circular economy and climate neutrality under the EU Green Deal – and developing and emerging countries (DECs) play important roles. They are essential for primary material chains, for example, for electric vehicle batteries. DECs are also part of secondary material chains, and Europe relies on them to recycle its plastic packaging. Despite the crucial roles that DECs play in Europe's transition to a circular economy, literature and policy discourses have not yet examined the EU-CEAP's impact. This discussion paper fills this gap by outlining the EU-CEAP's challenges and opportunities for DECs and presents recommendations for development cooperation.

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Abbreviations

BESS	battery energy storage system
DEC	developing and emerging country
DSTD	deep-sea tailings disposal
EC	European Commission
ELV	end-of-life vehicle
EPR	extended producer responsibility
EU	European Union
EU-CEAP	European Union Circular Economy Action Plan
EV	electric vehicle
GHG	greenhouse gas emission
HDPE	high-density polyethylene
LAB	lead-acid battery
LDPE	low-density polyethylene
LDV	light-duty vehicle
LiB	lithium-ion battery
PPW	plastic packaging waste
rPET	recycled PET (polyethylene terephthalate)
SUP	single-use plastics
WEEE	waste of electrical and electronic equipment
WSR	Waste Shipment Regulation

1 Introduction

With its European Green Deal of 2019, the European Union (EU) set about becoming the first climate-neutral continent by 2050. Key to reaching that objective is the European Union Circular Economy Action Plan (EU-CEAP) adopted in 2015 and revised five years later. By transitioning to a circular economy, the EU aims to create sustainable economic growth decoupled from resource use that respects planetary boundaries. The EU-CEAP is a non-binding strategic document that takes the form of directives and legislation on a product's entire life cycle. Regulations address product design, encourage circular processes, promote sustainable consumption and aim to ensure waste prevention by keeping resources in the life cycle for as long as possible (European Commission, 2020a).

Because value chains for products and materials are globally connected – including to developing and emerging countries (DECs) – the EU-CEAP is likely to have an impact far beyond Europe's borders. DECs are major suppliers of primary materials for the European market. For example, the Democratic Republic of Congo, Indonesia and Chile are important suppliers of the cobalt, nickel and lithium needed for electric vehicle (EV) batteries (GIZ & BGR, 2021; Langsdorf & Duin, 2022). But DECs play a particularly major role in treating secondary materials: To illustrate, a large share of European plastic packaging waste (PPW) is recycled in DECs, very often in Southeast Asia. The EU-CEAP could inspire global governance and encourage DECs to expand their national strategies to create circular economies. Thus far, most of their policies have focused on end-of-life waste management measures such as recycling. But that could dramatically change because EU-CEAP policy measures concern the entire material and product chain. Despite these far-reaching potential impacts, very little literature has examined how the EU-CEAP affects DECs.

It is therefore imperative to examine the socio-economic implications of European policies for DECs. This discussion paper draws on recent literature and expert interviews with circular economy practitioners to identify the major opportunities and challenges for DECs linked to Europe's circular economy transition. Directed at development cooperation policy-makers, it points out the major developments expected in DECs. But its findings and recommendations are subject to limitations because the EU-CEAP is recent and policy negotiations are ongoing. With detailed policies subject to change, it is difficult to formulate clear-cut implications. Furthermore, the EU-CEAP's legally binding nature depends on detailed roadmaps, directives and legislation.

The EU-CEAP addresses seven key product value chains: electronics and information and communications technology (ICT); batteries and vehicles; packaging; plastics; textiles; construction and buildings; and food, water and nutrients. This discussion paper focuses on plastic packaging and EVs and batteries sectors whose legislation process is more advanced than that of other sectors, providing a basis to explore potential impacts; the sectors are also closely connected to DECs. For each sector, the paper outlines the most relevant legislation and then examines the expected implications along the primary and secondary material streams before presenting recommendations for development cooperation. Potential role model effects of the EU-CEAP and related circular economy global governance processes are also introduced, and each chapter ends with a summary. The study is rounded off with a conclusion and outlook.

2 Framework and methodology

2.1 Analytical framework

This study focuses on the plastic packaging and the EVs and batteries sectors. The timeline of the EU consultation process and policy developments means that these two sectors have the most concrete regulations and directives. Other sectors are less advanced. For example, the European Commission (EC) is still discussing the Sustainable Strategy for Textiles (European Commission, 2021a), whose formulation remains vague. For the construction and buildings sector, consultations on the Strategy for Sustainable Built Environment will be delayed until the end of 2022 (European Parliament, 2022a). Therefore, this study does not analyse measures related to these sectors – which could be subjects for future research.

Multiple strategies, roadmaps and/or policy measures have been introduced to each sector. I do not aim to examine every single announcement but rather focus on a subset of measures selected using the following criteria:

- Advancement and liability. The study focuses on two types of laws that the EU can pass for all member states: regulations and directives. *Regulations* are valid for all member states as soon as they enter into force and replace relevant national laws; *directives* set goals for member states to achieve by certain dates – "transposing" the directives by passing or adjusting their national laws. Directives allow member states to consider their specific situations. The EU may make recommendations about implementing the directives; however, these are not binding (Kalms, 2019).
- Formulation of specific and/or quantified targets.
- Relevance to DECs as suggested by literature, industry and/or policy experts.
- Linkage to DECs.

Selected EU-CEAP measures in each sector are analysed along the primary and secondary material streams. The primary material stream refers to the demand for and sourcing of raw materials. The EU-CEAP might entail changes in demand for raw materials that affect exporting DECs. The secondary material stream concerns the reuse, repurposing and recycling of waste materials and their collection, transport and treatment. With DECs increasingly engaging at one or several steps in the secondary value chain, they may be impacted by the EU-CEAP. In addition to these two streams, the EU-CEAP might also impact DECs by inspiring them to expand their circularity policies. I will also discuss other global governance processes on the circular economy that could become relevant for DECs.

The analysis specially focuses on broad socio-economic impacts on DECs that include GDP growth, the share of export to GDP, employment opportunities, implications for labour, working conditions and health, as well as education and job-training opportunities. Environmental impacts of major concern for DECs are also mentioned.

2.2 Methodology

The study triangulates data by drawing on three types of sources. It began by reviewing literature of the last five years: articles from peer-reviewed academic journals, governmental reports and statistics, reports from non-governmental and multilateral organisations (such as the United Nations and Interpol), as well as website materials from professional associations and management consultancies such as McKinsey & Company. The literature review was supplemented with online interviews of 45 to 60 minutes each (see Table 1). Interviewees were

selected through snowball sampling to fill thematic gaps in the literature. Additional information was gained in email correspondence, phone calls and personal conversations.

Using multiple sources ensures that findings and results will be verified. Admittedly, the interview sample does not sufficiently represent organisations based in DECs, and interviewees from government institutions dominate while the private sector and NGOs are underrepresented.

Table 1: Overview of conducted interviews

Topical focus	Interviewee/event	Organisation type	Format
Plastic packaging	Cirplus	Private sector	Interview
Plastic packaging	Plastic2Beans	Private sector	Interview
Plastic packaging	Plastic Waste Free World Conference & Expo/Greener Manufacturing Show	Private sector	Personal exchanges
Plastic packaging	Zero Waste Europe	NGO	Interview
Plastic packaging	Customs Office, Bonn (*Zolldirektion Bonn*)	German government	Email exchange
Plastic packaging	District Government of Cologne (*Bezirksregierung Köln*)	German government	Phone call
Plastic packaging	Ministry for Environment of North Rhine-Westphalia (*Umweltministerium Nordrhein-Westfalen*)	German government	Interview
Plastic packaging, EVs & batteries	German Agency for International Cooperation GmbH *(Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ)*	German government	Three interviews, email exchanges
Plastic packaging, EVs & batteries	Federal Environment Ministry, BMU	German government	Two interviews
EVs & batteries	Netherlands Environmental Assessment Agency, PBL	Dutch government	Interview
EVs & batteries	Forum on Trade, Environment and the SDGs, TESS	Multilateral organisation	Interview
EVs & batteries	European Environment Agency	EU	Interview

3 Plastic packaging

3.1 Introduction

Worldwide, millions of tonnes of plastic are produced every year, with European countries, including Germany, the United Kingdom (UK) and Italy, among the world's largest consumers of plastic and producers of plastic waste (Statista, 2022). In Europe, the amount of plastic waste is soaring: Between 2005 and 2018, PPW increased by 21 per cent – to 17.2 million metric tonnes. Plastic waste is threatening its environment, especially the oceans where plastic is the most common type of waste (Statista, 2022).

The next chapters focus on plastic *packaging* waste because it is the largest single plastic waste stream (accounting for 61 per cent of all plastic waste). The second-largest plastic waste stream comes from agriculture, construction, electric and electronic equipment, and the automotive

sector – which generate 22 per cent of the EU's plastic waste, followed by other sources (17 per cent) (European Court of Auditors, 2020). Plastic packaging is the only type of plastic waste with a binding recycling target. The EC has not yet developed dedicated strategies or set specific targets for other sectors that generate plastic waste, although they may already have general waste management targets (European Court of Auditors, 2020).

The surge in European PPW increases pressure to find recycling solutions and alternatives to plastic packaging. To promote the sustainable use of plastics, the EU-CEAP includes plastic packaging legislation (see Section 3.2) including bans on certain plastic items that could impact DECs through the primary material stream and increase demand for alternative materials (see Section 3.3.1). EU-CEAP regulations could also impact DECs through the secondary material stream – the transboundary shipment of PPW and the construction of new recycling plants in multiple DECs (see Section 3.3.2).

3.2 Selected legislation

In January 2018, the first EU-CEAP included the European Strategy for Plastics with a Directive on Packaging and Packaging Waste (PPW) (2018/852/EC) amending the original directive on packaging and packaging waste (94/62/EC). It codifies the rules for packaging and packaging waste, covers all the packaging (waste) sold in Europe and harmonises national measures to prevent packaging and packaging waste polluting the environment (EUR-Lex, 2020a). The new EU-CEAP addresses EU waste exports. For that reason, I look at the updated EU Waste Shipment Regulation (WSR) (2020/2174/EC) on plastic waste exports, the EU Single-Use Plastics (SUP) Directive (2019/904/EC) and related plastic product bans and mandatory recycling contents. The European Strategy for Plastics also led to Directive EU 2018/851 that amended the Waste Framework Directive (2008/98/EC) (European Commission, 2018).

3.2.1 Packaging and Packaging Waste Directive: recycling targets

The EU's Amending PPW Directive lays out regulations for recycling packaging waste and defines targets for packaging materials. Effective 4 July 2018, it had to be transposed into EU national laws by 5 July 2020. Its PPW recycling targets are 50 per cent by 2025 and 55 per cent by 2030 (European Commission, 2021b). The amount of material that enters the actual recycling was used to calculate the recycling rate. For example, losses due to additional sorting steps such as float-sink separation must be accounted for even if that happens at the recycling plant (Antonopoulos, Faraca, & Tonini, 2021).

The directive sets clear recycling targets for member states. However, the literature shows that EU member states are having difficulties reaching the targets.

Overestimated recycling rates. As of 2018, the reported average EU-recycling rate for PPW was 41 per cent (European Court of Auditors, 2020). But this rate might be *over*estimated because the measuring point in the collection-sorting-recycling process is not aligned across member states and the amount of packaging put on the market is *under*estimated (European Commission, 2017; European Court of Auditors, 2020). After reviewing the PPW Directive of 2018, the EU introduced stricter requirements for calculating the recycling rate to better harmonise PPW reporting data. The stricter rules are expected to cause the recycling rate to drop from the current 42 to around 29 per cent (European Court of Auditors, 2020).

Barriers to recycling. Antonopoulos et al. (2021) find that an overall end-of-life recycling rate of PPW of about 49 per cent can only be achieved by 2030 using the best practices and technologies available. Achieving the 55 per cent PPW recycling target by 2030 requires substantial improvements at plants, in product design and collection systems, as well as at the

market level, including by creating markets for lower-value plastics. A McKinsey & Company survey (Kirilyuk, Mayer, Simons, & Witte, 2020) of 57 recycling companies in 12 European countries reveals that most recyclers are concerned about the lack of material standardisation and product recyclability, inefficient sorting quality and feedstock contamination due to low-quality plastic waste.

All this shows that the EU is struggling to meet its recycling targets: PPW recycling rates are hard to achieve by recycling in the EU alone. The EU WSR allows for PPW to be exported for recycling – under certain conditions.

3.2.2 Updated Waste Shipment Regulation: plastic waste

On 1 January 2021, the Waste Shipment Regulation (2006/1013/EC) was updated by 2020/2174/EC, which includes new regulations on plastic (EUR-Lex, 2020b). The WSR generally implements provisions of the Basel Convention on the Control of Transboundary Movements of Hazardous Waste (known as the Basel Convention) and the 1992 OECD Decision on the Control of Transboundary Movements of Waste Destined for Recovery Operations. It covers exporting and importing waste from the EU to third countries, and shipping waste between EU member states. It applies to almost all types of waste, with just a few exceptions like radioactive waste.

Relevance and shortcomings of the WSR (2020/2174/EC). The limitations of Europe's recycling capacities caused EU member states to rely on exporting plastic waste: Between 2012 and 2017, the EU exported around 30 per cent of its PPW to be recycled. PPW represents an increasingly large share of total plastic exported outside the EU, rising from 43 per cent (in 2012) to 75 (in 2017) (European Court of Auditors, 2020).

Data on the total volume of exported waste in recent years show mixed results. Germany, the EU's largest plastic waste exporter, decreased its waste exports by 33 per cent between 2010 and 2020 (Federal Statistical Office of Germany, 2021). Annual plastic waste exports from the EU-27 increased from 1.62 million metric tonnes (in 2005) to a peak of 3.24 million metric tonnes (in 2014). In 2018, however, EU-27 plastic waste exports declined to 2.3 million metric tonnes, which could be partly due to the Chinese import ban that year. Since then, EU waste exports have continued to increase (Statista, 2022), with annual exports to Turkey more than doubling since 2015. In 2020, Turkey was the main destination for waste exports from the EU-27: 14.38 million metric tonnes (Statista, 2022) "owing to [Turkey's] permissive environment, and appetite for receiving and processing foreign waste to generate revenue and the presence of criminal groups" (Comolli, 2021). Europol's organised crime threat assessment notes that illegal transportation, processing and disposal of waste is increasing in and outside the EU (EPRS, 2022). Environmental agencies and industry specialists say Romania and Bulgaria may well become Europe's next plastic waste havens (Comolli, 2021).

Indeed, the European Parliament found shortcomings in the WSR: Uneven implementation and enforcement and diverging interpretations of its provisions discourage the legal shipment of good-quality waste materials to acceptable/approved recycling facilities. This is due to different interpretations of hazardous and non-hazardous waste, insufficient controls – particularly of non-hazardous waste exports from the EU – and illegal shipments within and outside the EU. Additional WSR deficiencies were published in an appraisal by the European Parliamentary Research Service (EPRS, 2021b). In November 2021, the EU reacted to these shortcomings with an update in a "proposal WSR" (709/2021/COM, henceforth referred to as "the proposed WSR") (EUR-Lex, 2021) that was presented to EU ministers at the Environmental Council in December 2021. As of June 2022, the relevant committee had not yet reviewed the draft so the proposal had not been adopted (EPRS, 2022; European Parliament, 2022b). Here I describe

the current WSR (henceforth, “the WSR”) and anticipated updates. Regulations vary according to the type of waste and its destination.

The WSR. For exports from the EU to OECD countries, hazardous plastic waste (defined in AC300) and plastic waste that is hard to recycle (Y48) will be subject to the “prior notification and consent procedure” (EUR-Lex, 2020b; European Commission, 2021c): Both importing and exporting countries must authorise a shipment by a certain deadline (EPRS, 2022). Only general information is required to export non-hazardous (green-listed) waste from the EU to OECD countries (Art. 18) (EPRS, 2022).

The following regulation applies to shipments from the EU to non-OECD countries (European Commission, 2021c)**:**

- Hazardous plastic waste (as defined in A3210) and plastic waste that is hard to recycle (Y48) may not be exported from the EU to non-OECD countries.
- Clean, non-hazardous (green-listed) waste for recovery (defined in B3011) may only be exported from the EU to non-OECD countries under specific conditions outlined in Regulation 1418/2007/EC in WSR Art. 37: The importing country must indicate which rules (e.g., prohibition, prior notification and consent, other controls or none) apply to such imports. The receiving country can reject waste shipments that do not meet its criteria (EPRS, 2022).

The proposed WSR (709/2021/COM) presents new rules to overcome the shortcomings (EPRS, 2022; EUR-Lex, 2021):

- Before exporting waste, exporters would have to ensure that facilities in the receiving country have completed audits at least every three years. Exemptions of the audit requirement could apply to OECD countries that have international agreements with the exporting country if its waste treatment is recognised as environmentally sound by the EC (EPRS, 2022).
- Exports to OECD countries are subject to stricter monitoring and a “safeguard procedure”: The EC could suspend waste exports that considerably and quickly increase or when the importing country’s waste treatment is not proved to be environmentally sound (EPRS, 2022).
- Clean and non-hazardous (green-listed) waste may not be exported from the EU to non-OECD countries unless the importing countries indicate their willingness to receive the waste and can ensure its environmentally sound treatment following WSR Arts. 37 and 40. Non-OECD importing countries must demonstrate “a waste management strategy or plan, a legal framework for waste management, and a strategy for enforcement of domestic legislation on waste management and waste shipment; and that they are a party to relevant multilateral environmental agreements” (EPRS, 2022; EUR-Lex, 2021).

3.2.3 Ban on certain single-use plastics

The Single-Use Plastics Directive (2019/904/EC) introduced on 3 July 2021 includes a ban on certain SUPs: the 10 single-use plastic items most found on Europe’s beaches that represent 70 per cent of marine litter. Cotton bud sticks, cutlery, plates, straws, beverage stirrers, and sticks to be attached to and to support balloons may no longer be sold in the EU. The ban also applies to cups, including their covers and lids, food and beverage containers made of expanded polystyrene, and all products made of oxo-degradable plastic (European Commission, 2021f). The EU is focusing on limiting the use of other SUP products through awareness-raising measures, new design and labelling requirements, and waste management obligations for producers (European Commission, 2021g).

Implementation in the EU. An NGO report finds that EU members have not uniformly transposed the SUP Directive into their national laws (Copello, Haut, Maillot, & Mongodin, 2021). Estonia, France, Greece and Sweden are implementing the directive but Bulgaria and Poland must urgently scale up their efforts (Copello et al., 2021).

3.2.4 Mandatory recycled contents

Aside from banning certain plastic items, the SUP Directive lays out complementary policy measures. These include a 77 per cent target rate for the separate collection of plastic bottles by 2025 and 90 per cent by 2029. In addition, starting in 2025, PET beverage bottles must incorporate 25 per cent of recycled plastic; from 2030, 30 per cent recycled plastic is mandatory in *all* plastic beverage bottles (European Commission, 2021f). The mandatory recycled plastic content is likely to increase because the EC is reviewing the Packaging and Packaging Waste Directive and aiming to increase recycled content in other packaging types and is also seeking to reduce packaging waste and improve packaging design (European Commission, 2021e).

Implementation in the EU. With mandatory recycled content legislation looming, European recyclers have reported record prices and unstable supplies for recycled PET (rPET) (Packaging Europe, 2022). Similarly, the start-ups Plastic2Beans, a facilitator and consultancy for the Ethiopian recycling industry, and Cirplus, an online marketplace for recycled plastics, confirm surging demand prices for rPET (Cirplus, personal communication, 19 November 2021a; Plastic2Beans, personal communication, 23 November 2021).

3.3 Implications for developing countries and recommendations for development cooperation

3.3.1 Primary material stream: plastic substitutes

The EU-CEAP's impact. While the June 2021 Ban on Certain Single-Use Plastics prohibited the 10 single-use plastic items most often found on European beaches (Section 3.2.3), it applies to such a small range of products that there is little data to help predict trends and impacts on the primary material stream.

The UNCTAD (2021) report presents materials that could substitute for plastic packaging and reduce negative impacts on the environment and human health. Many other plastic alternatives may exist but the report just reviews some of the most eco-friendly materials that can be traded in large volumes by expanding existing value chains.

- Natural materials: jute, abaca, coir, kenaf, sisal, cotton, natural rubber and milk protein. Jute production is concentrated in DECs, which accounted for 92 per cent of all exports in 2019. The main suppliers are Bangladesh (74 per cent) and India (9 per cent). Bangladesh's jute industry employs about 500,000 people and earns USD 620 million annually. UNCTAD (2021) sees considerable further opportunity for growth in jute and recommends that jute be seen as a viable substitute for plastics. In addition, demand for jute from the textile industry is expected to grow (FAO, 2022). As for natural rubber, DECs accounted for 94 per cent of all exports in 2019; major suppliers are Thailand (31.5 per cent), Indonesia (30 per cent) and Côte d'Ivoire (8.5 per cent) (UNCTAD, 2021). Global demand for natural rubber is expected to grow by 4.8 per cent between 2022 and 2027 (Mordor Intelligence, 2022).

- Paper, paperboard and cellulose-based materials. Berg and Lindqvist (2019) observe significant growth in the paper and pulp market due to rising demand for consumer and industrial packaging and transport industry needs. Paper and pulp production is linked to

deforestation in Indonesia (WWF, 2021) so developments in EU legislation and related demand effects should be studied. Despite UNCTAD's positive outlook, European producers of paper packaging and forest-based plastic substitutes such as lignin (Lignin Industries, 2021) have begun to prefer European suppliers. They are concerned about the lack of transparency regarding social and environmental compliance in supply chains, inconsistencies in raw-material quality and rising costs from higher shipping fees – particularly during the COVID-19 pandemic – as well as the ability to access materials more easily in Northern Europe (Producers of paper packaging and plastic alternatives, personal communication, 11 October 2021).

Biodegradables and bio-based polymers. The SUP Directive has created public debate about using biodegradable and bio-based polymers as plastic substitutes and alternatives to natural materials and paper. But the directive prohibits biodegradable and bio-based plastics because there are no widely agreed technical standards that certify their harmless biodegradability (European Commission, 2021d). This is not expected to change until the directive is reviewed in 2027 and biodegradability in the marine environment is re-assessed. Just a few minor exemptions – if any – can be expected from the Policy Framework on Biobased, Biodegradable and Compostable Plastics due in 2022 (European Commission, 2022c). I thus base my discussion on natural materials and paper.

Opportunities and Risks. With DECs as key suppliers of natural materials, increased demand could create trade and investment opportunities and promote sustainable development in the Global South. UNCTAD (2021) notes that producing plastic substitutes is more labour intensive than conventional plastic and could create important employment and livelihood opportunities in developing countries. UNCTAD provides a broad overview of emerging material trends and impacts on trade flows to DECs and discusses trade policy measures to support plastic substitutes. But production upscaling could negatively affect DECs because cultivating and irrigating natural fibre crops (jute, kenaf and cotton) has a large water footprint (Korol, Hejna, Burchart-Korol, & Wachowicz, 2020) and strong international demand for natural rubber could drive the expansion of monoculture plantations, for example, in Southeast Asia. Rubber monoculture has been linked to deforestation, the extensive use of (artificial) fertilisers that may cause a loss of bird, bat and invertebrate biodiversity (Warren-Thomas, Dolman, & Edwards, 2015) and soil erosion/degradation (Regenerative Rubber Initiative, 2022).

Recommendations for development cooperation. Development cooperation should monitor the development of the SUP Directive that might be expanded to include other product categories (Copello et al., 2021) and intensify demand for alternative plastic materials from DECs. Increased demand for alternative packaging driven by growing consumer awareness and corporate commitments to reduce plastic packaging could also raise demand for alternative plastic materials. Given the directive, any analysis of future demand should focus on natural materials rather than biodegradables and bio-based polymers and papers. Development cooperation should also bear in mind that demand for natural materials from other sectors is not covered in this study and that Langsdorf and Duin (2022) discuss wood for construction.

3.3.2 Secondary material stream

3.3.2.1 Illegal plastic waste imports and waste havens

EU-CEAP impacts. At first glance, the decline in German plastic waste exports (Section 3.2.2) could be associated with the WSR's efficacy. However, as Section 3.2.2 hints, the waste trade system is not perfectly managed. Aside from the shortcomings noted by the European Parliament, NGOs assume that illegal waste trading will persist or significantly increase under the WSR (Rethink Plastic Alliance, 2021). China's 2018 import ban serves as a preview of

challenges that could occur with the WSR. The proposed WSR of November 2021 suggests new measures.

Challenges. Interpol's strategic analysis report about the global plastic waste market (Interpol, 2020) used open sources and criminal intelligence from 40 countries to identify new challenges in the plastic waste trade following the Chinese ban on importing waste from the world's most common plastic products. Until then, China had been the world's largest recipient of plastic waste: 45 per cent of G7 country exports between 1992 and 2018, and 85 per cent of Europe's plastic waste (Interpol, 2020). China received mostly low-quality waste after developed nations had sorted out the most valuable components such as PET and high-density polyethylene (HDPE). The imported waste was heavily contaminated with additives and dyes, leading China to impose its ban (Heinrich-Böll-Stiftung & BUND, 2019). There are several barriers to implementing the WSR:

New waste havens. While European waste exports to Turkey have been increasing since 2018, plastic waste exports from Europe and North America have largely been rerouted from China to Southeast Asia (see Section 3.2.2). Plastic scrap exports to Thailand rose nearly 70-fold in the first four months of 2018 over the same period in 2017; imports to Malaysia sextupled (Heinrich-Böll-Stiftung & BUND, 2019). Similar surges in plastic waste imports have been reported in the Philippines, Indonesia (Comolli, 2021) and Vietnam (Heinrich-Böll-Stiftung & BUND, 2019) where illegal waste shipments often end up in illicit landfills or are illegally incinerated. In Malaysia, for example, almost 40 illegal recycling factories opened, dumping toxic wastewater into waterways and polluting the air with the toxic fumes of burning plastic (Heinrich-Böll-Stiftung & BUND, 2019). Although Southeast Asia is expected to remain the primary destination for illicit plastic waste trade, following China's lead, some countries have begun their own import bans. Implementation success varies (Interpol, 2020) and attempts to regulate imports can encourage rerouting waste to other destinations. For example, Laos and Myanmar, along with African countries such as Zambia, are becoming major recipients of European and North American waste (GI-TOC, 2021; Interpol, 2020) and could become new illegal waste havens. The proposed WSR would hamper new waste havens by requiring importing countries to demonstrate their legal frameworks, enforcement approaches and waste management strategies.

Weak enforcement of import restrictions. Although many Southeast Asian countries have banned imports so as to encourage the use of domestic waste for recycling, some regulations were softened, delayed or discarded (GI-TOC, 2021). In one case, Thailand's import plastic ban planned for September 2020 was delayed for five years, which critics see as an attempt to secure steady waste flows for its growing number of foreign recycling facilities at the expense of Thailand's environment (Bangkok Post, 2021; GI-TOC, 2021). Another case concerns Indonesia's import ban of 2019: The next year, the government allowed imports of more contaminated plastic (and paper) waste – supposedly because of US trade association lobbying (GI-TOC, 2021). These examples show that a country's decision to import plastic waste can be influenced by lobbying and economic interests. The proposed WSR could make it more difficult for lobbyists and pressure groups to influence the import process by requiring documents to be submitted to the EC.

Social implications for informal waste workers. Researchers and development initiatives point to the importance of informal waste pickers in DECs in the global plastic waste management value chain. Such informal workers are the most affected by changes in the volume and quality of plastic waste (Kaza, Yao, Bhada-Tata, & Van Woerden, 2018). Little has been written about the social impacts of illegal plastic imports in particular, but general literature on informal waste workers in solid waste management mentions important facts and issues about illegal waste shipments. Informal workers, many of whom belong to vulnerable groups, including women, children, the elderly, the unemployed and migrants, are at great risk. They lack social security and health insurance, have precarious working conditions, cannot access education or training, and face social stigma and harassment (Kaza et al., 2018). Particularly informal workers in the

plastic waste sector face unstable prices and receive much lower prices for plastics than for other materials like paper, cardboard and metals because they are often contaminated with unrecyclable materials. In many regions like Latin America, only three out of five plastic materials are valuable for recycling: PET, HDPE and low-density polyethylene (LDPE) (Heinrich-Böll-Stiftung & BUND, 2019). As the share of low-value plastics in waste increases, informal workers will have more difficulty finding recycling companies to buy their waste. Yet it is informal workers who account for 25 to 50 per cent of all input material processed by recycling companies in Latin America (Heinrich-Böll-Stiftung & BUND, 2019). If waste shipment export restrictions, particularly those on quality, are not properly enforced by the authorities under the current and proposed WSRs, informal workers in importing countries could indirectly be faced with lower-quality plastics and unstable earning opportunities.

Monitoring loopholes in exporting countries. Prior experience has shown that the WSR and related monitoring are difficult to enforce in European exporting countries. Illegal waste shipments are often falsely labelled “green-listed plastic waste” which has fewer controls that are easier to circumvent (Vilella, Condamine, & Sangaralingam, 2021). Interpol (2020) reports an overall rise in the use of counterfeit documents and fake waste registrations. In Germany, for example, a “green” waste shipment merely requires self-declaration. While German district governments and customs authorities regularly check specific pre-licensed exporters, controls are largely random or only made in suspicious cases based on prior evidence. Moreover, the few staff members are confronted with the high volume of exports (Bezirksregierung Köln, personal communication, 8 November 2021; Umweltministerium NRW, personal communication, 24 January 2022). Another critical issue related to exporting green-listed plastic waste concerns the material quality, which is neither checked by customs nor reported: The UN Comtrade International Trade Statistics Database has information on the type of plastic waste exported, as well as the country of origin and country of destination – but none on its quality (Vilella, Condamine, & Sangaralingam, 2021). The WSR requires European exporters to present documentation that treatment and recycling at PPW destinations respect standards comparable to those in the EU (EUR-Lex, 2020b). That said, the European Court of Auditors recognises that third countries often cannot verify compliance with EU plastic waste treatment standards due to a lack of on-the-spot checks and controls by extended producer responsibility (EPR) organisations and authorities in importing countries (European Court of Auditors, 2020). The proposed WSR requires facilities of importing countries to make audits at least every three years, which could close this monitoring loophole.

Recommendations for development cooperation. Enforcing the current WSR has great challenges that the proposed WSR could reduce. Development cooperation should assist DECs by:

Supporting monitoring and enforcement in importing countries. The proposed WSR’s stricter regulations require DECs to get help in building their capacities for the expanded legal framework and enforcement, new waste management strategies and multilateral environmental agreements. DEC authorities often face shortages regarding law enforcement and prosecution. Waste-crime investigations require targeted and efficient inspection strategies: Development cooperation could provide training and staff resources to local customs authorities (Interpol, 2020). It could also help raise awareness within importing DECs, including on monitoring and prosecuting illegal waste practices. Comolli (2021) suggests NGOs and civil society should collaborate to encourage public debate on illegal waste imports and pressure governments to not weaken waste import laws. Countries need help with building administrative staff capacities to demonstrate their waste management strategies to the EC, while waste management facilities need help with audits. Besides helping DECs meet WSR requirements for EU imports, development cooperation should also help them satisfy Basel Convention requirements for non-EU imports.

Improving monitoring, investigations and traceability in exporting countries. It is important to mention the measures needed in exporting countries: more stringent and frequent controls of non-licensed export facilities because illegal plastic waste imports are often disguised as "green-listed". Waste-crime investigations could be strengthened through collaborations across multiple jurisdictions that adopt a network or approach like that used by the UK's Joint Unit for Waste Crime that unites environmental regulators, tax authorities and police agencies in a multi-agency task force (UK Environment Agency, HM Revenue & Customs, & National Crime Agency, 2021; Comolli, 2021). Stricter control mechanisms also require greater transparency and traceability of intra- and extra-EU waste-shipment routes (Rethink Plastic Alliance, 2021). Digitalisation like that used by the UK Department for Environment, Food and Rural Affairs (2019) to track a cargo's journey from start to finish can be a big help. To enhance waste traceability at the international level, Interpol (2020) recommends strengthening and standardising the national licensing system of waste facilities and making national databases of licensed facilities accessible to other countries, perhaps through the Basel Convention Secretariat. This would also allow development cooperation to better monitor plastic waste destinations and new waste havens.

3.3.2.2 New recycling plants and recycled plastic markets

EU-CEAP impacts. This section assumes that only recyclable plastic waste will be exported to DECs – with shipments monitored and enforced, which presents economic opportunities as well as potential risks. I also discuss how the SUP Directive's mandatory recycled content impacts on DECs. In Europe, prices for rPET have increased in recent years and are expected to further increase in light of the recycled content requirement (see Section 3.2.4). OECD (2018) and Brooks (2021) report global price increases for rPET and other types of recycled plastics. In the last few years, many foreign recycling companies have opened facilities in Africa and Southeast Asia. Comolli (2021) interviewed environmental agencies in Ghana and Zambia who report a sharp increase in applications from Chinese recycling companies to operate locally. Around the Ghanaian port city of Tema, the number of recycling facilities rose from five in 2013 to 20 in 2021. It was said that Chinese companies were coming because of rising costs of labour and environmental compliance in China as a result of the ban on importing plastics (Comolli, 2021). There may be other competitive advantages for the recycling industry in DECs, including informal recycling structures and the availability and local consumption of high-quality plastics (e.g., PET) coupled with the lack of large-scale recycling companies (Plastic2Beans, personal communication, 23 November 2021). Many companies operating in China have opened new branches in Indonesia, Malaysia and African countries (Xia, 2019).

Opportunities. These new recycling facilities opened by Chinese entrepreneurs could present similar opportunities to meet European demand for recycled plastics.

European export markets. Increased global and European demand for recycled plastics partly ignited by the EU-CEAP could incentivise investors to expand their recycling capacities in developing countries and enter export markets. Some Chinese plastic factories have been catering to local African markets as well as the Chinese market – filling the supply gap created by the Chinese import ban (Xia, 2019). The demand for recycled plastic spurred by the EU-CEAP and supply shortages could make Europe a new destination for the DECs' recycled plastics. Plastic2Beans has helped Ethiopian recyclers export recycled plastic flakes to Europe (Plastic2Beans, s. a.), but there is little data on other DECs in the European market.

Employment opportunities and technology spillovers for local recycling. New recycling facilities for foreign export markets could offer more employment in DECs. Recyclers in multiple African countries report that new facilities have mostly been employing local people (Xia, 2019). Many investments are being made in packaging plants but Chinese investors in Tanzania are also talking about building polyester fibre factories, which could increase economic opportunities in

the garment and textiles sector. According to Xia (2019), Chinese companies have heavily invested in training personnel, thus creating technology spillovers for the local recycling industry: More than half of the Chinese plastic recycling plants reported that Tanzanian employees had left to set up their own waste collection centres. The EU-CEAP and its mandatory recycled content requirements, as well as European requirements for high-quality recycled plastics, could encourage investors to construct new DEC recycling facilities or upgrade the recycling infrastructure, positively impacting on local recycling.

Supplementing domestic waste. A consistent supply of plastic waste is indispensable to keep the machinery in recycling facilities functioning. However, collection systems in DECs may not be able to supply consistent feedstock so some recycling facilities in DECs have used imported plastic waste (Plastic2Beans, personal communication, 23 November 2021).

Challenges. There are critical socio-economic implications and barriers related to importing European plastics, opening recycling plants in DECs and entering Europe's recycled plastics market.

Viability of recycled plastic exports. DECs represent only around 5 per cent of suppliers in the global market for recycled plastics (Cirplus, personal communication, 19 November 2021a) and have several challenges that can hamper their market viability, beginning with the quality of recycled plastics demanded in Europe. For example, the polyvinyl chloride (PVC) contamination level in rPET is one quality indicator that is becoming more important, especially for introducing recycled plastics in food packaging (Brouwer, Alvarado Chacon, F., & Thoden van Velzen, 2020). While some corporations have started to invest in manufacturing low-level PVC plastics in Southeast Asia (Brooks, 2021), DECs still have difficulty competing with the most technically advanced recycled food-grade plastics from Europe (Cirplus, personal communication, 19 November 2021a). Second, it is difficult for suppliers from DECs to prove the quality of their recycled plastic pellets because – unlike for virgin plastics – there is no recognised product standardisation scheme for *recycled* plastics. Third, DEC recyclers can only supply a limited volume whereas manufacturing companies in developed nations demand high amounts and a consistent supply of plastic that many smaller facilities in DECs cannot guarantee. Fourth, for corporate compliance, sourcing companies are increasingly demanding transparent value chains in DECs (Brooks, 2021). But for many DEC producers and recyclers that involves significant costs for auditing and certifying their facilities. Lastly, supplying European markets with recycled plastics partially produced from previously imported European waste is probably not environmentally or economically sensible. Importing plastic waste and exporting recycled pellets could have high emissions and transport costs.

Reduced demand for low-skilled labour; labour standards violated. Expanding production and industrial upgrading do not automatically increase employment opportunities. Chinese manufacturers report cutting staff by 30 to 40 per cent as a result of the new machinery's greater productivity. Demand could rise for technicians but plummet for low-skilled labourers (Xia, 2019). In the textile industry, using recycled plastics also has drawbacks because it requires high investments in more advanced machinery (e.g., for electrospinning) and is environmentally unsound because the recycling often requires using harmful solvents. Moreover, recycled food-packaging plastics is higher quality and should be reused in food packaging: Lower quality grade plastics can be utilised for textiles (Plastic2Beans, personal communication, 23 November 2021).

Furthermore, some recycling factories violate both human rights and environmental regulations, with incidents reported at Chinese recycling companies in Thailand, Malaysia, Tanzania (Xia, 2019) and Ghana (Comolli, 2021). Outside recycling facilities, it is very difficult to monitor labour standards – for example, of informal workers who have to work overtime and/or without adequate protective gear (Plastic2Beans, personal communication, 23 November 2021).

Substitution of domestic waste. Comolli (2021) suggests that there might be too little local waste to keep the growing number of recycling plants operating, which could encourage the procurement and processing of illegally imported waste. Some Chinese recyclers have been identified as doing just that (Comolli, 2021). In addition, imported plastic waste – assuming that it is cleaner and can be obtained more cheaply – could replace domestic waste and discourage the domestic recycling of local waste. That said, restrictions in the proposed WSR could decrease European imports in the short term and encourage DECs to improve the collection, segregation and treatment of domestic waste.

Recommendations for development cooperation. Development cooperation could support European plastic waste imports and global export markets for recycled plastics by:

Raising the quality of recycled plastics and labour standards. We have seen that engaging in the European recycling market can attract investments in recycling facilities and machinery, thus creating employment opportunities and benefits for the local recycling infrastructure. However, that could also reduce demand for low-skilled labour and violate labour standards. Because multiple barriers make entering the European market unfeasible in the short term, development cooperation should continue to focus on creating framework conditions that meet local demand. In the long term, as plastic recycling technology advances in DECs, entering the European market could become more feasible.

The quality of DEC recycled plastics must be raised for both local and foreign markets. Development cooperation could provide technical training and invest in the advanced machinery used in modern recycling plants. It could also advise DEC governments to introduce standards that raise product quality. For example, Plastic2Beans has been advising the Ethiopian government to introduce standards for transparent plastics because, unlike coloured plastics, they permit multiple recycling rounds. This could be particularly fruitful in countries where the recycling industry is promising but regulation does not yet exist (Plastic2Beans, personal communication, 23 November 2021). Development cooperation could also support initiatives to establish regional or international standards for recycled plastics. That would make it possible to compare quality and allow even small DEC suppliers to demonstrate their product quality. Examples include the Cirplus initiative to establish an internationally recognised version of the German DIN-SPEC (Cirplus, 2021b) and the initiative of the World Economic Forum and the African Circular Economy Alliance to create regional standards for food-grade rPET (Ugorgi & van der Ven, 2021). Gall, Wiener, Oliveira, Lang, and Hansen (2020) present a fair-trade business model in Nairobi, Kenya where recycled plastic fulfils the standards of high-income countries. Lastly, development cooperation should continue to help existing and emerging recycling plants comply with labour and environmental standards and cooperate with local NGOs like Petco Ethiopia, which is improving working conditions in the recycling industry (Petco Ethiopia, 2022).

Tracking new opportunities and risks related to plastic waste imports. If local waste volumes are insufficient, imported plastics can help keep recycling machinery running and profitable. But imported European waste could *replace* domestic waste and discourage its collection and recycling. There is little data on how European imported waste impacts on DECs: Development cooperation should monitor this. As NGOs demand, if risks prevail, further restrictions should be placed on exporting European plastic waste (Vilella, Condamine, & Sangaralingam, 2021).

3.3.2.3 Summary

The EU-CEAP aims to meet the challenges related to Europe's increasing plastic consumption and expected increase in PPW. Two aspects of the EU plastic packaging regulation have been examined:

The illegal plastic waste trade and waste havens. We have discussed the difficulties of enforcing and monitoring the Waste Shipment Regulation, which was introduced to restrict the export of hazardous, hard-to-recycle plastic waste to non-OECD countries. Issues linked to China's import ban on plastic from 2018 hint at future challenges to exporting waste from Europe. The illegal waste trade has been possible due to monitoring loopholes in importing and exporting countries. Alongside the prominent plastic waste importing countries in Southeast Asia (Thailand, Malaysia, Philippines, Indonesia and Vietnam), new waste havens are emerging in adjacent countries including Laos and Myanmar and beyond (Zambia). Lobbying and conflicting economic interests have often delayed or destroyed attempts by Southeast Asian countries to introduce import restrictions. Informal workers may be especially vulnerable to illegal waste shipments. The proposed WSR raises requirements for importers: Countries who wish to continue importing plastic waste must show they have adequate waste management plans, legal frameworks and enforcement strategies, belong to multilateral agreements and conduct waste facility audits. Development cooperation should help importing DECs meet these requirements by helping waste management facilities fulfil their audit requirements and building capacity so the administrative staff can deal with the EC and legal prosecutors – among other tasks. Measures should help DECs respect not only EU regulations but also fulfil requirements for non-EU imports like those in the Basel Convention. Monitoring loopholes in the exporting country is another issue. While not specifically a matter for development cooperation, waste traceability at the international level – starting from exporting nations – is needed to show how the waste trade is developing and anticipate new waste havens.

European markets and imports. We have examined some of these ambiguous effects linked to importing European waste, including the risks and opportunities for DECs. DECs could start to deal on European recycled plastics markets if European demand for recycled plastics continues to grow under the SUP Directive's recycled content requirements.

Trading on European markets for recycled plastics could increase employment opportunities and revenue streams in DECs although those could be limited to skilled workers on advanced machinery – while labour standards in recycling factories could be flagrantly breached. DEC access to the European market is impeded by multiple barriers including their lack of quality (verification) and limited ability to supply high volumes of recyclable plastic waste, difficulties in complying with labour and environmental standards, and emissions and transport costs. For these reasons, DECs entering the European recycled plastic market is a long-term issue for development cooperation. In the short term, more focus should be placed on raising the quality of recycled plastics for the local market, ensuring labour standards in recycling facilities and improving working conditions for informal workers. Development cooperation could also boost DEC recycling capacities by investing in advanced machinery and training local people to enhance the quality of the recycled plastic – which could also be improved by development cooperation advising and supporting governments with respect to recycling standards. In the long term, these measures could make recyclable plastics from DECs more competitive on the European market.

Importing plastic waste from Europe is not a clear win-win. Although the WSR could supplement domestic waste inputs and keep recycling machinery and facilities running and profitable, it can also lead to domestic waste being replaced by imported waste, especially if it costs less and is better quality – and that could discourage domestic plastic waste recycling. However, the *proposed* WSR could quickly lead to reductions in import volumes and re-incentivise domestic recycling efforts. Considering the impacts of European plastic waste imports as well as difficulties enforcing and monitoring the WSR, development cooperation should closely monitor WSR data on illegal waste shipments and how European imports negatively impact DECs. If the latter continue, it will be necessary to discuss limiting European plastic exports.

3.4 Role model effect and global governance

Apart from impacting the primary and secondary material streams, EU-CEAP plastic waste regulation could also inspire the expansion of circular economy policies. The database of Chatham House (2022) provides an overview of circular economy policies worldwide: In developing countries, product bans and waste management policies dominate. A prominent example of a product ban is that on single-use plastic in Africa, where 34 of 54 states have either passed a ban or passed laws to implement bans. Kenya is said to have “the strictest ban on single-use plastic in the world” – with fines of USD 40,000 for importing, manufacturing or selling single-use plastic bags (Greenpeace, 2020). However, few policies addressing earlier steps in the product and material cycle, such as waste avoidance and product ecodesign, are found in the database or literature. In contrast, EU-CEAP approaches improve packaging design to reduce packaging waste (European Commission, 2021e), reconceiving the entire product design and considering reusability in the design process. The EC Sustainable Products Initiative indicates that the EU aims to include circularity in the early steps of the product lifecycle, essentially through its revised Ecodesign Directive that obliges manufacturers to design product with minimal negative environmental impacts. As of June 2022, adding non-energy-related products and critical aspects such as product durability, reusability and reparability were being discussed (European Commission, 2022d). This could inspire DECs to institute product-design policies that implement circularity principles at the beginning of the value chain with regulations promoting plastics that are easier to recycle (see Section 3.3.2.2) and avoiding composites.

Besides the EU-CEAP, other global governance initiatives for a circular economy could also influence DECs. In March 2022, the United Nations Environment Assembly (UNEA) agreed to draft an internationally legally binding instrument for plastic pollution by 2024. Described as a “milestone” and the “most important international environmental deal since the Paris climate accord” (UNEP, 2022a), the End Plastic Pollution resolution is expected to impact plastic value chains in both developed and developing countries. Like the EU-CEAP, the UNEA resolution considers the whole product life cycle: from design and production through the disposal and reduction of plastic waste leakage. However, the final scope of the instrument must still be decided by member states in a multilateral setting (UNEP, 2022b). Details to be discussed include reporting, including national self-reporting, and enforcement mechanisms resembling those in compliance committees like the Basel Convention Secretariat (UNEP, 2022b). As with the EU-CEAP, DECs will need development cooperation assistance to implement UNEA requirements.

4 Electric vehicles and batteries

4.1 Introduction

Expanding the use of electric vehicles (EVs) is key to reducing greenhouse gas (GHG) emissions and meeting the European Green Deal goal of climate neutrality by 2050. In the EU-27 (plus the United Kingdom, Iceland and Norway), the share of registered electric cars increased from 2 per cent in 2018 to 11 in 2020 (European Environment Agency, 2021). By 2030, global EV sales are expected to reach around 31.1 million, an annual growth rate of 29 per cent (Walton et al., 2020). Other research shows that globally, more than 50 per cent of new vehicles sold in 2030 will be electric (BCG, 2020). Batteries are key to electrifying transport and mobility sectors and decarbonising economies. The most common types of EV batteries are lithium-ion batteries (LiBs), the focus of this discussion paper. They are the fastest growing technology due to their power and energy efficiency: Demand for LiBs is expected to exceed more than 30 per cent per year for the next decade. The preferred technology for e-mobility, LiBs are also frequently found in portable electronics and stationary battery energy storage

systems (BESSs) (EPRS, 2021a). An increase in European EVs and batteries will create battery waste, although with the lifetime of an LiB ranging between five and 20 years (depending on usage), predictions of expected waste volumes vary greatly. Nonetheless, researchers agree that although the waste stream will take several years to evolve, it will steadily increase (Graulich, et al., 2021). EU-CEAP regulations on EVs and batteries aim to increase battery lifetimes and decrease Europe's dependency on major battery raw materials such as cobalt, natural graphite, lithium and nickel (European Council, 2022). They also aim to improve waste management and material recovery. The EU-CEAP will impact DECs in two ways: the primary material chain and countries such as Indonesia and Chile that export nickel and lithium, and through steps in the secondary material value chain: reusing, repurposing and recycling EVs and their batteries.

4.2 Selected legislation

The requirements for EVs and EV batteries are embodied in the EU's Battery Directive, Proposal for a Battery Regulation and End-of-Life Vehicles Directive. Transboundary shipments of waste batteries are subject to the WSR (2020/2174/EC) which implements provisions of the Basel Convention (WEF, 2020). According to European law, directives must be transposed into domestic legislation by each member state, meaning that the Battery and End-of-Life Vehicles Directives represent minimum standards that individual member states must ensure through new national laws. In contrast, regulations become law in every EU member state as soon as they enter into force. The WSR is directly applicable throughout the EU and requires no individual legislation (WEF, 2020).

4.2.1 End-of-Life Vehicles Directive

The End-of-Life Vehicles (ELV) Directive (2000/53/EC) setting clear targets for ELVs and their components entered into force on 18 September 2000 and had to be transposed into national law by 21 April 2002. Since then, several amendments have been made, the last in 2018 (2018/849) (EUR-Lex, 2018). The EC expects to present a legislative proposal to revise the directive again in the final quarter of 2022 (European Commission, 2022b). The directive and its amendments target multiple levels of the waste hierarchy with "measures which aim, as a priority, at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of-life vehicles and their components to reduce the disposal of waste" (European Commission, 2022a).

The ELV Directive includes the following regulations (EUR-Lex, 2020d):

- Vehicle and equipment manufacturers must factor in vehicle dismantling, reuse and recovery when designing and producing their products and ensure that new vehicles are:
  - at least 85 per cent reusable and/or recyclable (by weight)
  - at least 95 per cent reusable and/or recoverable (by weight).
- Hazardous substances, such as lead, mercury, cadmium and hexavalent chromium, may not be used in new vehicles (EUR-Lex, 2020d).
- Manufacturers, importers and distributors must ensure adequate systems to collect ELVs and, where technically feasible, used parts from repaired passenger cars.
- Waste treatment facilities must have permits or be registered with the relevant authorities of the EU country where they are located.

- ELVs must be stripped before any further treatment, and hazardous substances and components removed and separated. The potential reuse, recovery or recycling of the waste must be considered.

- This legislation applies to passenger vehicles and small trucks – not big trucks, vintage vehicles, special-use vehicles or motorcycles.

4.2.2 Battery Directive and Proposal for a Battery Regulation

Batteries and accumulators are regulated in the Battery Directive (2006/66/EC) (EUR-Lex, 2006). In Germany, the directive was transposed into German law by the *Batteriegesetz* last amended in November 2020 (BMJ, 2009; Umweltbundesamt, 2020). In December 2020, the EC introduced a Proposal for a Battery Regulation to replace the Battery Directive (EUR-Lex, 2020c). On 17 March 2022, the EU Environment Council unanimously adopted the new proposal and agreed on a "General Approach" (European Council, 2022). A final agreement in the trilogue involving EU member states (EU Council), the European Parliament and the EC (BMUV, 2022a) is expected in coming months (BMUV, personal communication, 25 March 2022b). The General Approach is considered a milestone in adopting a Battery Regulation for several reasons. First, the proposal is expected to significantly impact on the EU battery market since it is legally binding and must be adopted by EU member states (European Council, 2021). Second, it establishes a comprehensive framework for all types of batteries, including portable ones (mainly used in consumer electronics, communications and computing), traction batteries (for automotive and electric vehicles), industrial batteries and batteries for light means of transport (LMT) such as e-bikes (BMUV, 2022a). Third, it addresses the entire life cycle: battery design, supply chain, carbon footprint and recycled content (BMUV, 2022a). The proposal is expected to lead the way to regulating other product categories (BMUV, personal communication, 25 March 2022b).

The most recent proposal concerns four primary materials for batteries: cobalt, natural graphite, lithium and nickel (European Council, 2022). Economic actors that sell rechargeable industrial and EV batteries containing these materials are subject to "supply chain due diligence obligations" under Annex II of the OECD Due Diligence Guidance for Responsible Supply Chains (OECD, 2013) and "mandatory third-party verification through notified bodies" (European Commission, 2020d; European Council, 2022). Art. 39 obliges economic actors to conduct risk analysis and management for their supply chains. Annex X adds environmental and social risk factors and other measures such as requiring producers to introduce standardised environmental management systems. Previous due diligence requirements had focused on human rights (BMUV, personal communication, 25 March 2022b; EUR-Lex, 2020c).

The Proposal for a Battery Regulation also includes measures regarding the secondary material stream that describe the order of priority for steps in battery waste management leading to disposal as described in the Waste Framework Directive (Directive 2008/98/EC), which also applies to EV batteries.

- *Reusing* refers to using a product or its component again *for the same* purpose, application, function or context, for example, when the whole vehicle is used again or its battery is placed in another EV. The vehicle or battery can be reviewed (diagnosed), repaired, restored, refurbished, reconditioned, replaced, rebuilt, remanufactured or reassembled with new or used components (Faessler, 2021). Reusing should be prioritised for all products to prevent waste (Watkins & Farmer, 2021). However, after remanufacturing – repairing, maintaining or replacing deficient battery cells – only a small share of EV batteries can be used in new EVs. Most used EV batteries are not suitable for remanufacturing but can be repurposed in other applications (GIZ, 2021).

- *Repurposing* (also referred to as “second use” or “second life application”) uses a product or some components *for a different* purpose, application, function or context. That includes putting an EV battery or its components in a stationary energy storage system (Faessler, 2021).

- *Recycling* is when a specialised company recovers valuable metals from battery cells and sells them for use in manufacturing new batteries (Niese, Pieper, Arora, & Xie, 2020).

Preparing EV batteries for either of these steps involves safely collecting, transporting and positively assessing them. Performance assessment can include making a visual inspection, verifying the battery voltage, determining its health, testing its capability and running cycling studies to observe cell capacity, voltage and physical properties (GIZ, 2021).

Measures in the Proposal for a Battery Regulation referring to the end-of-life and secondary material management of batteries cover various stages of the waste hierarchy.

1. To facilitate battery reuse, repair and recycling, in Art. 47 the proposal presents EPR obligations for batteries on the EU market. Producers must ensure waste management – organising and promoting separate collection – as well as reporting and financing those activities.

2. The proposal establishes a framework for repurposing industrial and EV batteries for a second life (Art. 59), for example, making it easier to use the EV battery to store stationary energy. Battery providers must ensure that repurposing operators can access the battery management system to determine battery health. It also sets out obligations to ensure that the examination, performance testing, packing and shipment of batteries and their components follow adequate quality control and safety instructions (EUR-Lex, 2020c).

3. Industrial, automotive and EV batteries must be fully collected. For portable batteries, the current collection rate of 45 per cent of batteries on the market should rise to 65 per cent by 2025 and 70 per cent by 2030 (European Commission, 2020d).

4. All collected waste batteries must be recycled (Art. 57).

    - The EC proposes raising the recycling efficiency targets for lead-acid batteries (recycling 75 per cent of their average weight by 2025 and 80 per cent by 2030) and new targets for lithium-based batteries (65 per cent by 2025 and 70 per cent by 2030) (European Commission, 2020d).

    - The EC proposes compulsory targets for quantified material recovery: 90 per cent for cobalt, copper, lead and nickel, and 35 per cent for lithium by the end of 2025. By 2030, recovery levels should reach 95 per cent for cobalt, copper, lead and nickel, and 70 per cent for lithium. In contrast to the recycling efficiency targets, the material recovery targets concern the battery material, not the weight (European Commission, 2020d).

5. To close the material loop, recovered materials should be used in battery production. The EC proposes gradually increasing the minimum levels of recycled content in new batteries.

    - As of 1 January 2027, industrial and EV batteries with internal storage will be required to declare the content of recycled cobalt, lead, lithium and nickel.

    - Starting 1 January 2030, these batteries will have to contain minimum recycled contents (12 per cent cobalt, 85 per cent lead, 4 per cent lithium and 4 per cent nickel).

    - From 1 January 2035, these levels will be raised to 20 per cent for cobalt, 10 per cent for lithium and 12 per cent for nickel, with the share for lead unchanged (European Commission, 2020d).

Aside from legislation impacting primary raw material sourcing and the secondary material stream, the proposal suggests mandatory public green procurement, carbon footprint requirements (declarations and maximum thresholds) and performance and durability requirements (electrochemical requirements for portable batteries and the phasing out of non-rechargeable portable batteries). The EC also plans multiple measures for improving information transparency and exchange, including a label/QR code on batteries that states its main characteristics (lifetime, charging capacity, collection requirements, hazardous substances and safety risks), an electronic exchange system for battery information and a battery passport for each industrial and EV battery on the market (EPRS, 2021a; European Commission, 2020d). In addition to the proposed framework, the EC supports battery development through a range of initiatives such as the European Battery Alliance and financial aid for research and innovation along the entire battery value chain (Melin et al., 2021).

4.2.3 Waste Shipment Regulation: batteries

Under the provisions of the Battery Directive Art. 15, battery treatment and recycling may take place outside the EU provided that EU legislation on shipping waste is respected (EUR-Lex, 2006). For the EU, the current and proposed WSRs (2006/1013/EC; 709/2021/COM) (see Section 3.2.2) is most relevant for the transport of EV batteries and related waste. The regulation concerns shipments between EU member states (and transit through non-EU states), EU to non-EU exports, and imports into the EU from non-EU countries as well as non-EU country shipments through the EU. The regulation incorporates provisions laid out in the Basel Convention and divides battery waste into three categories (Brink, Lucas, Baldé, & Kuehr, 2021; WEF, 2020):

1. Green-listed non-hazardous waste for reuse and recovery where exporters have to follow the “general information requirements” in Art.18.
2. Green-listed non-hazardous waste for disposal where the destination party’s prior written notification and consent is required for exports.
3. Hazardous waste may not be exported to non-OECD countries.

4.3 Implications for developing countries and recommendations for development cooperation

4.3.1 Primary material stream

This section looks at the implications of European legislation on DECs, focusing on impacts on the EV battery primary material stream. The EU-CEAP covers the use of cobalt, copper, nickel, lithium and lead in EV batteries. Since Langsdorf and Duin (2022) discuss the implications for cobalt and copper suppliers in developing countries, this study focuses on the nickel and lithium which are essential for LiBs.

The measures proposed in the EU-CEAP present the following risks and opportunities for DECs with respect to nickel and lithium. I introduce the current demand trends and then discuss supplier countries and related supply chain issues. Then I analyse the changes expected as a result of the EU-CEAP by examining the proposed due diligence obligations and contrast raw material demand expectations with EU-CEAP recycling regulations.

4.3.1.1 Demand for nickel and lithium

Opportunities. Growing interest and projected increases in EV manufacturing and rising demand for raw materials present opportunities for DECs to become more active suppliers.

Nickel. Over the next 20 years, nickel's largest growth sector is expected to be EVs, with global demand increasing from 92 kt (92 thousand tonnes or 92 million kg) in 2020 to 2.6 Mt (2.6 million tonnes or billion kg) in 2040. The European electric mobility transition is predicted to increase the EV sector's demand for nickel in the EU-27 from 17 kt in 2020 to 304 kt in 2030 and 560 kt in 2040 (Fraser et al., 2021). Nickel is increasingly valuable for the EV and battery industry: first because nickel-rich LiBs exhibit superior energy density and lower metal costs, which makes them preferable to higher cobalt-containing technology in EV production (Rushdi, Sutomo, Pius Ginting, & Anwar, 2021), and second, because manufacturing LiBs (with higher nickel ratios) is preferred because of the environmental and human rights risks linked to cobalt and its sourcing in the Democratic Republic of Congo (see Langsdorf & Duin, 2022). For this reason, manufacturers like Tesla have announced they will use "cobalt-free" batteries in their vehicles (Calma, 2020; Morris, 2020).

Nickel is mined in around 30 countries, with major suppliers Indonesia (26 per cent of global production), followed by the Philippines (15 per cent), Russia (9 per cent), New Caledonia (9 per cent) and Canada (8 per cent) (GIZ & BGR, 2021). In 2020, the EU imported USD 63.19 million worth of nickel from Indonesia (Trading Economics, 2022). Aware of the economic opportunities in EVs, Indonesia is increasingly seeking to attract investments for smelters and processing plants to raise its production capacity along the EV supply chain. Indonesia's 2014 ban on exporting raw ore forced mining companies to invest in value-added processing instead of relying on exporting raw materials (Huber, 2021). Analysts expect that by 2028, these policies will raise Indonesian nickel production from 26 to almost 60 per cent of global production (Treadgold, 2021).

Lithium. Lithium is another essential material in LiBs. By 2030, the EU is expected to need up to 18 times more lithium, with demand increasing by 60 in 2050 (Vranken, 2020). The world's largest lithium mining countries are Australia (accounting for 63 per cent of global mining), followed by Chile (20 per cent), China (8 per cent) and Argentina (7 per cent) (GIZ & BGR, 2021). Smaller operations in Brazil, Portugal, the US and Zimbabwe contribute small amounts of lithium (US Geological Survey, 2022). Other lithium resources are distributed in Bolivia (21 million tonnes), Congo (3 million tonnes), Mexico (1.7 million tonnes), Serbia (1.2 million tonnes), Peru (880,000 tonnes), Brazil (470,000 tonnes), Ghana (130,000 tonnes) and Namibia (50,000 tonnes) (US Geological Survey, 2022). In some countries with rich lithium deposits such as Bolivia, mining is restrained for political reasons (Tagesschau, 2021b). Chile is the EU's main lithium supplier (78 per cent of European supply), followed by the US (8 per cent) and Russia (4 per cent) (Vranken, 2020). Like Indonesia, Chile aims to limit raw lithium exports and hopes to build a manufacturing ecosystem around lithium extraction – by selling Chile-based businesses raw lithium at preferential prices for transformation into value-added products such as batteries (Leali, 2020; European Commission, 2020c).

Challenges. Sourcing raw materials – a major economic branch in supplier countries – is associated with multiple environmental and health risks:

Nickel. Smelting nickel emits sulphur dioxide that pollutes the air and the sulphuric acid used for leaching contaminates the water. Many nickel deposits require high-pressure leaching that requires lots of energy (Kirilyuk et al., 2020). In Indonesian nickel mines, coal-fired power plants are often the main energy source – associated with respiratory health issues for local residents (Rushdi et al., 2021). One of the most serious environmental threats comes from disposing of millions of tonnes of raw material waste (nickel tailings, known as DSTD) each year. That damages the marine ecosystem, as exemplified by tailing disposal in Indonesia's Buyat Bay

(Rushdi et al., 2021), while DSTDs planned in the Indonesian coral triangle (near Morowali, Obi, and Weda) pose a high risk to coral reef species (Rushdi et al., 2021). The depletion of marine ecosystems degrades local community livelihoods, especially those of fishermen and farmers (Rushdi et al., 2021). Forced resettlement and abuses of workers' rights have also been associated with nickel mining in Indonesia (Rushdi et al., 2021). For these reasons, the EC is already monitoring nickel, which may be termed a "critical raw material" (European Commission, 2020b; Vranken, 2020).

Lithium. In 2020, the EC added lithium (along with other materials like bauxite, titanium and strontium) to its list of critical raw materials (European Commission, 2020b). Current methods for extracting lithium from rock is energy-intensive; extracting lithium from brine requires lots of water (Castelvecchi, 2021). Arid ecosystems risk water shortages because lithium mining can negatively impact groundwater levels (GIZ & BGR, 2021), as in Chile's largest salt flat, Salar de Atacama (DW, 2018), while brine extraction is associated with social conflicts regarding land and resource usage, and the violation of indigenous rights (GIZ & BGR, 2021).

EU-CEAP impacts. Given the environmental, health and social risks in sourcing nickel and lithium, the Proposal for a Battery Regulation can positively impact on DECs in two ways:

*Due diligence obligations***.** First, nickel and lithium suppliers in DECs will be affected by European manufacturers enforcing supply chain due diligence obligations (see Section 4.2.2). In fact, the EU-CEAP merely formalises sustainability demands that EV manufacturers have already raised: In 2020, Tesla announced its preference for nickel suppliers that comply with sustainability standards (Hall, 2020) and Volkswagen announced that it was auditing its mineral suppliers to ensure business partners respect the environment, working conditions and human rights standards (Volkswagen, 2020). In the Global Battery Alliance, brands such as Audi, BMW and Renault share data on battery suppliers who comply with socio-environmental supply chain requirements (Global Battery Alliance, 2022). The Proposal for a Battery Regulation and corporate demands for supply-chain due diligence show that suppliers who can verify the implementation of environmental management systems and human rights practices will gain a competitive advantage in the European market – and suppliers who can't, will gradually be phased out. This could reduce negative environmental externalities in producing countries and incentivise raw material suppliers in DECs. But it could also affect employment opportunities for those who lack the finance, capacity and knowledge to implement the regulations.

Recovery, recycling and recycled content targets. Besides formulating due diligence requirements, the EU Proposal for a Battery Regulation presents recycling targets in three major areas: recycling efficiency targets of 65 per cent for LiBs by 2025 (70 per cent by 2030) and material recovery targets of 90 per cent for cobalt, copper, lead and nickel by 2025 (95 per cent by 2030) and 35 per cent for lithium by the end of 2025 (70 per cent by late 2030). It also proposes legislation on the recycled content of new batteries, starting with the declaration of obligation to do that and minimum levels for each material: 12 per cent for cobalt, 85 per cent for lead, and 4 per cent for lithium and nickel by 2030 – rising to 20 per cent for cobalt, 10 per cent for lithium and 12 per cent nickel (with lead unchanged) by 2035 (European Commission, 2020d). These recycling measures are the EU's attempt to reduce its reliance on foreign mineral sources by establishing a circular economy for battery raw materials that risks lowering the demand for nickel and lithium from its main suppliers, Indonesia and Chile.

Nickel can be recycled with no significant loss in quality and has the highest recycling rate (68 per cent) of battery raw materials. Recycled nickel from end-of-life batteries is expected to become an important source of nickel after 2030 – based on the assumption that between 2030 and 2040, more batteries will reach the limit of their useful lives and collection rates will increase (Fraser et al., 2021). However, despite forecasts promoting nickel recycling, Indonesia will likely continue to be an important supplier for the EU because throughout the 2020s, most supply will probably come from primary sources. Several new nickel projects in and outside Indonesia are

expected to enter production in the next five years (Fraser et al., 2021). If recycled nickel from batteries *and* non-batteries are counted, recycled material is also not likely to overtake primary ("virgin") and/or "Class 1" nickel (98.9% nickel) before the 2030s (Fraser et al., 2021). Recycled nickel's availability is limited by several factors, such as insufficient industrial recycling capacity along with too few investment funds for recycling and long-term investments (Fraser et al., 2021). Finally, recycled nickel is needed to limit a supply deficit: Despite anticipated recycling capacities, a nickel deficit of 165 kt is expected for 2030 (206 kt for 2040). A dual sourcing strategy is recommended to ensure long-term supply security (Fraser et al., 2021). The EU-27 is advised to not isolate itself from the international nickel market which fills domestic-EU supply gaps: Indonesia is expected to continue to be an important supplier for Europe until at least 2040.

The EU's ambitious targets to double lithium material recovery from 35 per cent in 2025 to 70 per cent in 2030 seem to contradict current practice: Low prices for primary lithium and lithium's low percentage by weight in batteries make recycling lithium economically unattractive compared to recycling nickel and cobalt (Church & Wuennenberg, 2019). Alessia et al. (2021) put the current contribution of recovered lithium to materials demand at less than 1 per cent. Besides seeking to decrease lithium imports, the EU is also mobilising investments to source 80 per cent of its lithium demand in Europe by 2025 (Vranken, 2020). There seems to be little progress, however: Mining projects in Germany (Tagesschau, 2021a) and Portugal (Carter & Sans, 2021) have been significantly slowed by enormous resistance from local NGOs and citizens. This means that EU-CEAP measures are unlikely to significantly dampen the surge in demand for lithium from Chile in coming years.

Recommendations for development cooperation. Since the very low recycling and recovery efforts for lithium and nickel are not expected to pick up before 2030 and material demand keeps rising, the EU will continue to rely on primary raw material imports – at least in the short and medium terms. Recommendations for development cooperation thus concern improving and supporting supply chain sustainability along primary value chains. They assume that in the next years, European demand for nickel imports will continue to rise significantly, while lithium recycling and local sourcing are unlikely to accelerate. Recommendations might need to be adapted to new advancements in European nickel and lithium recycling and local sourcing.

Indonesia and Chile are major suppliers of nickel and lithium to Europe who need support to develop nickel and lithium industries that guarantee environmental and social sustainability in their downstream supply chains. To that end, development cooperation could help supplier country governments develop environmental protections. For nickel mining, that could be banning DSTD and supporting alternatives. Rushdi et al. (2021) describe international standards for alternative tailing management that involve a dam system and a downstream method. For lithium mining, environmental protection regulations could adhere to the principles of the International Council of Mining and Metals (ICMM), which do not just minimise negative environmental impacts but also aim to maximise benefits for the communities (ICMM, 2022). Many suppliers in DECs also need help to implement sustainability standards. Development cooperation could help facilities meet auditing requirements by offering capacity building in labour rights and environmental management systems (Rushdi et al., 2021). Third, while environmental regulations and capacity-building activities are long-term objectives that take time to set up, in the meantime, development cooperation could support the local communities that are directly impacted. With respect to nickel mining, farmers and fishermen need help to preserve their land and livelihoods (Rushdi et al., 2021), while lithium regulations could focus on securing water rights for the local and indigenous population around Chile's lithium mines (DW, 2018).

4.3.1.2 Summary

The European transition to low-carbon mobility is expected to significantly increase the demand for raw materials for EV batteries. The previous section focused on the demand for nickel and lithium that creates opportunities for Indonesia and Chile to strengthen their positions as major suppliers to the EU. But both countries are faced with major environmental and health risks from mining those materials – from DSTDs when mining nickel to water shortage issues when recovering lithium.

Given the growing demand for raw materials, the EU-CEAP and its Battery Directive and Proposal for a Battery Regulation present due diligence obligations and circularity measures. The former can be passed on to suppliers in DECs, pressuring them to comply with socio-environmental standards. Non-compliant suppliers would gradually be phased out of the market, thereby reducing on-site environmental impacts, but also endangering smaller and new facilities that do not have the financial capacity or know-how to comply.

In theory, EU-CEAP measures related to recycling efficiency, material recovery and recycled content could reduce demand for primary nickel and lithium from Indonesia and Chile in the long run. Recycled nickel has been shown to be suitable for multiple recycling cycles but is not expected to overtake primary nickel before the 2030s. Until then, primary nickel will remain key to Europe's dual sourcing strategy. The EU has also set ambitious targets to double material recovery targets for lithium within five years – from 2025 to 2030 – and heavily invest in mining lithium in Europe. But recycling lithium is not economically attractive, and civil protests are slowing down mining projects in Europe. As a result, recycled lithium is not expected to replace primary sourced lithium in the next years and the EU-CEAP is unlikely to significantly reduce European demand for nickel and lithium from Indonesia and Chile in the next few years. That said, the EU is only one buyer and DECs are likely to be confronted by surging demand for raw materials from other regions, especially China.

EU due diligence obligations and Europe's steadily rising demand for battery raw materials in the next years mean that development cooperation must continue to help major supplier countries meet socio-environmental requirements along the supply chain – perhaps by helping supplier country governments ban harmful practices such as DSTD or implement mining guidelines. They could directly help build capacities so mines can fulfil auditing requirements and local communities can mitigate risks at mining sites and maintain their livelihoods.

All estimates here are subject to limitations regarding developments in recycling. They are based on the latest reports about the recycling industry but new technologies or changes in raw material prices could speed up or slow down the adoption of recycled materials.

4.3.2 Secondary material stream

This section shows how DECs are relevant at various levels in the secondary material stream of EV batteries and the impacts of EU-CEAP regulation. Most literature on reusing EV batteries is about remanufacturing activities in developed countries. But a few sources highlight the growing practice of DECs reusing whole EVs. Besides focusing on reusing EVs, this section also covers the later stages of battery waste management: repurposing and recycling.

4.3.2.1 Reusing electric vehicles

UNEP (2020) puts the EU among the largest exporters of used light-duty vehicles (LDVs) – exporting 54 per cent (14 million) of them, followed by Japan (27 per cent) and the US (18 per cent) from 2015 to 2018. Around 70 per cent of exported LDVs go to developing countries, with most LDVs from Europe going to West and North Africa (UNEP, 2020). As of 2017/2018, Japan

was the largest exporter of EVs, distantly followed by the EU (UNEP, 2020). While modest in absolute numbers, the share of exported used hybrid and EVs in all used cars exported from the EU in 2020 was 14 per cent (Eurostat, 2021). That is expected to grow rapidly in the next five to 15 years.

Opportunities. For many DECs, new EVs are unfeasible because of their high purchase price (Rajper & Albrecht, 2020) but imported used EVs offer affordable access to electric mobility and a chance to leapfrog to lower carbon emission vehicle fleets (UNEP, 2020). EVs could also help DECs reduce noise and air pollution and decrease dependency on (foreign) fossil fuels (Parajuly, Ternald, & Kuehr, 2020). Accordingly, some DECs have been providing incentives to import EVs, such as lower duties and tax exemptions for hybrid and EVs. Sri Lanka has the most hybrid and EVs per capita, which can be partly attributed to a substantial tax reduction (UNEP, 2020). Since introducing import advantages, Mauritius has also experienced a rapid increase in imported hybrid and EVs, with hybrid vehicle sales increasing from 43 in 2009 to 14,754 in May 2020 (UNEP, 2020). Countries like Egypt and Bhutan that had banned or severely restricted used-vehicle imports are considering loosening the rules (UNEP, 2020).

Challenges. DECs cannot rely on the trickle-down effect of used EVs alone to save the climate: The used vehicles cannot decarbonise transport quickly enough (Gaventa, 2021). The literature points to the lack of standards, infrastructure and grid stability in DECs as impeding the adoption and diffusion of EVs.

Lack of standards for imported EVs. According to the UNEP (2020), two thirds of the countries importing combustion engine vehicles have “weak” or “very weak” policies regulating the emissions, safety and fuel-economy standards of imported vehicles. Many DECs also lack regulation about importing EVs and longevity is a major concern, especially for used EVs: Electric drivetrain components tend to remain good but batteries lose range and performance (Gaventa, 2021). Used EVs have at least partially depleted batteries so it is not clear how much longer used EVs will perform. Purchasers of second-hand EVs might have to invest in costly new battery sets. Used EVs also do not have state-of-the-art battery management systems or charging options (Grütter & Kim, 2019; see Section 4.3.2.3 for battery recycling).

Lack of charging, infrastructure and electrical grid stability. Another issue concerns insufficient charging infrastructures for imported EVs. After expanding its tax reduction scheme from hybrid to fully electric vehicles in 2015, Sri Lanka experienced a significant increase in imports of fully electric vehicles for two years. Then the trend levelled off because of the lack of charging infrastructure and concerns about battery life and recycling. Hybrid vehicles thus continue to dominate the Sri Lankan market, making up almost half of imported LDVs (UNEP, 2020). Furthermore, roads, pavements and walkways in DECs may not be suitable for EVs and their charging infrastructure. The additional weight of EVs (especially buses and trucks) may strain roads and highways, while charging docks exacerbate traffic congestion in urban areas and block sidewalks (Alam & Lee, 2021). However, the main hindrance to developing sustainable charging infrastructure relates to the power grid: European grids have been able to accommodate the surge in EVs but in many African countries electricity systems are weak with stretched capacities. Frequent power brownouts and blackouts further inhibit the diffusion of imported EVs (Gaventa, 2021). In rural areas, access to electric power is an even larger problem. For example, only a third of Mozambican households have regular access to electricity. Unstable electrical grids can impede the transition to electric public transport services, including minibuses (Gaventa, 2021).

EU-CEAP impacts. Importing used EVs may allow DECs to leapfrog to low-carbon fleets but current EU-CEAP legislation has no quantified targets and does not ensure consistent import volumes of EVs – nor does it offer a reliable framework to ensure their quality or suitability for reuse.

The ELV Directive has been criticised for being vague and not paying enough attention to EV reuse. Unlike the recycling directive, it has no quantified mandatory targets for reuse. With EU reuse rates reportedly ranging between zero and more than 30 per cent (EEB, 2020), critics urge that reuse calculation methods and incentives be harmonised to avoid market distortions (EEB, 2020). Without clear EU targets, member states lack incentive to invest in EV reuse as foreseen by the waste management hierarchy and could feel pressured to recycle EVs. Used EV exports are increasing very slowly, which could retard DECs transitioning to EVs. Data from the European Environmental Bureau (EEB, 2020) on ELVs reveal a large number of unreported "missing vehicles" each year – around 3.7 million vehicles whose whereabouts are unknown and which could have been illegally exported from the EU. Europe's growing EV market means that EVs may well be increasingly represented in the figures for missing vehicles. The lack of clear quality requirements for EU member states on *exporting* EVs makes it even more important for DECs to introduce *import* regulations on factors such as road safety, emissions, energy standards and expected battery lifespan. Absent such regulations, DECs could become dumping grounds for nearly dysfunctional EVs (EEB, 2020).

Recommendations for development cooperation. Development cooperation should help DECs overcome challenges related to the import, adoption and diffusion of used EVs and lower risks due to gaps in EU-CEAP legislation on the quality of exported EVs.

Developing standards. Development cooperation could support DEC policy processes: First of all, import policies that ensure standards for imported EVs, especially battery longevity. Mauritius introduced fiscal incentives for low and no-emission vehicles, a verification and inspection scheme to monitor import permits and inspection certificates as well as vehicle age, roadworthiness and usability. Its policies increased hybrid and EV imports and sales – from 43 in 2009 to 14,754 in 2020 (UNEP, 2020). Development cooperation could help other importers of EVs from Europe – particularly African countries – implement similar policies focusing on battery longevity. Policies could include age restrictions, labelling requirements and fiscal instruments such as taxation based on vehicle age (UNEP, 2020).

Infrastructure expansion and grid stability. Development cooperation must help DECs expand charging infrastructure and improve electrical grid stability. Recognising it lacks charging infrastructure, India, for example, is planning to invest in charging stations as part of its National Electric Mobility Mission Plan 2020 (Deb, Tammi, Kalita, & Mahanta, 2018). That and similar endeavours by other developing and emerging countries should be further supported.

4.3.2.2 Repurposing EV batteries

Although expanding the life cycle of EV batteries is desirable, that will eventually render them unsuitable for their primary purpose. That means reused EV batteries should be re*purposed* for other applications. Because EVs typically require high performance batteries, batteries are replaced when their capacity falls below 70-80 per cent. However, the remaining capacity suffices for less demanding stationary uses (Faessler, 2021). Repurposed EV batteries can be used in battery energy storage systems to provide energy backups in (renewable) energy generation, 5G infrastructures and data centres (Bobba et al., 2018). Less common repurposing options include forklifts, street lighting, and hybrid and electric propulsion ships (Watkins & Farmer, 2021). Before EV batteries are inserted into a second-use application, their health and capacity must be tested. Battery cells are repurposed by specialised companies, preferably without dismantling them – often in combination with a new set of power electronics, software and housing structure (Niese, Pieper, Arora, & Xie, 2020). Alternatively, a battery pack is dismantled and the modules and cells are tested and reused in a new battery pack with new materials and components (Bobba et al., 2018).

In the EU, repurposing as a business model is still at the trial stage. EV manufacturers including Renault, BMW and Volkswagen have started to explore repurposing EV batteries, although

much more in-depth research is needed to estimate the viability and scalability of their business models (Fraunhofer ISI, 2020). The literature describes various repurposing applications in DECs: China, South Korea and Japan dominate the second-use market in Asia, where application areas range from private consumers to industry. In South America and Africa, most repurposing is to store energy for backup power and off-grid applications for critical infrastructure such as hospitals, schools and electric lighting (Faessler, 2021).

Opportunities. During the transition to renewable energies, demand for energy storage solutions is increasing. It is estimated that by 2030 the global market value of LiB-based energy storage alone will be more than USD 30 billion (Engel, Hertzke, & Siccardo, 2019; GIZ, 2021). As the GIZ (2021) report shows, demand for energy storage solutions is also increasing in developing countries such as Kenya and the surrounding East Africa region. This can be attributed to efforts to increase rural energy access and the growing share of energy from transient, renewable energy sources. Repurposing used EV batteries for BESSs can facilitate the development of smart grids and cleaner energy production and consumption in DECs (Faessler, 2021). Promising cases of repurposed EV batteries include backup power and off-grid energy storage applications in Kenya (GIZ, 2021) and photovoltaic systems in Tanzania (Falk, Nedjalkov, Angelmahr, & Schade, 2020). Researchers are further highlighting positive socio-economic benefits resulting from a consistent supply of clean energy and improved health care, education, business and job opportunities (GIZ, 2021). However, when assessing the market viability of repurposing, the cost of repurposed batteries must be compared with that of first-use battery systems.

Challenges. Whether or not DECs can reap benefits related to repurposed batteries for BESSs depends on factors such as the availability, condition, price and import of used EV batteries.

Availability of used EV batteries. EVs are less common in DEC markets because their high cost cannot compete with internal combustion engine vehicles (Rajper & Albrecht, 2020). DECs depend on second-use battery imports from Europe, North America, Australia, New Zealand and Asia (Faessler, 2021). Although there are more and more EV markets in Europe, Fraunhofer ISI (2020) expect only a fraction of the decommissioned traction batteries to be available for secondary applications because the real usage duration of EVs is unclear: European consumers could continue using EVs with capacity ranges below 70-80 per cent that would otherwise be available to the secondary market. Fraunhofer ISI (2020) do not expect a significant number of used EV batteries until 2030 at the earliest, which could limit the number of exports to DECs.

The condition of used EV batteries. Whether EV batteries imported into DECs are suitable for repurposing depends on whether the batteries are standardised, labelled and designed to enable second-life usage (Faessler, 2021). The current lack of labelling and unstandardised battery systems makes assessing the suitability of batteries for repurposing more complicated (GIZ, 2021).

The price of used EV batteries. Another major challenge is the price gap between first- and second-use batteries. As prices for first-use batteries gradually drop, second-use costs must also decline (Faessler, 2021). However, the steps in repurposing EV batteries – dissembling, handling, characterisation and reassembly – are still mostly done manually, which leads to high labour costs (Faessler, 2021). Zhao et al. (2021, p. 199) suggest that second-life applications "could remain profitable in countries with high productivity and low labour costs" despite price declines for new batteries (GIZ, 2021), thus enabling DECs to overcome the challenge.

EU-CEAP impacts. Art. 59 of the EU Proposal for a Battery Regulation mentions "requirements related to the repurposing and remanufacturing of industrial and electric vehicle batteries" that could facilitate the usage of EV batteries for stationary energy storage (European Council, 2022, p.183). Since DECs will have to import EV batteries for repurposing from Europe for the foreseeable future, this regulation will decide whether they can reap the benefits of BESSs and overcome the challenges. However, the latest process document in the General Approach (Art.

59) remains vague. It includes requirements for battery holders to present battery health evaluations and tests before reusing and repurposing to “a competent authority”. But the formulations contain no quantifiable targets such as a reuse quota (European Council, 2022, p.184). That the legislation nonetheless considers and formalises requirements for second life is considered a milestone. Quantifying is difficult because that requires data on end-of-life battery volumes that is not yet available (BMUV, personal communication, 25 March 2022b). The vagueness of Art. 59 limits predictions about the implications of EU repurposing policies for DECs.

Transboundary battery shipments. The transboundary shipments of EV batteries are regulated under the Waste Shipment Regulation and the Basel Convention which forbid shipping hazardous waste from the EU to non-OECD countries. That said, there is no export ban if the waste is declared to be intended for recovery – batteries that can be repaired, refurbished or reused (World Economic Forum, 2020). This exemption has sparked ongoing debate about whether shipments are being correctly labelled for recovery. The Proposal for a Battery Regulation Art. 58 stipulates that EU member states may inspect and monitor suspicious shipments of used batteries for compliance with the minimum requirements in Annex XIV (European Council, 2022). However, experience trading electronic waste shows the WSR’s flawed enforcement: Customs and port authorities have practical difficulties checking the labelling since no codes clarify whether the waste is intended for recovery or disposal. Shipments also often lack *any* documentation about their condition and content. Moreover, only a few customs staff members are on duty at any time and they have to make decisions based on little information in record time – which increases the risk of faulty declarations (Brink et al., 2021). This could negatively impact the quality of EV batteries exported to DECs for repurposing and recycling. Importing countries may also lack legal capacity and staff to implement the Basel Convention. Nigeria, for example, has not yet enacted any implementing legislation (World Economic Forum, 2020). All this makes it more likely that low-quality and possibly hazardous batteries will reach DECs.

Recommendations for development cooperation. In light of these challenges – including the still vague Proposal for a Battery Regulation – development policy-makers should sharpen legislation to create a market environment that facilitates repurposing. It would be possible, for example, to add requirements with design considerations on the secondary usage of batteries. Stricter design regulations for battery design in Europe could result in DECs being faced with simpler repurposing processes. Improved standardisation and labelling requirements in EU legislation could also ensure that battery exports to DECs meet the technical capacity and safety requirements for repurposing (GIZ, 2021). In addition, DECs could be helped to establish local policies (e.g., tax benefits) that benefit repurposing (GIZ, 2021). Development cooperation could further consider the practical limitations of duty and port authorities to enforce regulations under Proposal for a Battery Regulation Art. 58, the WSR and the Basel Convention, and make better use of lessons learnt from shipping waste of electrical and electronic equipment (WEEE).

4.3.2.3 Recycling EV batteries

The waste hierarchy (Watkins & Farmer, 2021) stipulates that EV batteries should only be recycled after reusing and repurposing options have been exhausted. But in Europe, collection rates for automotive LiBs are low and recycling is technologically challenging and costly. In 2019, EU annual recycling capacity was around 160,000 EV batteries (Alves Dias, Blagoeva, Pavel, & Arvanitidis, 2018) and concentrated in Germany, Belgium and France (European Commission, 2019). Graulich et al. (2021) and Watkins and Farmer (2021) provide estimates showing that the EU’s capacity will not be able to handle the expected increase in LiB waste. However, that could expand and attract other countries’ waste EVs for recycling (Alves Dias et al., 2018; Watkins & Farmer, 2021). Europe’s recycling market lags behind those of China and South Korea, which have the largest and longest established recycling companies: In the global recycling market – forecast to have an annual worth of USD 31 billion by 2040 – over half the

LiBs are recycled in China (Watkins & Farmer, 2021). Asian dominance of the recycling industry is reflected in research: The vast majority of peer-reviewed articles on LiB recycling originate in China and South Korea, where more research is on recycling than reuse (ESMAP, 2020). India is beefing up LiB recycling but other DECs lag far behind, with little evidence that they will catch up (ESMAP, 2020).

Opportunities. Both using secondary raw materials and establishing domestic recycling facilities could bring DECs socio-economic and environmental benefits.

Reducing environmental risks. Recycled battery materials are expected to reduce GHGs related to battery production by 90 per cent (Zhao et al., 2021). LiB recycling strategies are important for preventing environmental hazards related to common disposal methods: Solid-waste landfills are associated with metal-rich ash and leachate that contaminate soil, water tributaries and reservoirs; waste-based power plants and incinerators pollute the air (Alam & Lee, 2021).

Supply chain resilience. LiBs contain costly raw materials that present socio-environmental risks (see Section 4.3.1.1) but recycling battery materials can help DECs create more resilient and independent supply chains by reducing the need for imports/exports and protecting manufacturers from price fluctuations (GIZ, 2021; Watkins & Farmer, 2021). India, for example, has been trying to reduce its dependency on LiB material imports from China (Deshwal, Sangwan, & Dahiya, 2022). India is considered a pioneer in battery recycling: Four major companies built recycling systems in 2019 (GIZ, 2021). India introduced its Electric Mobility Mission Plan 2020 to stimulate the EV domestic market: A domestic EV recycling market could reduce environmental hazards related to battery disposal and ensure the country's supply of critical raw materials. While costs for recycling in India are still considered high (around USD 1.20 – 1.35 per kg), its recycling market was expected to grow more by 2022 (GIZ, 2021).

Cost savings and profits. Battery recycling could also provide DECs with cost-saving and profit potentials. According to GIZ (2021), the costs of *not* setting up recycling systems are a major concern. The Basel Convention stipulates that used LiBs are only permitted for transboundary shipment if the country of destination can ensure treatment in facilities that comply with safety standards. Lacking their own recycling facilities, DECs like Kenya risk high follow-up costs from importing used EVs and used EV batteries because of the need to ship discarded batteries to recycling plants in Europe, the US or Asia. As PREVENT Waste Alliance and StEP (2022) write, the procedure is costly and time-consuming due to the Basel Convention's requirement for "prior information and consent". It is also problematic to ship exports to developed countries for recycling because unreliable transport, storage or handling can cause internal and external short circuits due to thermal effects or mechanical damage. Hence, many shipping companies refrain from exporting LiB and waste batteries pile up in DECs. However, local recycling plants like those in Nigeria could significantly cut shipping costs by turning waste batteries into a "black mass" (a mixture of lithium, nickel, manganese, cobalt and graphite): Shipping five tonnes of unprocessed batteries costs USD 3,500, whereas the same weight of black mass can be shipped for USD 3,000. Black mass can also generate revenue of USD 400-1,900 per tonne, depending on its composition, for example, its cobalt content (GIZ, 2021).

Challenges. In DECs, LiB recycling has multiple restrictions, with the most prominent challenges involving economic barriers.

The recycling process and environmental impacts. The economic profitability of LiB recycling partly depends on the recycling process. According to GIZ (2021), there are three common practices: pyrometallurgy (smelting with heat and flame), hydrometallurgy (leaching with acids and alkalis) and direct recycling (a mechanical process), which differ in profitability (the number of different materials recovered) and environmental impacts. The lower-cost pyrometallurgical processing is associated with higher GHGs, while the hydrometallurgical method requires less energy but is more costly. Direct recycling promises the highest rate of return and is considered

the most environmentally sound option because it does not require environmentally harmful caustic agents (ESMAP, 2020). However, scaling up for industrial use is still being tested in the US (Watkins & Farmer, 2021) and there are logistical challenges including the collection, storage and transport infrastructure for LiBs (Watkins & Farmer, 2021). The absence of standard guidelines for these stages could potentially limit applicability in DECs.

Technical complexity and material composition. The many different types of LiBs, each with a distinct design, is difficult for recycling facilities, while LiB EV batteries are becoming bulkier and making disassembly more complex, riskier and expensive (ESMAP, 2020). To reduce production and sales costs of LiBs, the trend is to reduce or even entirely remove cobalt – one of the most expensive and valuable materials in EV batteries – from EVs (Morris, 2020). However, that could negatively impact the economic profitability and attractiveness of recycling. Some studies suggest that the value of the recovered materials from batteries that do not contain cobalt may never cover the costs of the recycling process (Graulich et al., 2021; Watkins & Farmer, 2021). Other materials such as lithium are cheaper to mine than to recycle (Castelvecchi, 2021; Watkins & Farmer, 2021). Hence, almost no lithium is recovered in the EU because that is more costly than purchasing (EPRS, 2021a). Despite these challenges, ESMAP (2020) estimates that if the production of LiB proceeds at the current pace, recycling will eventually become more profitable.

EU-CEAP impacts. The EU-CEAP and related battery regulations could promote recycling in DECs. The Proposal for a Battery Regulation – with its LiB recycling efficiency targets, material recovery targets and minimum levels of recycled content – could stimulate European demand for recycled battery or related precursor materials. By not requiring recycling to take place in Europe, the regulation could incentivise DECs to become active on the recycling market. To minimize the costs related to transboundary shipments set out in the WSR and Basel Convention, DECs could be encouraged to develop their recycling markets and sell black mass to Europe. But the Proposal for a Battery Regulation does not contain regulations on designing EV batteries to facilitate their disassembly and recycling. This poses a challenge to future generations of EV batteries whose technical complexity and material composition could continue to make recycling economically unattractive.

Recommendations for development cooperation. Development cooperation could facilitate the adoption of EV battery recycling in DECs in multiple ways. First, the economic attractiveness of recycling could be boosted by providing DECs with the skills and financial capacity to overcome the technical complexities. For example, with the collection of LiBs still in its infancy in DECs (Graulich et al., 2021; ESMAP, 2020), it would be possible to help collection facilities adopt the sorting, classification and labelling practices needed to prepare EV batteries for recycling (ESMAP, 2020). Meanwhile, European policy should promote battery design requirements related to disassembly and recycling. Once market-ready, direct recycling practices – expected to be the least environmentally harmful and most economically rewarding – should be implemented in DECs. Development cooperation could also help enhance the regulatory framework (e.g., collection/recycling targets and EPR programs) since Africa and Latin America have just a few regulations in place (ESMAP, 2020). Finally, while battery recycling facilities are being developed and built, DECs need help with implementing the Basel Convention requirements: standardising and auditing its “prior information and consent” procedures using an online platform (see PREVENT Waste Alliance and StEP, 2022).

4.3.2.4 Summary

With EV sales surging in Europe, the volume of discarded EVs and their batteries is expected to rise. The waste hierarchy stipulates that EVs and their batteries must follow a sequence of reusing, repurposing and recycling, with DECs playing an important role in each level of the secondary value chain. The EU-CEAP and associated legislation such as the End-of-Life Vehicles Directive, the Battery Directive/Proposal for a Battery Regulation, and the WSR and the Basel Convention affect all stages of that hierarchy and DECs.

Reusing EVs. While there is little information available on the role of DECs in the reuse of EV batteries, some exists on their reuse of EVs. West and North Africa are major importers of used vehicles from Europe, with a growing share of EVs. Sri Lanka, Egypt, Bhutan and Mauritius have identified used EV imports as an affordable opportunity to transition to low-emission mobility and have introduced relevant policies. Although the European ELV Directive mentions reuse and recycling goals that could result in sufficient EV exports to DECs, it lacks extended producer responsibility and does not ensure vehicle quality, safety or environmental standards. In most DECs, weak regulations on importing used vehicles could result in imports of used, unsafe and aged EVs. Development cooperation could help DECs introduce stricter import policies, expand their electricity infrastructures and improve grid stability so they can use the imported EVs.

Repurposing. Repurposing used EV batteries – especially for renewable battery energy storage solutions – allows DECs to expand their renewable off-grid energy infrastructures and helps them transition to sustainable energy. Consistent energy access presents both jobs and socio-economic opportunities. Literature describes previous success stories in Kenya and Tanzania, which need renewable (off-grid) energy structures to provide energy in rural areas. In DECs, repurposing is challenged by the availability, condition and price of imported EVs and EV batteries. While the Proposal for a Battery Regulation states that repurposing is important, its requirements are vague and it includes no quantitative targets. Policy-makers and development cooperation could work to integrate requirements, such as design, standardisation and labelling, to ensure that EV batteries are designed and manufactured to facilitate repurposing in DECs. Finally, development cooperation could draw on lessons learned from the WEEE to ensure that waste shipment requirements are enforced for batteries.

Recycling. Most DECs are slow to begin LiB recycling although that could offer them multiple opportunities, including reducing the socio-environmental risks related to primary raw material extraction and increasing resilience in the battery material supply chain. DECs with their own recycling facilities can help reduce the costs of exporting to recycling facilities in developed countries. Sales of black mass from first-stage recycling can be profitable for DECs that import a lot of EVs and EV batteries – as India, Kenya and Nigeria demonstrate. Challenges to recycling LiBs mostly concern high costs in the recycling process, and the technical complexity and material composition of EV batteries.

The EU-CEAP contains material recovery targets and legislation on recycled content that can increase demand for recycled materials. The Proposal for a Battery Regulation does not require recycling to take place in Europe so DECs that import EVs and have used-EV markets could be encouraged to expand their recycling markets and sell black mass to Europe. To facilitate adoption of EV battery recycling in DECs, development cooperation could help make LiB recycling more economically attractive by providing funding to recycle technically complex EV batteries and helping DECs implement direct recycling. Easier disassembly and recycling design requirements in EU policy could be encouraged and DECs helped to institute regulatory frameworks for recycling (e.g., collection/recycling targets and EPR programmes). While a more favourable recycling environment is being created, DECs will need support to implement Basel Convention requirements like the “prior information and consent” procedure.

Limitations. The biggest limitation to this analysis is the many EU-CEAP policy formulations that remained vague as of June 2022 and the ongoing debate and possible major amendments to the Proposal for a Battery Regulation that could change the implications for DECs. Nevertheless, this discussion paper provides an overview of key issues.

4.3.3 Role model effect and global governance

Global initiatives on EVs and EV-battery life cycles that could impact DECs include cross-sectoral guidelines such as the UN Guiding Principles on Business and Human Rights (UNHR, 2011) and sector-specific guidelines such as the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD, 2013). A few initiatives – including the Global Battery Alliance (Global Battery Alliance, 2022), a public-private collaboration platform – consider not just sourcing but the entire battery value chain. However, there are not yet any multilateral agreements on EV and battery circularity. The white paper by the World Economic Forum and the Global Battery Alliance (2021) is the first to suggest establishing a Framework for Safe and Efficient Global Movement of Batteries with circularity principles. Development cooperation could get more involved in drafting such frameworks with the aim of developing a global agreement like the UNEA draft resolution for plastic waste.

5 Conclusion and outlook

German development cooperation previously sought to foster the transition to the circular economy at the end-of-life stage: building or expanding waste-management infrastructure and systems (BMZ, 2019). In contrast, under the EU-CEAP, Europe's transition to a circular and climate-neutral economy is expected to impact DECs, which are important players in all the material and value streams. This discussion paper highlights the crucial role of DECs in supplying the raw materials now required that will remain necessary with implementation of the EU-CEAP. DECs are also impacted by EU-CEAP regulations on the secondary material stream. The following recommendations concern the plastic packaging, and EVs and batteries sectors:

Plastic packaging

Observe single-use plastic ban legislation. This paper discusses how the Ban on Certain Single-Use Plastics impacts the primary material stream by creating demand for alternative plastic materials (jute, rubber and paper). Development cooperation is advised to further monitor whether the bans are expanded to broader plastic product categories, which could increase demand for scalable plastic alternatives such as jute (in Bangladesh) and natural rubber (in Thailand). Since no major significant demand surge for plastic alternatives is expected due to the directive's narrow jurisdiction, stronger focus should be placed on the following recommendations:

Support Waste Shipment Regulation enforcement and monitoring. Implementation of EU recycling targets for packaging waste and the WSR could increase the illegal trade in plastic waste. Europe still relies on plastic recycling in DECs and the proposed WSR would restrict imports of plastic waste into DECs by requiring importers to demonstrate adequate waste management plans, law enforcement and waste facility audits. This highlights the need for development cooperation to help with monitoring and control mechanisms, especially in countries that risk becoming new waste havens, such as Laos, Myanmar and Zambia. Importing countries will need assistance in fulfilling the criteria in the proposed WSR and other waste shipment regulations like the Basel Convention. Monitoring waste shipments in European export countries may go beyond the sphere of development cooperation, but many monitoring loopholes exist in European exporting countries and helping limit illegal waste trading is crucial.

Raise the quality of recycled plastics and labour standards. The mandatory recycled content targets in the SUP Directive, along with shortages of recycled plastics in Europe, could incentivise recyclers in DECs to enter the European recycled plastics market. While that might open new economic and employment opportunities, many barriers exist for DECs – including quality verification, the input volume of recyclable plastic waste, compliance standards, and

emissions and transport costs. Development cooperation could begin by improving recycled plastics markets in DECs: investing in local recycling capacities and helping governments create framework conditions to promote higher quality recycled plastics. These measures could eventually make recyclable plastics from DECs more competitive on the European market.

Observe future developments related to importing European waste. Importing European waste in line with the WSR can reap contradictory effects: While DECs could benefit from more consistent waste input for their recycling facilities, European imports could replace domestic waste and discourage domestic waste recycling. This effect could, however, be mitigated by the proposed WSR's stricter import regulations that might reduce import volumes in the short term and encourage domestic recycling in DECs. Development cooperation must closely monitor WSR enforcement and observe how European imports impact on local recycling markets in DECs. If negative impacts prevail, further discussion on restricting exports of European waste to DECs may be needed.

Electric vehicles and batteries

Help battery raw material suppliers fulfil their supply chain obligations. DECs are impacted by the EU-CEAP through the primary material stream because they are and will remain important suppliers of essential battery raw materials for Europe's electric mobility transition. For the short and medium term or longer, the EU will continue to rely on nickel and lithium imports from DECs because EU recycling and recovery efforts are not expected to pick up before 2030. Amendments to the EU Proposal for a Regulation and the Battery Directive require battery raw material suppliers such as Indonesia and Chile to comply with stricter supply chain regulations. Development cooperation could help these suppliers fulfil European human rights and environmental due diligence requirements and still remain competitive in Europe. This might involve helping supplier countries develop environmental protection legislation such as banning environmental hazardous procedures like DSTDs – or helping them implement international mining guidelines. DEC suppliers could also be assisted with information and training to meet auditing and verification standards, and communities affected by mining sites could be helped to protect their livelihoods.

Support DECs in all steps of the EV battery waste hierarchy. In the secondary material stream, development cooperation must acknowledge that the EU-CEAP has implications for all the steps in the EV and battery waste hierarchy. DECs play a part in reusing EVs and repurposing and recycling EV batteries. Reusing EVs must be facilitated for DECs that are expected to import a lot of EVs: Sri Lanka, Egypt, Bhutan and Mauritius. Since the ELV Directive does not ensure the quality, safety or environmental standards of imported vehicles, development cooperation must help formulate policies ensuring that only safe and environmentally sound vehicles are imported. DECs also need assistance in improving their electrical grids to accommodate growing EV imports and for repurposing EVs. European regulation does not yet include battery design, labelling and standardisation requirements that adequately consider secondary use applications. Development cooperation and environmental ministries should therefore push for design requirements that make it possible for DECs to reuse EV batteries, for example in the renewable off-grid energy infrastructures required in many East African countries. Development cooperation could also help lower the economic barriers to recycling for DECs. In addition to advocating for design, labelling and standardisation requirements that make it possible to disassemble batteries, development cooperation could offer financial support for dealing with the technical complexity of recycling EV batteries, for example, by providing loans for machinery that can cope with multiple EV battery types. Recycling facilities could be helped to adopt more environmentally favourable recycling processes (e.g., direct recycling).

Role model effect and global governance

Besides its impact on DECs through the primary and secondary material chains in each sector, this discussion paper also points to how the EU-CEAP can inspire DEC policy-makers to expand their bans on single-use plastic and waste management policies requirements for plastic packaging.

Besides the EU-CEAP, other circular economy efforts could also impact on DECs. While some global circularity initiatives such as the UNEA resolution against plastic pollution are more established, sectors like EVs and batteries still need initiatives. Development cooperation is advised to anticipate impacts of the EU-CEAP and other global initiatives on national policies in DECs and support global processes to advance the circular economy.

Outlook

This discussion paper includes legislative amendments as of June 2022. But many policy processes in the EU-CEAP are still in progress, hence, recommendations should be viewed against any newer developments in EU-CEAP-related legislation. As the EU-CEAP advances in other areas, development cooperation is encouraged to also examine impacts in other sectors, including textiles and buildings and construction. This paper shows that for the plastic packaging and EVs and batteries sectors, the EU-CEAP has implications that reach far beyond Europe. Current development policy approaches should thus be expanded beyond waste management and recycling. If development policy adapts its field of action to the EU-CEAP's impact areas – across the entire product and material life cycle – DECs, too, will benefit from Europe's transition to circularity and carbon neutrality.

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