Challenges in applying extended producer responsibility policies in developing countries: A case study in e-waste management in Serbia

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Abstract

The consumption of electrical and electronic products has become an essential human need in developed societies, while waste from electrical and electronic equipment (WEEE) is one of the fastest-growing waste streams. Record quantities of generated waste equipment (e-waste) and its potentially hazardous nature sheds light on several challenges that governments need to overcome in planning and implementing procedures to meet the requirements imposed by European Union (EU) legislation. This paper identifies the main shortcomings and explores the possibilities for the implementation of an adequate e-waste collection system in Serbia by adopting the main principles of good practice applied in developed EU countries. The concept of Extended Producer Responsibility (EPR) was first formally introduced in the 1990s, and today is one of the main principles on which the EU Directive on waste electrical and electronic equipment is based. This study features examples of EPR policy-making and explains the underlying of two commonly used EPR systems designs, the first with a cooperative approach and the second with a competitive one. Presented EPR approaches are afterward analyzed and evaluated in terms of effectiveness and efficiency, revealing their strengths and weaknesses. Key learnings from the analysis of current implementation practice are summarized in policy design recommendations that guide the development of a better e-waste management system in Serbia.

Keywords: Extended producer responsibility, WEEE, E-waste management, Environmental policy

1. Introduction

Governments around the world are developing national waste electrical and electronic equipment (WEEE or e-waste) policies and legislation to deal with the rapid growth of end-of-life electrical and electronic products. In response to the recently predicted scenarios of Parajuly *et al.* [1], which envisions more than doubling annual WEEE production over the next 30 years, requires a reconsideration of the present approaches, or at least significant implementation of current laws and regulations. However, enforcement is a key issue even in some countries where legally binding policies are enacted [2].

Serbia as European Union (EU) candidate country, through national legislation, has harmonized and adopted the majority of the Union's environment policy requirements regarding WEEE, with certain targets postponed concerning the legislation currently valid for EU member states. For example, a 4 kg/cap target of collected WEEE needs to be achieved before the end of 2019. This is in contrast with collection targets in EU countries, which starting from 2016, were set to the 45% of electrical and electronic equipment (EEE) placed on the market in the previous 3 years [3]. However, the fulfillment of the quantitative targets of WEEE management defined by national legislation, in the sense of the EU Directive, in practice has not reached the appropriate levels. According to Marinkovic *et al.* [4], only 2.78 kg per inhabitant of WEEE has been collected annually in Serbia. The reason can be found in the lack of an appropriate WEEE collection system for households and small businesses. Moreover, in Serbia WEEE management infrastructure is not yet fully developed or, in rural areas, is entirely absent. Thus, companies that perform treatment and recycling of WEEE, directly or through intermediaries, also have the role of e-waste collectors [3]. Hence, e-waste is managed mostly by the informal sector, often under inferior conditions, causing severe health effects to workers as well as to the children who often live, work and play near e-waste management activities.

To establish efficient management and control of e-waste, the EU has adopted the Directive on Waste Electrical and Electronic Equipment 2002/96/EC (also known as the WEEE Directive), which was supplemented by Directive 2012/19/EU. The purpose of this Directive is to contribute to sustainable production and consumption by the prevention of WEEE generation and also by the re-use, recycling, and other forms of recovery of such wastes to reduce

the disposal of waste. According to WEEE Directive, this would contribute to the efficient use of resources and the retrieval of valuable secondary raw materials. The WEEE Directive is based on the principle of producer responsibility (EPR) to create the link between the production phase and the waste phase of a product. The WEEE Directive put the principle in concrete terms and assigns responsibility to producers and other stakeholders involved in the lifecycle of electric and electronic products, in particular, those operators directly involved in the collection and treatment of WEEE [5]. On the other side, passing responsibility to producers as polluters is not only a matter of environmental policy but also the most effective means of achieving higher environmental standards in product design and production of EEE which take into full account and facilitate its repair, possible upgrading, re-use, disassembly, and recycling.

The WEEE Directive was mainly aimed at ensuring a take-back and collection system provided by producers and correct treatment of the collected WEEE by imposing recycling and recovery targets, but nothing was imposed in terms of the supply chain structure [6]. According to Huisman *et al.* [7], the collection is the crucial point to the accomplishment of the policy objectives and only a small portion of electronic waste is actually collected in the EU. The latest data published by Forti *et al.* [2] reveals that on average the ratio of the WEEE collected to new electrical and electronic equipment (EEE) placed on the market is only 42.5% in the EU. Moreover, globally in 2019, the formally documented amount of collected and properly recycled e-waste was 17.4%, compared to generated.

This spots light on the lack of a clear definition of producer responsibility in terms of European directives [1]. One of the main aspects that the WEEE directive does not directly address is who exactly is responsible, both in terms of collection facilities and financially, for collecting WEEE from private households. Indeed, Member States have allocated in different ways the responsibility for setting up collection facilities (physical responsibility) and for financing these activities (financial responsibility for collection) [8]. The directive leaves to the producers the freedom to choose whether to fulfill their responsibility by implementing their own individual recovery system or participating in collective collection schemes or shared systems with other companies which are associated in order to reap the benefits of economies of scale. In the vast majority of European countries, the most widespread collection system is of the second type [9]. Collective collection schemes can be divided into two main models [10]:

- Cooperative approach
- Competitive approach

Sweden has been selected as an exemplary case representing the situation where a cooperative approach for compliance with producer responsibility requirements is the dominant model. Here, all logistics and processors are engaged through El-Kretsen, the Swedish e-waste system provider. In Germany, collective systems were installed with a competitive approach where over 20 system providers compete. This paper aims to explore the possibilities for the implementation of an adequate e-waste collection system in Serbia by adopting the main principles of good practice applied in developed EU countries. Thus, the objectives of this study are to analyze the advantages and disadvantages of the EPR approach applied in selected countries, as well as the shortcomings in the e-waste management system in Serbia to give recommendations for overcoming barriers to the sustainable e-waste management system in this country.

2. Methodology

Within this work, the identification of the shortcomings of the e-waste collection system in Serbia and the possibilities for establishing an adequate system are analyzed. Based on a case study investigated in Germany and Sweden recommendations and extensions to improve the system in Serbia are derived and exemplify good practice in WEEE management organizations.

2.1. Allocation of responsibility for collection of WEEE from private households

Regarding collection facilities, the Directive does not explicitly identify who should be responsible for setting up the infrastructure. It only indicates that distributors should accept WEEE from consumers on a ‘‘one-to-one” basis when selling new products, although the Member States can deviate from this requirement if they can show that an alternative procedure is just as convenient for consumers [5]. Consequently, each Member State in the transposition of the WEEE Directive is free to allocate the physical responsibility either to the producer, distributor, or the local government [8]. A similar situation applies to the financial responsibility for WEEE collection from households. The Directive states that producers are financially responsible for "at least" collection from the place of collection onwards, i.e. that the financial responsibility of producers starts from the place of collection and not from households. Again,

the Directive does not specify a solution for allocating the responsibility for financing the collection from households. This leaves the part of the responsibility to the municipalities, which are usually in charge of e-waste collection from citizens. WEEE Directive leaves producers free to decide whether to fulfill their responsibility by applying their own individual collection and treatment system or by participating in collective schemes.

2.2. Sweden as a representative case of a compliance system with a cooperative approach

In the cooperative approach, a manufacturer organization (= system provider) manages the collection and recovery itself or uses a subsidiary. The common way of financing is to collect product-specific fees, which are paid to the system supplier for each newly sold device. Unlike the competitive approach, the cooperative approach does not require a common body. Instead, one association of producers coordinates the collection, transport, and allocation to the recycling plants performs reporting and control tasks, such as the calculation of recovery rates or cost-equivalent charges, as well as the detection of unauthorized collectors [10]. According to Van Rossem *et al.* [11], cooperative collective systems operate in those Member States where a collective system was already operating before the implementation of the WEEE Directive. They have developed and continue to have in place national compliance systems, initiated by producers or their trade associations collectively, to practically arrange the take-back and recycling operations on behalf of members. In those Member States, even when different collecting schemes are introduced, there is no competition between product categories, establishing a sort of protected and non-competing market [8]. Electric and electronic appliances are registered by the Swedish Environmental Agency - Naturvårdsverket. In 2001, a non-profit organization called El-Kretsen was founded, although some producers have developed alternative solutions mainly for WEEE from businesses most obligated producers fulfill their obligation by being members of El-Kretsen. The collection system that El-Kretsen in conjunction with municipalities developed is called El-Retur, and today encompasses a nationwide collection network of approximately 950 collection points in 290 municipalities for household WEEE [5]. Municipalities are physically responsible for the collection of WEEE from private households and financial responsibility for the operation of collection sites, but in return, they receive a reimbursement that depends on the amount of collected material. El-Kretsen is responsible for providing the collection containers, transportation, and recycling of WEEE collected at these sites. The need for coordination by a central authority, i.e. in terms of allocation of collection sites for WEEE from households, is limited by the fact that EL-Kretsen is the only compliance scheme operating and it has exclusive access to municipal collection sites. This simplifies both the coordination of the collection of WEEE in practice as well (in terms of container provision and pickup scheduling, etc) and the monitoring of producer compliance by the authorities. In the Swedish Ordinance, distributors are not obligated to offer a collection of WEEE on a 1:1 basis when supplying new products as collection rates had already exceeded the WEEE Directive targets [5].

2.3. Germany as a representative case of a compliance system with a competitive approach

The German EPR legislation for WEEE, the "ElektroG", has adopted the majority of the WEEE Directive. The industry was granted the choice to assume producer responsibility collectively with a competitive approach, where several service providers, i.e. logistics, recycling, and waste management companies operate and compete. The determination of the EPR system design was left to the electronics industry founded a private regulatory authority for this purpose, the "Stiftung Elektro-Altgeräte Register" (further referred to as EAR) [12]. The main objective of the EAR Foundation is to act as a neutral registration body and clearinghouse. Entrusted with sovereign rights by the Federal Environment Agency, EAR Foundation is responsible for performing administrative tasks. This, besides registration of producers via the Internet portal, includes allocation of registration numbers to producers, keeping records of the quantities of products placed on the market, coordination of the provision of suitable containers and collection of WEEE from municipal collection points, calculation of individual obligations of producers, levying of fees associated with the ElektoG and enforcement of its administrative decisions and examination and certification of financial guarantees for B2C EEE [13, 5]. In terms of producer responsibility for new WEEE, the ElektroG provides producers a choice to either finance the WEEE from their products (though sampling or sorting) or based on their share of the total quantity of EEE per type of equipment placed on the market [5]. Municipalities and producers share the responsibility for waste management, the former being responsible for WEEE collection from private households without a fee in six different groups and the latter being responsible for WEEE transport, treatment, and quality assurance [12, 14]. Municipalities are not obliged to provide a defined collection infrastructure, instead, producers are required to deploy the necessary collecting container free of charge at the place of collection of the local authorities

[5, 14]. Hand-over points run by municipalities notify the EAR when a full box at their collection site is ready for pick-up. Then a producer/importer is chosen from a database that tracks the obligation fulfillment status of each producer/importer, which is calculated based on market shares. To calculate market shares, EAR collects sales data from producers and importers and calculates market shares in each category [12]. Retailers have not been obligated to provide collection on a 1:1 basis, although they can offer collection voluntarily. The obligation to take back is only limited to devices with an edge length >25 cm from private households (as defined by the German Waste Management and Product Recycling Act) as well as to old appliances from another origin, provided that the normal household quantity of 5 devices is not exceeded. Unlike many MS a financial guarantee is required from all producers and no exemption is provided to producers that are members of recycling consortia [5].

2.4. Availability of data regarding WEEE management in Serbia

According to Oberdörfer *et al.* [14], separate collection of WEEE by the official waste management sector is more or less restricted to collection from businesses and is predominantly conducted by the operators of WEEE treatment plants themselves. No regular collection system for WEEE from households and small businesses exists. Municipalities do not provide collection facilities for separate waste collection from households. Retailers have according to legislation on WEEE the obligation to take back WEEE on a one-for-one basis, however, the indication is given that the option is hardly used by end-users. At irregular time intervals, non-systematic collection campaigns are organized by waste collection and recycling companies, providing large containers for bulky waste and metal scrap. WEEE containing valuable materials is furthermore collected by numerous actors of the informal waste collection sector, who provide pick-up services from households.

There are four main companies for WEEE pre-treatment in Serbia. According to the data obtained from leading recycling companies, about 15,000 – 20,000 tons of e-waste are treated annually in Serbia, which also represents the total amount of collected WEEE. Based on these figures, it can be estimated that in Serbia about 2.78 kg per inhabitant of e-waste is collected annually [4]. Consequently, is obvious that WEEE collection schemes offer room for improvement. While disposal of e-waste without prior treatment is not allowed, the majority of WEEE (especially from households), still is disposed of mixed with municipal waste in landfills [3].

The Republic of Serbia is in the process of approximating its environmental legislation with the EU acquis. Directive 2012/19/EU on WEEE was partially transposed through the Law on Waste Management (LWM) ("Official Gazette of RS", No. 36/2009, 88/2010, 14/2016, and 95/2018) and Law on Charges for Usage of Public Goods ("Official Gazette of RS", No. 95/2018, 49/2019, 86/2019, 156/2020 and 15/2021). Detailed provisions were laid down in 2010 in the Rulebook on WEEE[1]. Other relevant legislation are the Regulation on Products that become specific waste streams after use (Official Gazette of the Republic of Serbia, no. 54/2010, 3/2014)[2] establishing a database of producers/importers, reporting procedures and fees, and the Governmental Order on Amount and Conditions for the Award of Incentive Funds (Official Gazette of the Republic of Serbia, no. 88/2009, 67/2010 and 101/2010 and 41/13).

According to the LWM, e-waste is classified as a specific waste stream and has the character of hazardous waste. The LWM stipulates the conditions under which companies can be permitted the waste collection, transport, treatment, and storage. In that manner, all companies involved in the collection or treatment of e-waste need to have permits issued by the Ministry of environmental protection (MEP) and they are obligated to record all annual quantities of collected/treated WEEE divided by category. Also, EEE producers/importers, are obligated to record all annual quantities of products placed on the market. All related information must be sent to the Serbian Environmental Protection Agency (SEPA) [3].

The Law on Charges for Usage of Public Goods defines the payment of environmental taxes on WEEE by producers and importers of EEE. Tax rates are established according to the type of EEE placed on the market. There are 10 categories of EEE, with a range of products in each category, taxes are based on individual products and their associated weight. Currently, the producers/importers must pay a tax to the Green Fond, established in 2018 as a

[1] Rulebook on the list of electric and electronic products, measures of prohibition and restriction of use of electric and electronic equipment containing hazardous substances, methods and procedures of managing waste from electric and electronic products

[2] Regulation on products that become specific waste streams after use, on the daily log form for records of the quantity and type of products produced and imported, and on the annual report, on the method and time frame for submitting the annual report, on the fee payers, the calculation criteria, the amount and the method for the calculation and payment of the fee ("Official Gazette of the RS" Nos 54/10, 86/11, 15/12 and 03/14)

budget fund. This Fond is designed for recording funds intended for financing the preparation, implementation, and development of programs, projects, and other activities in the field of conservation, sustainable use, protection, and improvement of the environment. The Ministry of Finance is responsible for controlling the distribution of the Fund's resources. This tax should be used to finance the management of WEEE – that is, collection, transport, and treatment. In reality, to avoid paying the fee for WEEE management, many producers and importers of EEE do not follow obligations to record and refer all quantities of EEE. According to SEPA [15], only 66% of fee payers met their legal reporting obligation. Therefore, the quality of data reported to SEPA on EEE quantities remains limited, so on the other hand, the funds that should be given as subsidies to recyclers and collectors are missing.

Following the assessment of the systemic integration of the transposed EU acquis on WEEE into the national legislative framework, it can be stated that Serbia has partially transposed the WEEE Directive, but the level of transposition is quite low, with slightly less than half of the provisions fully transposed by national legislation [14]. The Rulebook on WEEE obligation to keep records does not extend to collection facilities, it is given only that the operator or collective operator keeps records on the amount of waste equipment, components, materials, and substances from that equipment that enters the treatment plant and leaves it for further use or disposal. Detailed rules on how producers/importers have to comply with their obligations or delegate all their obligations are missing till now. While the Rulebook on WEEE stipulates separate collection of this type of waste and sets annual collection targets, it does not state who is responsible for achieving these targets. Furthermore, the detailed reporting requirements set out in Commission Decision 2005/369/EC on the amount of WEEE collected from private households and the amount from sources other than private households have not been transposed. The Rulebook on WEEE does not include a method of calculation, as set out in the Directive. It is not defined who and in which way calculates the targets for reuse/recycling/recovery and also collection targets, i.e. whether the operator/collective operator calculates targets based on its records and submits data to the SEPA, or the SEPA calculates based on input and output data of waste from the plant, submitted by operators. The Rulebook does not include the detailed requirements for monitoring compliance with targets set out in the Commission Decision 2005/369/EC.

The Law on Waste Management does not provide a legal framework for the establishment of collective and individual schemes following the principle of "producer responsibility", as prescribed by WEEE Directive. However, the Rulebook on WEEE introduced the term "collective operator" established by producers and importers who place more than 15.000 tons of EEE per year on the market of the Republic of Serbia. The collective operator is obliged to manage waste equipment and at least one treatment plant. Unfortunately, such a body has not been formed in Serbia so far, which is contrary to the provisions of the law which stipulates that producers and importers pay compensation to the Green Fund for electrical and electronic waste that they put on the market.

The Serbian LVM has set out two principles that reflect the main provisions of the principles of "extended producer responsibility". The first is "producer responsibility" and requires that producers, importers, distributors, and retailers of products that affect the increase in the amount of waste are responsible for waste resulting from their activities. The producer shall bear the greatest responsibility as he determines the composition and characteristics of products and their packaging. The producer shall be obliged to ensure the reduction of waste generation, production of recyclable products, as well as the development of the reuse and recycling market. The producer or importer can collect e-waste on their own or may authorize some other legal person to assume on his behalf the products after use. According to the second “polluter pays" principle, the polluter is obliged to bear the full costs of his actions. The costs of production, treatment and disposal of waste must be included in the price of the product. However, the polluter pays principle has not been fully implemented, while the producer responsibility principle is not represented at all in the management of special waste streams.

The WEEE Directive demands the registration of the producers with data about the company and the product. At the beginning of 2012, SEPA developed the information system of the National Register of Pollution Sources, which serves for registration of producers/importers of EEE, electronic submission of data on the amount of EEE placed on the national market by weight, and category of EEE, as well as annual reports on the management of generated e-waste and issuing waste management permits. However, in Serbia, there is no national register for waste electrical and electronic equipment, which in addition to the registration of manufacturers has the task of collecting information required by the WEEE Directive, necessary for the adequate installation of EPR systems. The Register launched by SEPA does not require information that the producer/importer must provide upon registration such as information on how the producer meets its responsibilities (individual or collective scheme, including information on the financial guarantee, selling technique used, e.g. distance selling). The financial guarantee for the event of insolvency also is not

defined by national regulations. In addition, it does not require information when submitting annual reports on the quantity, by weight, of EEE waste separately collected, recycled, prepared for reuse, recovered, and disposed of within the country or shipped inside or outside the Union. In contrast to collecting data in EU countries, the Serbian Environmental Protection Agency once a year receives data from the Customs Administration on each import of products. However, goods are recorded based on tariff number, which may at the same time belong to products that will become specific waste at the end of their life, but this cannot be determined with certainty, because more than one product can be registered under one tariff number. This leads to the loss of information on the share of money for different classes and subclasses of electrical and electronic equipment in the total amount of fees.

The Directive requirements on authorized representatives have not been transposed. Producers supplying EEE using distance communication shall be registered in the Member State that they sell to. Where such producers are not registered in the Member State that they are selling to, they shall be registered through their authorized representatives. Member States shall draw up a register of producers, including producers supplying EEE using distance communication, and has the possibility of entering online in their national register all relevant information reflecting that producer's activities in that Member State. The register shall serve to monitor compliance with the requirements of this Directive.

3. Results and Discussion

Legislation in the EU is strongly centralized around regulatory bodies established by producers, based on WEEE Directive, this is in contrast to Serbia, where is no such organization. In Germany for example, EAR serves as a "national register for waste electric equipment" and coordinates actions to achieve collection targets and fully implement producer responsibilities principles [3]. Unlike the situation in countries with a competitive approach, in Sweden where the cooperative approach is used, the organization of producers El-Kretsen coordinates the collection, transport, and allocation to the recycling plants, and also calculates recovery rates or cost-equivalent charges and Swedish Environmental Agency registers producers [12]. The following table shows the key differences between the approaches in e-waste management implemented in Germany, Sweden, and Serbia.

Table 1. Comparison of the framework important for WEEE collection

	Registration of EEE	Compliance scheme	Collecting from households	Responsible for the financing of collection	Responsible for financing of recycling	Method of financing	Collection on a 1:1 basis	Control of results	Ref.
Serbia	Env. Agency	There is none	Informal sector and occasionally collection and recycling companies	Producers/ importers	Producers/ importers	Product-specific fees	Required	MEP	Authors of study
Sweden	Env. Agency	El-Kretsen (only one collection system)	Municipalities	Producers/ importers	Producers/ importers	Product-specific fees	Not required	Env. Agency	Friege et al. [13]
Germany	EAR	EAR (Multiple collection systems)	Municipalities	Municipalities	Producers/ importers	Market share	Not required	Federal Env. Agency	Friege et al. [13]

*Compliance Scheme or "PCS" means a scheme accredited as a producer compliance scheme for the purposes of the Regulations by an Environment Agency.

In terms of producer responsibility for new WEEE the difference in producer compliance scheme, inter alia, is in the way of financing. In the cooperative approach, the common way of financing is to collect product-specific fees, which are paid to the system supplier for each newly sold device. While, in the competitive approach clearing house

determines the collection obligation of each producer based on their market share, and assigns the collection and financing responsibility to the producer directly or as part of a compliance scheme [6]. In this system, due to the own logistics of each producer, increased logistics effort is required. In the interpretation of the cooperative approach, the logistics are carried out via one producer's organization and thus leading to optimization in logistics and reducing the costs of collection. Furthermore, the competition in the competitive approach results in a constantly changing market for suppliers of collection systems and disposal companies. This leads to an increase in actors and a lack of transparency in the collection chain. Conversely, collecting systems with the highest level of transparency can advantageously influence the collection of WEEE and the exchange of experience between manufacturers and disposal companies leads to the ongoing optimization of the collection system. The collective system with a cooperative approach is thus identified as the best implementation of producer responsibility in terms of cost-effectiveness and collection structure [10].

To define an adequate system that can be applied in Serbia, it must be taken into account which of the above principles is more favourable in terms of economy, logistical efficiency, complexity, and most importantly effectiveness of the collecting system. Results of the comparative analysis are shown in Table 2.

Table 2. Main variables used to compare different collection schemes [16]

Variables	Cooperative approach	Competitive approach
Logistics efficiency	High	Low
Level of complexity	Low	High
Impartiality	Absent	Present
Level of Competition between schemes	Absent	High
The overall effectiveness of the collecting system	High	Low
Economies of Scale	Yes	No

However, in Serbia, the producer pays a fee when placing products on the market, but since there is no producer organization, the money goes to the state budget, i.e. under the authority of the Ministry of Environmental Protection. The 4 leading recycling companies, which also have the role of e-waste collectors, collect e-waste separately throughout the country, crossing their paths and thus increasing logistics costs and reducing the efficiency of collection. Based on the conducted analysis, it can be seen that the current situation in the e-waste management system in Serbia does not follow any compliance scheme to meet the objectives of the EPR principle, and the legislation strives for a competitive system where SEPA will be the main managing body for registration and reporting, while MEP funds through the Green Fund. The legal gap analysis of the harmonization of relevant Serbian legislation showed that out of 248 obligations defined by the WEEE Directive, Serbia has fully transposed 115, partially transposed 30, and 103 have yet to be transposed [17]. Based on this, it is clear that substantial changes are needed in terms of management, financing, and adoption of amendments to the Law on Waste Management and other ministerial orders, which will provide the legal basis for the implementation of newly planned policies.

4. Conclusion

The adoption of the WEEE Directive in Serbia underlined a weak political capacity and inadequate technical expertise to understand the complexity of the policy. Serbia, as a developing country, when transposing the WEEE Directive, should harmonize its national WEEE regulations with existing policy instruments and norms, which would ensure greater cooperation between different entities and available infrastructures. However, there is a lack of some essential provisions necessary for establishing a functioning WEEE management system in Serbia. Inadequate implementation of adopted legislation and partially adopted or omitted key parts of the WEEE Directive, which relate to the implementation of the EPR, have resulted in a limited collection outcome. Strong coordination of EPR and waste policy is needed to implement an adequate e-waste management system. In the first place, it is necessary to establish a national register for waste electrical and electronic equipment by the WEEE Directive, responsible for the coordination of money, information and material flows through the system.

Based on a previous analysis of different e-waste collection systems, it is concluded that municipalities have a key role in e-waste collection from households. According to examples of good practices from developed EU countries, municipalities must collect household waste, but no obligation to establish collection infrastructure. Instead, producers

or importers should organize the provision of containers, transport, and treatment of e-waste. In terms of financing, the collection of e-waste from households in countries with a cooperative approach such as Sweden's municipalities does not have this obligation, which is in contrast to Germany where a competitive approach is represented. Since e-waste collection from households is performed by municipalities, i.e. public services it is necessary to clearly define their role in the national legislation.

Serbia hasn't adopted any producer's compliance scheme to meet EPR targets, as the EU Member States have done. In most countries, where a competitive approach is represented, the role of the clearing houses is to ensure surveillance and a fair allocation of resources among competing collective schemes, while in countries with a cooperative approach there is only one collection system that unites all producers and takes full responsibility for financing the system. Based on the analysis, it was concluded that the scheme of compliance with the competitive approach has been identified as the best implementation of producer responsibility in terms of cost-effectiveness and collection structure.

In order to implement an adequate WEEE management system, a decision must be made on management, logistics, and infrastructure solutions, taking into account economic and social criteria. It is equally important to design a system that will be accepted by the local population, which would contribute to greater efficiency and financial sustainability of the system. In terms of Serbian legislation the definition, role, and obligations of each stakeholder need to be clearly laid out in the regulations. In more detail, recommendations are:

- definitions for the role of municipalities and the government.
- establishment of a national registration body.
- a clear definition of who is responsible for organizing the collection and recycling.
- a clear definition of who is responsible for financing the e-waste collection and recycling.
- a clear definition of who is responsible for achieving collection targets.
- ensure the implementation of the "producer responsibility" and "polluter pays" principle and implements the bond industry's inspection process to ensure true reporting.
- adoption of the principle of extended producer responsibility
- a clear definition of "producer", if the system is based on the EPR principle. (without this, no producer will feel obliged to comply, and the fair enforcement of legal provisions across the industry will be more difficult).
- documentation of producers' compliance status and a clear description of the goals and targets of the legislation.
- detailed rules on how producers/importers have to comply with their obligations or delegate all their obligations.
- change of collection targets and introduction of a system of shared responsibility for achieving them.
- definition of who is responsible for the public information campaign.

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