

Article

Understanding the Impacts of Transboundary Waste Shipment Policies: The Case of Plastic and Electronic Waste

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Abstract: Impact assessment is a part of the policy implementation cycle, which can support the design and implementation of effective policies at a minimum cost. It can be instrumental in understanding policy options available to tackle a particular issue before devising a policy and in analyzing the performance of already implemented policy instruments with respect to the desired goals. When it comes to environmental policies, demonstrating the worth and merit of any regulation is even more important. The knowledge gathered from the evaluation of existing policies can help improve the quality of new environmental policies. This paper analyzes policy impacts and their assessments related to the transboundary movement of waste. E-waste and plastic waste fractions are used as cases in order to study three associated policies and their impact assessments. Learnings from the analysis are summarized and measures for strengthening the impact assessment approaches are recommended based on the evidence from recent developments in the transboundary movement of waste fractions. Impact assessments of waste management and shipment policies could benefit from a more comprehensive but issue-oriented approach that looks beyond the short-term economic savings.

Keywords: impact assessment; policy evaluation; e-waste; plastic waste; waste shipment; Chinese import ban

1. Introduction

Transboundary trade of waste fractions facilitates efficient management of waste through resource recovery and proper disposal of residual wastes by making use of an international network of facilities. Correspondingly, with well-established waste management industries and access to open markets, various waste fractions are shipped globally as commodities. These trades mainly involve non-hazardous waste fractions for resource recovery purposes of material recycling and energy recovery. Examples of this include material recyclates from waste sorting facilities for common household wastes, various end-of-life products such as electrical and electronic products (e-products), and vehicles that contain valuable resources such as metals and high quality plastics [1,2]. In some cases, special waste types have to be transported across borders for proper management that requires safe disposal (e.g., residues from waste incineration plants for landfilling) or special treatment (e.g., radioactive and other hazardous wastes) [3].

Paper and metals are the major non-hazardous waste streams that are shipped across borders, each amounting to 8–10 million metric tons (Mt) in 2005 originated from the EU and mostly headed to the Far East [4]. Between 2010 and 2014, the EU shipped up to €10 billion worth non-hazardous waste to non-OECD (the Organization for Economic Co-operation and Development) countries every

year [5]. Several policies at national, regional, and international levels govern these transboundary trades. They include the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal [6], the OECD Decision on the Control of Transboundary Movements of Wastes Destined for Recovery Operations (OECD/LEGAL/0266) [7], and The European Waste Shipment Regulation ((EC) No 1013/2006) [8].

The preprocessing of waste fractions and their subsequent shipments have to comply with national and international shipment regulations relevant to the waste fraction in question. However, with the growing amounts of waste shipped internationally, it is also believed that illegal shipments of wastes have also grown significantly in recent years. Illegal trafficking of waste can have not only implications for the environment and human health, but also negative effects on legal trade and the corresponding economic transactions [9]. The destination of such illegal flows are often countries without proper regulations and waste management infrastructure where the received waste materials are processed in suboptimal conditions. Rudimentary recycling practices of e-waste, which contains several heavy metals and organic compounds, can lead to local air, water, and soil pollution [10]. Similarly, improper handling of plastic waste and the resulting contamination can lead to a range of adverse effects on human health and wildlife, as well as to ocean and fresh waterways pollution [11]. Besides exposing populations to toxic substances, illegal waste trade and handling is also associated with economic issues such as tax fraud and money laundering [9].

Even in the presence of several regulations, significant amounts of illegal waste shipments are occurring across the European borders and beyond. While the majority of waste is legally shipped for resource recovery purposes, estimates suggest that 25% of the overall shipments do not comply with the regulations [12]. Although some of these policies have been assessed and revised over the past years, the problem of illegal waste trafficking persists as a serious concern for global stakeholders. It is not clearly documented to what extent the policies designed to regulate transboundary trading of waste have affected the trend of illegal waste shipments across the European and international borders. To this end, our paper studies modalities of policy impact assessment in the waste sector with a focus on transboundary shipments. In particular, we look into the impacts of policies linked to waste shipments and management at the European level and review how these impacts are analyzed in relation with the advancement of such policy instruments. The goal is to understand impacts of waste trade and management policies and analyze the policy assessment approaches in order to identify opportunities for improvement.

2. Policy Impact Assessment

A policy generally refers to objectives and actions in relation to a political issue and can be in the form of strategic plans, legislation, public interventions, financial incentives, etc. that are expected to change the behavior of a target group in order to bring about the desired changes [13]. A policy impact assessment is aimed at bringing scientific evidence to the attention of decision makers using evaluation and prediction of potential impacts of different policy options [14]. It is an approach to support the development of evidence-based policies and monitor their implementation [15]. Policies are evaluated for their performances and impact assessments (as well as evaluations) are a part of the policy cycle in public management that serves two purposes [16]. An impact assessment is equivalent to policymakers' business planning and a part of needs analysis and planning activity of the policy cycle that prospectively analyzes the anticipated impacts of an intervention (Ex ante). It is also an evaluation mechanism to measure the effects of an intervention including a wider range of issues (e.g., cost, efficiency, and the unintended effects of an intervention), which is a part of the evaluation and management activity of the policy cycle (Ex post). The term impact assessment is understood to have a narrow focus (on pre-defined set of impacts), whereas impact evaluation means a broader approach to cover a wider range of issues. However, these terms often have been used interchangeably.

In broader terms, impact assessment methods can be grouped into theory-based impact evaluation and counterfactual impact evaluation [17]. The theory-based approach involves establishing a 'theory of change'—a description of the 'cause and effect' from an intervention to its

desired effects [15]. The counterfactual approach compares what would have happened in the absence of an intervention to actual outcomes occurring with the intervention. It can also compare the results of a particular intervention with those of a different intervention [18].

In Europe, the European Commission, as a part of its Better Regulation agenda, has a commitment to plan, adopt, design, implement, enforce, evaluate and revise all EU interventions including legislative or non-legislative, spending and other measures to ensure their highest possible quality [19]. It has set standards and guidelines for a quality impact assessment and recommends a careful planning and sufficient time to achieve the desired quality. Regarding the need of a policy impact assessment, the European Commission's document 'Better Regulation Toolbox' states: "An Impact Assessment is required when the expected economic, environmental or social impacts of EU action are likely to be significant." The policy evaluation framework developed by the European Environment Agency (EEA) takes into account elements including inputs, outputs, impacts, results, external factor, and other policies and evaluates an intervention based on four criteria: relevance, effectiveness, efficiency, and coherence [13].

There is still relatively little literature on lessons from policy impact assessment, but the academic interest in understanding policy assessment is growing [14]. Although impact assessments can be instrumental in informing policy processes, the effective use of this tool has not been encouraging yet. Especially when it comes to assessing environmental policies, academicians argue that the process of assessments is too rigid and linear to account for complex socio-ecological problems linked to sustainability [20].

3. Methodology and Scope

In order to achieve the stated goals of this paper, we review policy impacts and the assessments of policies that cover e-waste and plastic waste streams. The above waste fractions are chosen mainly because of two reasons. Firstly, they have seen a rapid growth in quantities during the last decades and have attracted a lot of attention in the growing discussion of resource sustainability and in the concept of circular economy. Secondly, there have been numerous changes in policies at the national, regional, and international level regarding the transboundary movement of both waste streams during the recent years. Out of those, three major policy interventions covering these two streams are studied, which include a) the European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EU) [21], b) the Waste Shipment Regulation ((EC) No 1013/2006) [8], and c) the Chinese Ban on Waste Import [22]. This work tries to answer the following two key research questions:

- (1) What are the strengths and weaknesses of the current approach of policy impact assessments concerning transboundary shipments of waste fractions?
- (2) What lessons can be drawn from the current practices in terms of improving future impact assessments?

In the case of the WEEE Directive and the WSR, we review past and ongoing policy impact assessments. However, in the case of the Chinese Ban, which is a more recently implemented policy and whose impacts are yet to be systematically assessed, we evaluate immediate and direct impacts of the policy within and outside of China. Drawing on these case studies of policy impacts, their assessments, and methodologies, we offer the key findings and recommendations. The two waste fractions and three policies are briefly introduced in the following sub-sections.

3.1. Waste Fractions

3.1.1. E-Waste

Waste electrical and electronic equipment—commonly known as e-waste or WEEE—has been in the spotlight of discussions on both legal and illegal transboundary waste shipments. Only 20% of the 50 Mt e-waste generated globally is collected and treated under the official system [23], which leaves a large fraction to be dealt with by the informal and illegal actors. Main issues linked to the transboundary e-waste flow include insufficient management of hazardous substances and improper

processing of e-waste, resulting in losses of valuable resources. Often, illegally shipped waste streams are processed by the informal recycling sector, which also means a loss of business opportunities for actors in the formal waste management sector in both origin and destination countries. In addition, the informal waste processing practices are linked to environmental and human health related issues at the destination, which are often poor and underdeveloped countries [24].

Reuse is often stated as the goal of shipping used electronics from industrialized countries (primarily the USA and European countries) to developing economies, including China and African countries [25]. Although many products are shipped as used items with some reuse potential, not all of the shipped items may be reusable. Disguised as functional products, such items are often shipped from Europe to destinations in East Asia and Africa. Nigeria in 2010, for example, received 100 kilo metric tons (kt) of non-functional electronic products (basically e-waste) which was 30% of the total 'used items' imported [26]. For comparison, the Netherlands exported 44 kt of used e-products in the same year [27]. The assessment from Geeraerts, Illes [24] concluded that "A large part of the unreported, but collected, WEEE may either be treated in the EU without due environmental care or illegally shipped to developing countries where parts of the valuable material are recycled in ways dangerous to the health and environment, or dumped".

3.1.2. Plastic Waste

Around 350 Mt plastic was produced in 2018 globally compared to 1.5 Mt in 1950 [28,29]. The amount of plastic wastes collected and traded globally for material and energy recovery grew from 15 Mt in 2007 to 45 Mt by 2015, which is still only about 15% of total plastic production. This indicates that under the officially documented flow, only a small fraction of the plastic waste is traded across boundaries for resource recovery. Less than 20% of the global plastic (~65 Mt) is produced in Europe, of which 40% is used for packaging. The main source of plastic waste is the post-consumer plastic, especially coming from municipal waste collection. More than 8 Mt of plastic waste was collected in the EU for recycling in 2016 [28]. Out of the collected plastic waste, almost half was exported outside the EU, of which 87% was going to China directly or via Hong Kong [29].

Besides the EU, China has also been the destination for plastic waste originating from other OECD countries, including USA, Canada, and Japan as the major exporters. China received 56% of global plastic wastes, with the quantity increasing from about 6 Mt to 9 Mt between 2006 and 2012. This pattern was disrupted with the introduction of the 'Green Fence' operation by China in 2013 that was aimed at increasing the quality of imported plastic wastes as well as reducing illegal flows [30]. Following a decent success of the initiative, China announced a complete ban of select non-industrial plastic waste as part of the 2017 'National Sword' initiative.

3.2. Policies

3.2.1. WEEE Directive

The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EU) was aimed at preventing as well as reducing the disposal of e-waste by promoting reuse and recycling [21]. It requires the EU member states to establish a separate system for collection and treatment of household e-waste along with the reporting of the amounts collected and treated. It allows the shipments of e-waste for treatment operations when complied with the Council Regulation (EEC) No. 259/93 of 1 February 1993. The recast of WEEE Directive (2012/19/EU) [31] mandates that the Member States of the European Union also "ensure that shipments of used electrical and electronic equipment (EEE) suspected to be WEEE are carried out in accordance with the minimum requirements and monitor such shipments accordingly". The WEEE Directive has been a milestone in the management of e-waste in Europe and has facilitated collection and reporting of e-waste against the set target. However, it has not been satisfactorily successful in achieving the overall goal of reducing environmental impacts of e-waste that can come through better product design, as well as through reuse and waste reduction [32].

3.2.2. Waste Shipment Regulation

The primary goal of the EU Waste Shipment Regulation (WSR) introduced in 2006 was to address the uncontrolled flows of waste across borders [8]. It implements the provisions of the Basel Convention including a ban on export of hazardous waste to non-OECD countries and a ban on export of waste for disposal. The WSR provides basic rules (two procedures) for controlling transboundary movement of waste shipping and transiting between EU as well as non-EU countries. The control producers include general information requirements (Art. 18) for waste streams for recovery purposes (so called “green” listed waste—non-hazardous waste) and prior written notification and consent for waste designated for disposal and for recovery purposes (so called “amber” listed waste—exhibit hazardous properties and unlisted waste—which is not listed on any annexes). The regulation was amended in 2014 through Regulation (EU) No 660/2014 to strengthen inspection systems for the shipment of waste with a plan to apply the changes by 2017. The WSR is currently being evaluated again by the European Commission with a deadline of December 2020 [33].

3.2.3. Chinese Import Ban

China has been the global destination for various waste streams that have recycling potential including packaging waste, metal scraps, plastics, and e-waste. In July 2017, the Chinese government notified the World Trade Organization of its plan to impose bans on 24 types of waste streams, including plastics in packaging waste [22]. China was taking in more than half of the global plastic waste. As a result of this new policy (hereafter referred to simply as the ‘Ban’), an average of about 8 Mt of plastic waste per year is estimated to be displaced globally over the next decade [30]. China announced a further Ban for years 2019 and 2020, adding 16 new types of waste for each year (mixed metal scrap, plastic scrap from industrial sources, etc.).

4. Case Studies

4.1. Impact Assessment of European Policies

4.1.1. WEEE Directive

The European Commission assessed impacts of the WEEE Directive in 2008 [34], which has served as the foundation for the recast of the WEEE Directive in 2012 [31]. The stated objective of the assessment was “to solve problems with the effectiveness and the efficiency of the Directive”. Accordingly, this assessment was mainly focused on the ‘effectiveness’ and ‘efficiency’ of the WEEE Directive. A thorough quantitative analysis as well as consultation process was used for reviewing the implementation, which took three years to complete. Several policy options (six concerning the effectiveness and eight concerning the efficiency) were analyzed for their economic, environmental and social impacts. A summary of the assessment is provided in Table A1 in Appendix A.

The methodology used for the impact assessment of the WEEE Directive involved a thorough and comprehensive approach, which used evidence-based and mixed methods (qualitative and quantitative) for understanding the ‘effectiveness’ and ‘efficiency’ of the Directive. This can be highlighted as the major strength of the impact assessment. Some of the recommendations from this assessment made it to the recast of the WEEE Directive. For example, the new collection and recycling targets based on the amount of put on market EEE. The assessment, however, did not consider the ‘coherence’ and ‘relevance’ components (other two criteria suggested by the EEA in its impact assessment methodology) as comprehensively. Additionally, the policy option evaluations and subsequent recommendations are mainly focused on the economy of policy implementation, although other aspects were investigated in detail.

4.1.2. Waste Shipment Regulation

The European Commission conducted an impact assessment of the WSR in 2013 with the stated objective of “the protection of the environment and health by reducing illegal waste shipments” [35].

The methodology involved public consultation with stakeholders and contributors (including 25 industry organizations, 18 Member State authorities, 11 individuals, 5 private companies, 3 non-governmental organizations (NGOs), 2 public organizations, and 1 EEA country authority). Based on this consultation, several policy options were evaluated with the aim to “strengthen the inspections and enforcement of the WSR in order to effectively prevent illegal waste shipments”. Each option was assessed based on its costs, benefits, and ‘how does the option solve the problem’. The costs included implementation costs (personnel, hardware, etc.), whereas the benefits considered were economic benefits, employment impacts, and market implications. Table A2 in Appendix A offers a summary of the assessment.

The comprehensive methodology used to include multiple stakeholders makes the assessment strong. However, it is worth highlighting that industries were the largest contributor (25 industries out of 65 total stakeholders consulted) during the consultation process. Moreover, environmental and social aspects were not as much prioritized as the economic costs. The shipment of hazardous waste to non-OECD countries was highlighted as a problem but this assessment of EU’s key waste export regulation did not cover the impacts of transboundary shipments in the destination countries outside the EU. Similarly, despite being highlighted as an important issue, a focus on the impacts of waste crime was missing.

The WSR was amended in 2014 through Regulation (EU) No 660/2014 of 15 May 2014, mainly in order to fortify Member States’ inspection systems. The WSR is currently being evaluated again by the European Commission with a deadline of 31 December 2020 [33]. This time, the assessment appears to be more comprehensive that is based on the EEA’s evaluation framework, which involves the assessment of five criteria (effectiveness, efficiency, coherence, relevance, and EU added value). Table A3 in Appendix A summarizes the approach of this currently ongoing impact assessment.

4.2. Impacts of the Chinese Import Ban

Waste management and recycling businesses in China were affected directly by the Ban. Crackdowns on environmental crimes by waste importers began across the country with the Ban in order to stop the inbound flow of the banned waste streams completely. Facing stricter control, waste companies either moved to other countries or stopped the business altogether. The Ban, nevertheless, did have some positive impacts, such as the benefits of not having to deal with residual waste (in terms of impacts on human health and the local environment), the promotion of legally compliant waste management industries, the establishment of waste separation and recycling systems, and an expected growth of the domestic recycling industry [36].

There were direct implications of the Ban within China, but its impacts have been apparent at a much larger scale globally. The global plastic exports fell by half in 2018 compared to 2016 [37]. Effects of the Ban became instantly apparent in the major plastic waste exporting countries as well as in other Asian countries that became the new destination. After the Ban, much of the waste was diverted to other Asian countries including Malaysia, Vietnam, The Philippines, Thailand, Indonesia, and Cambodia. These new destination countries, however, did not have the infrastructure capacity to handle the sudden growth in incoming waste streams. As a result, the waste is often being handled by small-scale scrap processors with little to no environmental regulations. More importantly, other potentially hazardous waste streams (e.g., e-waste) illegally flowing to countries like Thailand disguised as recyclable plastic waste also increased after the Ban [38].

With the Chinese recycling market taking in more than half of the global plastic exports, the waste management systems in many western industrialized countries depended largely on this market. Not surprisingly, the introduction of the Ban has changed the dynamics of the global waste recycling industry, which appears to have been a moment of reckoning for waste managers globally. The Ban has exposed not only the weak links in the ‘global recycling chain’, but also shady business practices and the real cost of waste management in terms of environmental damages.

Waste management companies in many US cities relied on businesses in China to buy their processed materials. Since the Ban, there are fewer buyers and recycling companies are struggling to keep their profit margins. Therefore, they pass this cost on to the cities, in some cases four times what

they charged previously [39]. The increased recycling cost of household waste has forced several cities to shut down their material recycling plants and to send the recyclable fractions either to landfill or for incineration, which incited the fear of increased pollution [40].

European countries are facing similar challenges. Waste export from the EU to China dropped by 96% in the first two months after the Ban compared to the previous year [41]. The UK for example, which exports 60% of recovered waste plastic, is having to deal with the lack of recycling capacity as the technical capacity of waste plastic recycling is not enough to handle the generated waste. This highlights that the ambitious recycling targets of the EU are dependent on foreign markets for the export of secondary resources. The Ban has shown how vulnerable the waste recycling industry is in the absence of quality and profitable recycling infrastructure in the EU [42].

5. Key Findings

5.1. Dominance of Economic Aspects

Economic aspects, which define the ‘efficiency’ of a policy initiative, often dominate policy evaluation process. The main costs in waste management include costs related to the administrative burden as well as costs for other stakeholders for collection and transportation, treatment and disposal costs, and additional costs for control and reporting. These costs have been the focus in the evaluation of both the WEEE Directive and the WSR. Other aspects, especially environmental and social issues, were not addressed as comprehensively. This is a common concern, also brought up by researchers, that more politically salient economic concerns overshadow the environmental and social issues in some approaches to impact assessment [14].

5.2. Stakeholders Involvement

The method and scope of impact assessments appear to be defined largely by the owner as well as the motive behind the assessment. In case of the WEEE Directive, the priority was a proper management of e-waste in the EU member states at minimum socioeconomic and environmental cost. The assessment identifies, among others, the ‘citizens and traders in third countries’ as stakeholders to be affected by the Directive. However, the review process does not seem to benefit from the feedback from this group of stakeholders. Although it may be understandably difficult and even out of scope for the EU policy cycle, collecting inputs from stakeholders that are affected directly or indirectly from the problem could help in finding better solutions. Businesses formed the largest fraction of stakeholders in the review process of the WSR. Out of the 65 stakeholders consulted, 30 were industry organizations and private companies, and only five were NGOs and public organizations. The dominance of economic aspects in policy assessments aligns well with this fact that industry actors are the main group of stakeholders in the process.

5.3. Geographical Scope

Illegal shipments and improper handling in countries beyond the European borders is not within the scope of the European waste legislations that aim to improve waste collection and processing in Europe. Given that a regional policy is implemented within a specific region, understandably, it may not cover the implications outside of its geographical boundaries. However, in the context of waste materials, an internationally traded commodity, it should be a common concern for both countries of origin and destination. Any waste shipment that does not follow national, regional, and international regulations can be seen as illegal trade and therefore as a criminal case. Illegal trade of e-waste is linked not only to environmental and health impacts, but also to organized crime involving several legal actors such as businesses involved in e-waste management [24]. Such activities are mainly driven by profit. Given that most countries are signatories of the Basel Convention and that the lifecycle management of many products and corresponding wastes depends on a globalized mechanism, policies covering these activities can benefit from a larger geographical scope and coherence across borders.

The case of the Chinese Ban illustrates how the policy impacts can extend beyond borders. The policy recently implemented by the Chinese government seems to have larger impact in Europe than the WEEE Directive and WSR that have been around for years. China's refusal to receive the low-grade recyclates is fueling the discussion about waste prevention, innovation, circular economy, and closed loops within the EU. An important fact to consider is that there has been a significant gap in environmental policies and legislative provisions between the EU and the third countries the EU trades waste with, including China. The Chinese Ban did not appear overnight, it was in the making since 1996 when China started implementing increasingly strict pollution prevention measures [43]. The imbalance in the strength of environmental legislations means the trade is not purely based on mutual financial benefits, but also on offsetting of environmental burdens. It might be worth analyzing how EU policies failed to internalize these realities that led to today's scenario. Non-compliant waste shipments are behind the transboundary environmental problems such as marine plastic pollutions, addressing which will require international cooperation and compliance from all concerned parties [44].

5.4. Isolated Nature of Assessments

Coherence with other policy interventions covering different dimensions of the same or similar issues should be an important part of an impact assessment, which was not found to be the case in the reviewed assessments. Policy evaluation is usually mandated and impact assessments are carried out individually per policy. However, addressing a specific issue such as the transboundary waste movement requires an understanding of the whole product lifecycle ranging from material extractions for production to collection, processing, and final material or energy recovery, as well as disposal of waste. This also means that other policies covering the product lifecycle become relevant in the assessment of the product EoL-related policy. In the case of illegal trade of e-waste, for example, it is not only the WEEE Directive but also other interventions such the EcoDesign Directive [45], RoHS Directive [46], the WSR, as well as the EU Action Plan for the Circular Economy [47] become relevant. An 'issue-based' approach would assess the transboundary shipment of e-waste in a broader context, covering the whole lifecycle of e-products. This kind of 'issue-based' policy impact assessment can be useful for studying the links among several relevant policies that are already implemented, as well as those that are planned.

5.5. Unintended Impacts

Policy impact assessment is a part of policy cycle that evaluates how a given policy performs against the set goals, but does not necessarily assess the changes in a given sector because of the policies implemented. However, any regulatory intervention, which uses burdensome requirements (e.g., fees and other obligations) or bans and enforcement, carries the risk of unintended and often negative consequences. While assessing the 'effectiveness', impact assessments should measure the effect, including intended as well as unintended changes resulting directly or indirectly from a policy intervention. So-called 'risk indicators' have been proposed to assist in identifying potential unintended consequences for new legislation [48]. Such risks should be considered early in the policy formulation. Examples of unintended impacts from the case studies used by Morgan and Clarke [48] corresponding to the risk indicator 'introducing fees or obligations' are presented in Table B1 in Appendix B. Although it is important to anticipate possible unintended consequences of any policy intervention, failure to do so is not necessarily a reason for the consequences, as regulations are often complex and it is not always possible to foresee such consequences upfront.

5.6. Implementation of Assessment Outcomes

Although the assessment of the WEEE Directive clearly identified the widespread illegal trade of e-waste to third countries, the changes made in the Directive following that assessment has not resulted in significant improvements of the situation. The documented collection rate under the official e-waste collection system is still below 40%, with non-compliant collection within the EU also

being a source of illegal e-waste flows. This suggests that either the assessment did not address all identified problems, or the recommendations of the assessments went unimplemented.

Similarly, the implementation of findings from the review of the WSR is also not clearly visible. About 90% of stakeholders discarded the 'No action at EU level' option during the consultation. However, there is not enough evidence to suggest that today's situation is different from what would have happened with 'no action'. Another option to have 'binding EU legislation' for inspection was equally favorable among the stakeholders, which also appears to have been left unimplemented. It was obvious from the consultation process that the concerned stakeholders clearly favor an action on improving the inspection as the single most important measure for controlling illegal waste shipment. Nevertheless, the lack of progress in its implementation raises the question on the value of policy impact assessment.

6. Conclusions and Recommendations

The primary goals of a policy impact assessment include making policymakers aware of socio-economic and environmental issues, as well as involving the public in the policy cycle in order to improve the validity of a policy. It should be a tool for serving multiple purposes such as increasing competitiveness and legitimacy, and for finding possible solution to the need for simplification of policy [14]. However, many impact assessments are used only to narrowly evaluate how successfully a given policy has performed. A more comprehensive and integrated approach for assessment is needed for evaluating policies linked to waste management and shipments. Such an approach should: a) focus beyond the economic aspects of policy interventions, b) include as many groups of concerned stakeholders as possible, c) consider relevant policies implemented across geographical borders, d) take into account unintended impacts along with the intended ones, and e) be realistic about the implementation of the assessment's findings.

The task of carrying out such a comprehensive approach, however, can be difficult and may require more effort. In order to make such a comprehensive approach feasible, an assessment may only focus on a specific issue. Other criteria for such an issue-oriented customized methodology should also consider: a) a defined timeline for the assessment and extrapolation of impacts, b) detailed scenarios (quantitative and qualitative) under different policy options, and c) differentially weighted scores for the criteria (relevance, effectiveness, efficiency, coherence) as per the given context.

Finally, the lack of data is a serious concern when it comes to understanding the impacts of illegal waste shipment and management activities. A robust counterfactual assessment is often not easy (or even possible) because of the unavailable data. By definition, illegal waste trades are not documented transactions. On top, while dealing with multiple stakeholders from several countries, it becomes even more challenging to collect precise data on the routes, quantities, and types of waste flows. There is a need for establishing a systematic sampling approach that can be employed in order to enable data collection that will ultimately enrich the quantitative counterfactual assessment. The underlying causes for illegal waste shipments include differences in treatment and disposal cost between the EU and third countries, incompleteness of existing guidelines, gaps in enforcement in some member states, and organized crime in the waste sector [35]. There is a need for a more proactive approach from policy makers to foresee and act upon changes in policies at the global level. This could save delays in progress on the environmental front and could justify policy decisions in terms of financial gains.

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Appendix A—Summary of European policy impact assessment

Table A1. Summary of the WEEE Directive (2002/96/EU) impact assessment [34].

Key objective	“to solve problems with the effectiveness and the efficiency of the Directive”
Objectives	Ensure proper treatment of collected WEEE, Reduce WEEE going to landfill, Remove unnecessary costs in doing this, Promote low-skilled employment, Support high-tech innovation and export growth
Method	Several options were considered and after filtering out some of them through a stakeholder consultation process, a few were selected. Each of the selected options were analyzed for the economic, environmental and social impacts.
Outcome: Costs and benefits were analyzed quantitatively based on:	<p>Six options to improve the <i>Effectiveness</i></p> <ol style="list-style-type: none"> 1: Take no action 2: Introduce minimum legal requirements for inspections of WEEE treatment 3: Introduce minimum inspection requirements for waste shipments 4: Increase the collection targets (85% of WEEE arising), make producers responsible for this target and include B2B equipment in the scope of the collection target 5: Set a 100% collection target on the environmentally most relevant streams 6: Envisage collection targets set in relation to EEE put on the market in the preceding year
Cost of WEEE collection and treatment as well as enforcement cost and Benefits in terms of avoided environmental damage	<p>and another eight options to tackle <i>Efficiency</i></p> <ol style="list-style-type: none"> 1: Take no action <p><i>To clarify scope and categorization (alternatives):</i></p> <ol style="list-style-type: none"> 2: Clarifying the scope by using fixed lists of products 3: Defining the scope under the RoHS Directive 4: Classifying categories of equipment <p><i>To cut administrative burden from registration and reporting (alternatives):</i></p> <ol style="list-style-type: none"> 5: Inter-operability of national registers and harmonization of reporting requirements 6: EU operated Register <p><i>Other</i></p> <ol style="list-style-type: none"> 7: Include the reuse of whole appliances in the components, material and substance reuse and recycling targets Option 8: Include recycling and recovery targets for medical devices
Indicators of progress	Cuts on administrative burden, Effectively achieve the Directives aims, Separate collection/treatment of WEEE
Recommended options	To improve Effectiveness: 2,3,4,6 To improve Efficiency: 3,5,7,8
On Coherence	Mainly considered the goal of supporting the recycling industry in the EU RoHS, REACH, EuP

Table A1. Summary of the WSR ((EC) No 1013/2006) impact assessment (2013) [35].

Key objective	“The protection of the environment and health by reducing illegal waste shipments”
Objectives	<ul style="list-style-type: none"> - Improve implementation of WSR - Reduce costs for the EU Member States - Increase access to raw materials - Ensure level playing field for European actors

	<ul style="list-style-type: none"> - Make waste shipment inspections more effective - Harmonize inspection criteria across EU 				
Method	<ul style="list-style-type: none"> - Public consultation (65 contributors: 25 industry organizations, 18 Member State authorities, 11 individuals, 5 private companies, 3 NGOs, 2 public organizations and 1 EEA country authority). - Impact analysis of several proposed policy options 				
Outcome: Costs and benefits were analyzed	<p>Policy Options</p> <p>1: No action at EU level</p> <p>2: Specific requirements and criteria for waste shipment inspections in EU legislation</p> <p>3: Guidance for waste shipment inspections at EU level</p> <p>4: Combination of EU legislative requirements and guidance</p>				
Indicators of progress	<ul style="list-style-type: none"> - Establishment of adequate infrastructures, capacities and enforcement systems - Reduction of illegal waste shipments - Monitoring by the Commission - On-the-spot projects - Estimates based on increased recycling rates 				
Comparison of policy options	Options	1	2	3	4
	Economic impacts	0	+++	+/-	+++
	Social impacts	0	++	-	++
	Environmental impacts	0	+++	+	++++

Table A2. Summary of the WSR impact assessment (2017–2020) [33].

Assessed by	DG ENV B3 (started in 2017) http://ec.europa.eu/environment/waste/shipments/evaluation_of_the_wsr.htm
Key objective	“... intended to assess whether the WSR meets its objectives and is coherent with the general objectives of EU environmental policy, Circular Economy and the internal market.”
Objectives	<ul style="list-style-type: none"> - Identify measures to improve the implementation of the WSR - Investigate costs and benefits associated with the implementation of the WSR for the stakeholders, at local, national and EU level

Method	<p>EEA Method:</p> <ul style="list-style-type: none"> - Will assess the criteria of: (i) effectiveness, (ii) efficiency, (iii) coherence, (iv) relevance and, (v) EU added value of the WSR <p>Retrospective:</p> <ul style="list-style-type: none"> - Standard evaluation criteria (relevance, effectiveness, efficiency, coherence and consistency and EU added value) was used <p>Evidence base:</p> <ul style="list-style-type: none"> - Evidence from monitoring - Previous evaluations and other reports - Evidence from assessing the implementation and application of legislation (complaints, infringement procedures) - Consultation (with relevant stakeholders) <p>(65 contributors: 25 industry organizations, 18 Member State authorities, 5 private companies, 11 individuals, 3 NGOs, 2 public organizations and 1 EEA country authority).</p>
Outcome (expected)	<ul style="list-style-type: none"> - Effectiveness: how successful the WSR has been in achieving its objectives or progressing towards them. - Efficiency: costs and benefits of the EU intervention as they accrue to different stakeholders, identifying what factors are driving these costs/benefits and how these factors relate to the EU intervention - Relevance: the relationship between needs and problems of society and the objectives of the WSR - Coherence: how well the WSR has worked internally and with other relevant EU/international obligations or regulations - EU added value: added value of the EU-wide harmonized regime established by the WSR (together with Regulation (EC) No 1418/2007) as compared to what would be achieved by Member States at national, regional and international levels alone

Appendix B Examples of unintended impacts

Table B1. Examples of unintended impacts from the case studies used by Morgen and Clarke corresponding to the risk indicator ‘introducing fees or obligations’ [48].

Legislation	Details	Intended Impact	Unintended Impact
U.S.-Resource Conservation and Recovery Act 1976 and other legislation	<ul style="list-style-type: none"> - Requires hazardous waste to be disposed of through environmentally friendly disposal system - Introduces and permit system for operators and registration system for generators, defines hazardous waste and introduces log-book system 	Promote recycling of potentially environmentally dangerous products	Dumping or open burning of waste and involvement of organized crime groups in dumping or destroying hazardous waste through their participation as transporters and operators of landfills or treatment facilities
Japan	Law introduced requiring the return to manufacturers of end-of-life electrical equipment	Promote recycling of potentially environmentally dangerous products	Increase in illegal dumping after the law was introduced

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