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# 1. Introduction

## 1.1 Background and Context

One of the biggest challenges twenty-first century faces is a transition from a linear to circular economy. The degradation of environment, scarcity of resources and intensifying of climate change are all major problems that need to be addressed as soon as possible in order to protect the environment and ensure societal growth. Because of this, the need for sustainable waste management and recycling has grown drastically in most developed countries in the recent years. The European Union has already set in place comprehensive frameworks to make sure that they do their part in saving biodiversity, slow down climate change and manage resources sustainably. Unfortunately, many countries that are not a part of the EU ecosystem and are still considered developing countries or emerging economies can't even consider the transition to circular economy due to other issues and focuses. Most commonly used justifications for the slow transition are a weak infrastructure, low public awareness, data collection and corruption. My hopes are to show how privately held businesses and companies can successfully raise awareness and help transition to a more sustainable society through the case study of Reciklomat and what they have done in the years while they were operational.

In this thesis I will focus on Serbia, but most of the talking points are transferable to EU candidate countries and many developing countries. Serbia is still considered a developing country, and it has been EU candidate country since March of 2012 (Consilium, 2012, p. 2) that is why I will use it in the thesis as a proxy for other countries that might be in a similar position. Through the case study of Reciklomat, a Serbian business that organized a long-term recycling initiative in Belgrade, we will see how small projects and business alike this one can make a change even when the infrastructure to support it is not put in place. Serbia and Reciklomat were chosen as the focus of the thesis because of the convenience of getting trusted information from sources in Serbia.

Serbia's road to achieving circular economy and complying with the EU goals and regulations is important for not only for Serbia to reach the milestone of joining the EU, but it is also very important for the wellbeing of everyone in the country. In the recent years especially the smog and air pollution in Serbia have been a lot worse. According to the 2024 IQAir World Air Quality Report, Serbia placed as the 3<sup>rd</sup> most polluted in Europe (IQAir, 2024, n.p.). A big part of this is due to the illegal waste burning and illegal landfills which will be mentioned later on in the thesis.

## 1.2 Methodology

This thesis combines a qualitative case study with a policy and data analysis approach. Firstly, through the analysis of EU and Serbian policies, regulations and frameworks we get to know the state of the situation that Serbia finds itself in. The official data is drawn from Serbian Environmental Protection Agency (SEPA), Eurostat, World Bank and other similar sources, while policy frameworks are drawn from EU directives and Serbian National Strategies.

In order to get insight into the waste management and recycling industry in Serbia, interviews were conducted with members of Sekopak, Ball Corporation, and the General Director of Reciklomat, Sava Terzić. For Reciklomat, besides the interview there was a short questionnaire with 10 open ended questions that helped get a clearer picture. All of the above mentioned provided valuable insights, data and helped find other relevant sources and reports.

## 2. EU Environmental and Circular Economy Agenda

### 2.1 Sustainable Development Goals

The United Nations introduced the 2030 Agenda for Sustainable Development in 2015. They have established 17 Sustainable Development Goals (SDGs) as a guiding framework that will be universal for addressing global challenges. The SDGs cover many different areas such as environmental, social, and economic dimensions. Their aim is to eliminate poverty, ensure prosperity for all, and protect the planet (United Nations, 2015, p. 13). Each of the goals in this framework has specific targets and indicators which are designed to provide progress that can be measured. Opposite to the Millennium Development Goals which were focused mostly on the countries that are developing, the SDGs apply universally to all developed and developing nations in order to integrate sustainable policies, business models and social practices. One of the core principles of Sustainable Development Goals is integrated and indivisible development. This means that no goal can be achieved in isolation and environmental protection must advance alongside economic growth and social inclusion.

Relevant SDGs for this thesis are Waste Management and Circular Economy practices included in SDGs 11 and 12, but also in SDGs 13 and 9

Even though all the SDGs contribute to a broader sustainability agenda, some are more directly connected to waste management, recycling and circular economy:

- SDG 12: Responsible Consumption and Production – this goal is the most directly correlated SDG to waste management. Target 12.5 calls for substantial reduction of waste generation through prevention, reduction, recycling and reuse (United Nations, 2015, p.14). It also aligns with the EU Circular Economy Action Plan and the objectives of the Packaging and Packaging Waste Directive.
- SDG 11: Sustainable Cities and Communities – this goal emphasizes the need for long term sustainable urban planning. It includes efficient waste management systems and reduced environmental impact of cities. Since urban areas generate the majority of municipal waste, this goal is highly relevant (UN-Habitat, 2020, ch. 1).
- SDG 13: Climate Action – highlights the role of waste management in reducing greenhouse gas emissions since landfilling is a huge source of methane. By moving away from landfills

toward recycling and reuse, countries can make measurable contributions to their climate targets (IPCC, 2021, SPM, n.p.).

- SDG 9: Industry, Innovation, and Infrastructure – is relevant through the development of innovative technologies and sustainable industrial practices, such as smart recycling systems. Circular economy business models provide new opportunities for industrial transformation and green growth (OECD, 2019, ch. 2).

These SDGs are a guiding framework with which national policies and company level initiatives are very often evaluated. For an EU candidate country, aligning waste management practices and developing with these standards in mind is a big step towards becoming a sustainable country.

## 2.2 EU Green Deal

The European Green Deal is the European Union's most important and well-known strategy for growth and sustainable development (European Commission, 2019a, p. 2). Its aim is to make Europe the first climate-neutral continent by the year 2050 (European Commission, 2019a, p. 4). The Green Deal focuses on environmental protection as a tool for economic growth, modernization, competition, and innovation. The core premise of it is to decouple economic growth from resource use and ensure that no one is left behind in the process. This means that traditional GDP growth is possible and desired, but it is necessary to disassociate it from consumption of raw materials and natural resources (European Commission, 2019a, p. 2).

The Deal sets binding targets of reducing net greenhouse gas (GHG) emissions by at least 55% by 2030 compared to the 1990 levels. This goal is also referred to as "Fit for 55" (European Commission, 2021a; Regulation (EU) 2021/1119, Art. 4). For now, this target leads the way towards the goal of climate neutrality by 2050. It is supported by a comprehensive framework of policies covering energy, transport, industry, waste, agriculture and pollution-reduction strategies prepared by the European Commission with the help of Member Countries. The framework emphasizes systemic change in the infrastructure rather than isolated interventions (European Commission, 2019a, p. 6).

Relevant goals linked to circular economy and waste management are:

- Decarbonization and Resource Efficiency: this goal focuses on efficiently using resources, cutting down energy usage and waste, while fostering the culture and systems of reusing, recycling, and substituting the finite raw materials (European Commission, 2020a, p. 3).

- Circular Economy Transition: through the Circular Economy Action Plan, the EU Green Deal imposes measures to ensure sustainable product design, consumer empowerment, and waste reduction and recycling targets (European Commission, 2020a, p. 4).
- Zero Pollution Ambition: the EU aims to reduce the levels of air, water and soil pollution to no longer harmful to health and natural ecosystems by the year 2050. In case of waste management this means reducing landfill reliance and phasing out hazardous materials (European Commission, 2021b, p.2).
- Sustainable Industry and Innovation: the production models must change, especially in the high-impact sectors such as plastics, packaging, textiles, construction and similar industries. The priority is on innovation in the smart waste management, and sustainable business modes (European Commission, 2020a, p. 5).

The EU Green Deal Investment Plan dedicated at least 1 trillion € in sustainable investments in the coming years. The Just Transition Mechanism that was put in place ensures that this aid supports the regions and communities who are most in need of it (European Commission, 2020b, p. 1). This mechanism backs up the claim of not leaving anyone behind.

### 2.3 EU Circular Economy Action Plan

The EU Circular Economy Action Plan (CEAP) is one of the most important parts of the European Green Deal. It provides an in-depth roadmap with the goal of making Europe's economy more efficient with its resources and more sustainable in the long term (European Commission, 2020a, p. 2). The 2020 Action Plan is an updated and expanded version of the 2015 Action Plan but goes beyond it by linking circularity with climate neutrality, biodiversity, and industrial competitiveness. The current way markets work in the world is closer to the “take, make, dispose” model, the CEAP strives to close this loop of the product lifecycles. It intends to do so by using materials for a longer time, reducing waste, stimulating innovation in sustainable production and consumption and reducing consumption (European Commission, 2020a, p. 4).

The biggest focus is put on the entirety of lifecycle of the products. The Action Plan sets new rules under the Sustainable Product Policy Initiative, it develops the needs of eco-design beyond only energy related products to other sectors like textile, electronics, packaging, and energy storage. This way of doing things aims to make goods sold in EU more durable, repairable, and recyclable; it also ensures that information about the environmental impact of these goods is easily accessible and

available to the consumers. A big emphasis is placed on consumer empowerment through processes like the right to repair, clear and transparent labeling, and all in all helping citizens make informed sustainable decisions (European Commission, 2020a, p. 6).

Central priorities of CEAP are waste prevention and reduction. The targets are ambitious, like for example requiring all packaging to be reusable or recyclable by 2030. The high impact sectors (plastics, electronics, batteries, textiles, construction and food) are areas where circular solutions can deliver the biggest benefits. The plan in these sectors calls for innovation in business models, increased use of secondary raw materials (already recycled materials), and development of digital product passports which will allow tracking the material composition and facilitating recycling (European Commission, 2020a, p. 7–8).

The Action Plan also puts limits on waste exports by proposing restrictions to make sure that waste generated in the EU is treated domestically in a manner that is safe for the environment. By enforcing stricter controls, EU aims to reduce the burden placed on third party countries and reinforce the development of its own recycling capacity (European Commission, 2020a, p. 9).

The CEAP functions as a roadmap of non-negotiables that have to be adopted progressively through the process of getting accepted into the EU. The benchmarks embedded in the plan translate into goals measured in many different areas using different frameworks like the Packaging and Packaging Waste Directive, and the Waste Framework Directive (European Commission, 2020a, p. 11).

## 2.4 Key Regulatory Frameworks (Packaging and Packaging Waste Directive (PPWD), Waste Framework Directive)

The transition to a circular economy requires a robust legal framework that clearly defines the obligations of EU Member States and sets targets for waste management that must be met. The two directives that we will be focusing in particular in this context are: the Waste Framework Directive (WFD) and the Packaging Waste Directive (PPWD). These two directives together establish the benchmark which both EU Member States must align their collection systems, producer responsibility, waste management, and recycling with.

The Waste Framework Directive (2008/98/EC, amended in 2018) provides the legal foundation for EU waste policy. It introduces a waste hierarchy; this is a principle that places prevention, reuse, and recycling above recovery and disposal, and introduces extended producer responsibility (EPR) as a

binding obligation for Member States; more importantly this Directive sets quantitative targets for reuse and recycling of municipal waste which are:

at least 55% by 2025, rising to 60% by 2030 and 65% until 2035. There is also a limit on landfilling set by this directive. The limit is set at maximum of 10% of municipal waste to be disposed in landfills by 2035 (Directive 2008/98/EC, Art. 11). In addition, clear obligations for separate collection are established. They mandate that by 2023 bio-waste is collected separately, and by 2025 separate collection systems extend to textiles and hazardous household waste as well (Directive 2008/98/EC, Art. 22).

These provisions are designed to increase recycling performance and also ensure the quality of secondary raw materials entering the market, which is of great importance for the functioning of a circular economy.

Packaging and Packaging Waste Directive (94/62/EC, amended in 2018) complements the previously mentioned Waste Framework Directive which addresses one of the largest and most visible waste streams in Europe. The PPWD directive sets very specific recycling targets for packaging materials. It requires that by 2025 at least 65% of all the packaging be recycled, with the minimum levels for individual materials set at:

- 50% for plastic
- 25% for wood
- 70% for ferrous metals
- 50% for aluminium
- 70% for glass
- 75% for paper and cardboard

These numbers rise to an even more ambitious and strict goal for 2030 when the overall target rises to 70% and material specific goals increase to (Directive 94/62/EC, Annex II):

- 55% for plastic
- 30% for wood
- 80% for ferrous metals
- 60% for aluminium
- 75% for glass
- 85% for paper and cardboard

The PPWD directive also requires the Member States to introduce the extended producer responsibility schemes for packaging that covers the full range of materials on the market. In this way the costs of collection and recycling are shifted onto producers, with fee structures designed to reward sustainable packaging design and penalize materials that are not as easy to recycle.

Both these directives also acknowledge that reliable statistics are essential for monitoring progress and compliance, so they pay high attention to data and its verification. Standardized rules for calculating and reporting recycling are set in place in order to ensure that the numbers from reported recycling reflect actual material entering recycling operations, and not just the waste collected. These governance provisions highlight the fact that the challenge is not only infrastructural, but also institutional. This will require countries to build robust monitoring systems and reporting mechanisms that are trustworthy.

The EU has also moved to improve and modernize the PPWD framework with a new Packaging and Packaging Waste Regulation (PPWR). This regulation was adopted in January 2025 but is set to apply from August 2026. Unlike PPWD, the PPWR will be directly applicable across all Member States and eliminate discrepancies in national implementation. Its scope goes beyond PPWD, it addresses other issues such as excessive packaging, mandatory recycled content, and harmonized reuse systems (European Commission, 2025, pp. 3–4). For Serbia and other EU candidate countries this shift in regulation raises the bar even further since now its alignment will have to introduce the EU rules into national law and comply with the binding obligations.

Taken together the WFD, PPWD, and their successors set the baseline conditions for participating together in the EU's circular economy. They define numerical recycling targets together with systemic changes and requirements for waste collection, producer responsibility and quality control over data. As we will see later, for Serbia, the alignment with these frameworks is highly challenging and among the most demanding elements of the EU accession process in the field of environmental policy. Closing this gap requires large scale investment, infrastructure changes, and innovation. In this environment where there is not a lot done for the waste management and recycling from the governments' side, a large part of the heavy lifting falls on initiatives in the private sector.

### 3. Serbia's Waste Management

#### 3.1 State of Waste Management and Recycling in Serbia

In the last decade the trajectory of waste management in Serbia shows us the duality of the situation at hand. While there is some progress that is significant toward aligning with European Union frameworks, the weaknesses of the lack of infrastructure almost nullify the chances of effective implementation. The total amount of waste in Serbia has grown steadily in both absolute and per capita terms, and the pressure that this growth puts on the already weak infrastructure clearly emerges.

##### 3.1.1 Waste Production Trends

Between the years 2015 and 2020, the amount of annual municipal waste increased from almost 1.8 million tons to approximately 3 million tons (SEPA, 2021, p. 8). The growth can also be seen on the per capita basis. Serbians produced around 338 kg of municipal waste annually in 2019, this was significantly lower than the EU average of 500 kg (Eurostat, 2021). However, in just a year this number saw a sharp increase to 427 kg per capita and is still on the rise. This rising trend suggests broader patterns of economic growth, change in consumption behavior and urbanization. However, unlike the EU Member States Serbia's waste management relies heavily on depositing its waste at landfills since it does not have a developed recycling system (European Commission, 2020, p. 106).

##### 3.1.2 Waste Collection and Landfilling

In 2010 only about 70% of Serbia's population had access to organized waste collection, whereas by 2019 this number increased to 86% (NALED, 2021, ch. 3). While this expansion is significant and reduced some of the illegal dumping and open waste burning (these are still a very common occurrence in rural areas) the treatment of the waste still remains inadequate. Nearly 80% of municipal waste that was collected in the year 2020 was deposited in landfills without pre-treatment (SEPA, 2021, p. 8). This is the polar opposite of what the PPWD mandates by year 2035.

Majority of the household packaging waste consistently enters mixed municipal waste streams where it is destined to end up in a landfill rather than in recycling (World Bank, 2024, ch. 3.6). The separate

collection infrastructure is almost non-existent. In the rare case it is put in place, recycling is only available in very advanced urban areas.

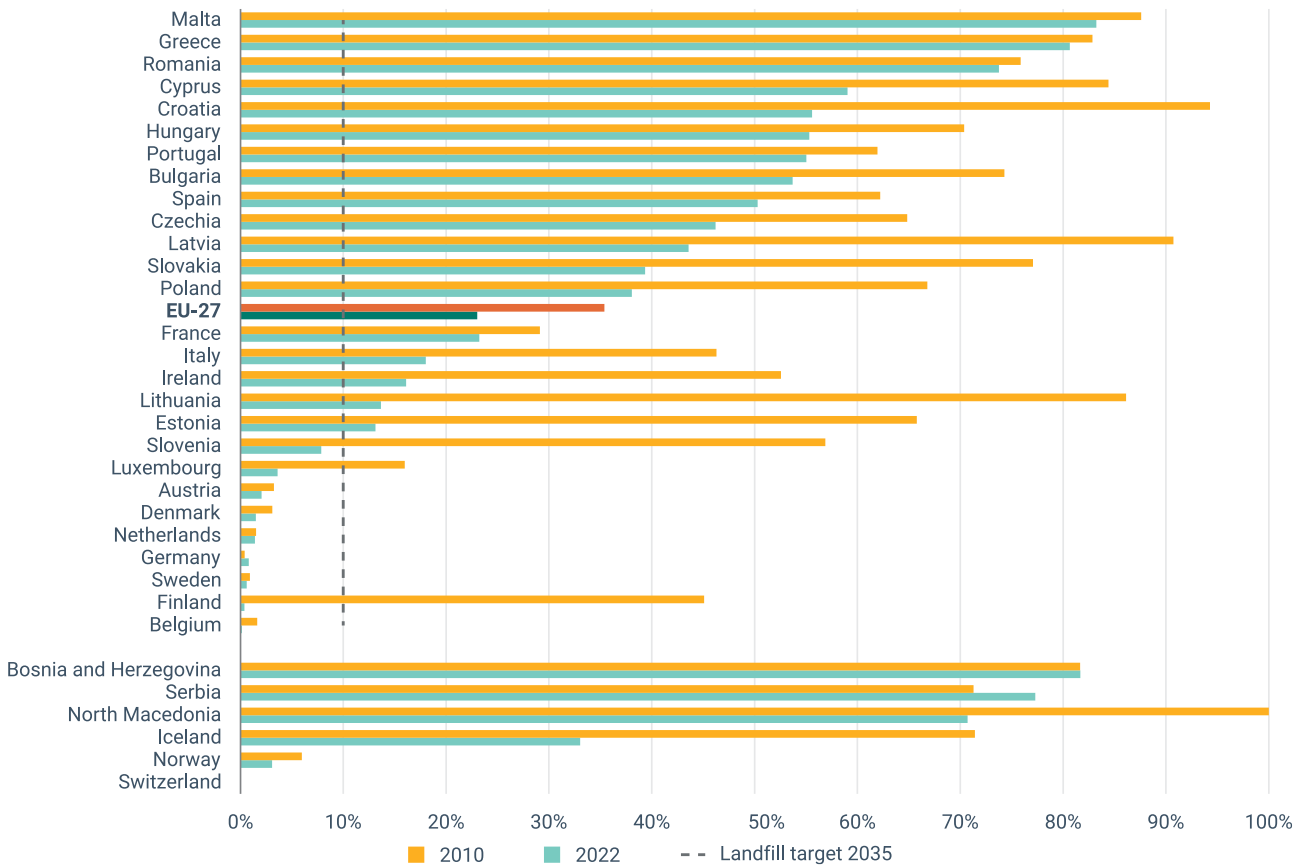


Figure 1. (Source: EU Environment Agency, Levels of Landfilling in European countries)

In Figure 1, we can see the levels of landfilling of European countries. This graph shows that Serbia is among Malta and Greece for the most reliant countries on landfilling. Along with this, Serbia is the only country in which the landfill percentage usage increased in the 12-year time window. This showcases just how crucial landfills are in the current system of waste management in Serbia and why it will be hard to switch to more sustainable practices.

### 3.1.3 Recycling Performance and Packaging Waste

Recycling rates reveal the severity of the challenge ahead of Serbia. National reports show that only around 15% of municipal waste, 450 000 tons, was recycled in 2020 (SEPA, 2021, ch. 6). Of this waste recycled less than 2% was household waste. Instead, Serbia’s recycling performance relies heavily on the commercial and industrial streams, with almost no contribution from the municipal collection. The packaging sector showcases this imbalance. While Serbia’s reported packaging waste recycling rate was 60% in 2020, almost the entirety of this achievement was because of the efforts of

collective schemes and industrial sources (NALED, 2021, p. 54). The rates of household packaging recovery were still negligible. Of roughly 240 000 tons of packaging waste mixed in municipal streams, only about 54 000 tons were actually captured by organized systems (NALED, 2021, p. 55). This reliance on industrial recyclables to boost recycling rates showcases the absence of the systems, infrastructure and awareness of households to partake in recycling. To contrast this, in the EU Member States household level recycling props up the whole waste management ecosystem.

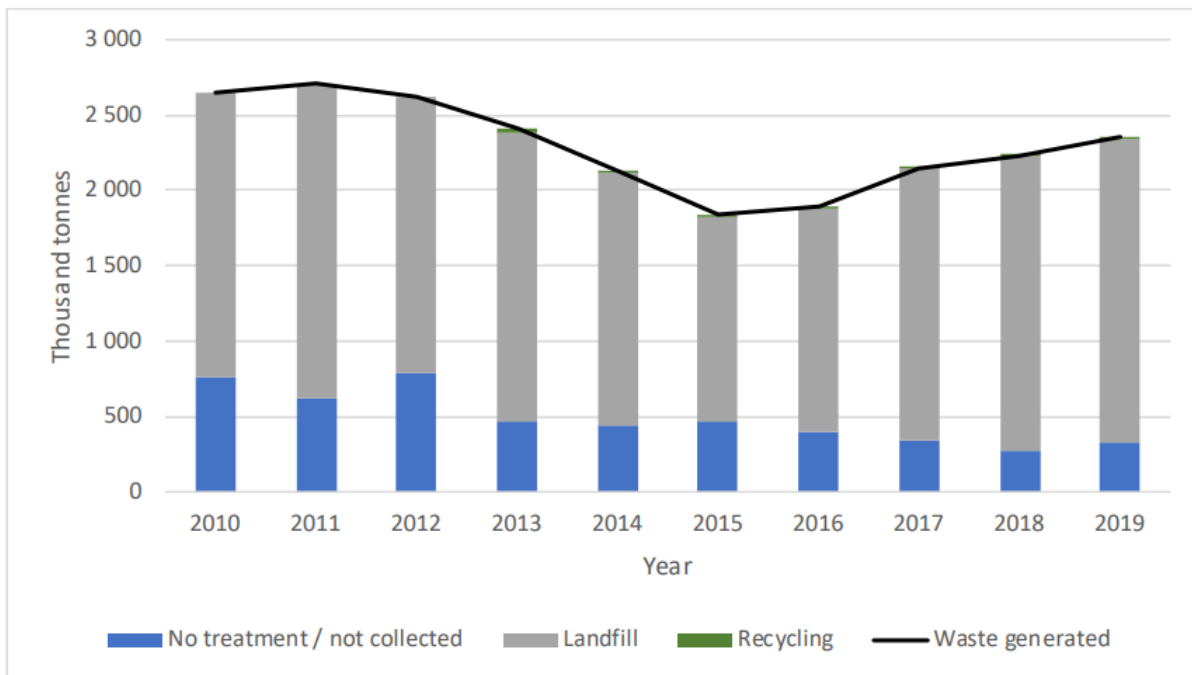


Figure 2. (Source: Eurostat 2021, Municipal waste generation and treatment in thousands of tons 2010-2019)

### 3.1.4 Role of Roma and the Informal Sector

In Serbia the estimated number of the Roma population is between 300 000 and 460 000 (Minority Rights Group, 2016, n.p.) while the population of the whole country is 6.5 million. Roma represent a significant fraction of the population (5-7%) and an essential but very often overlooked component of Serbia's waste management. They are very often absent from official statistics and excluded from formal waste management frameworks. However, Roma and other informal collectors play a vital role in recyclable materials collection. It is estimated that between 30 000 and 50 000 individuals from mostly Roma communities engage in informal waste collection activities (SEPA, 2021, p. 16). Their impact is mostly seen in recovering plastics, metals, paper, and glass from municipal waste streets and landfills. However, this contribution is not always welcome as sometimes they resort to practices like breaking open recycling collection containers in order to get to the materials.

The conditions in which they work are also very dangerous and unsanitary. Having to resort to practices such as manual sorting of waste in non-suitable environments. They do not have formal contracts, social and health protections, and legal recognition as service providers. The earnings of the Roma are also very unstable, often depending on the bargaining power of the intermediaries who buy the collected waste from them and on the fluctuating market prices of secondary raw materials. Social stigmatization further makes their marginalization worse which reinforces their exclusion from both municipal employment systems and extended producer responsibility (EPR) schemes.

Integrating Roma collectors into formal waste management systems offers both the environmental and social benefits. Inclusion could take form of cooperatives, municipal contractors or recognition with EPR schemes. These types of programs have been successfully piloted in several Latin American and EU countries (World Bank, 2020, p. 9-11, 21-28). Providing training, safety equipment, and giving access to stable markets would not only improve the lives of informal collectors but also help in stabilizing Serbia's recycling flows. Such inclusions would also contribute to reducing poverty and social exclusion of the Roma community, aligning waste policies with broader human rights and SDGs.

In Serbia, where municipal recycling rates remain very low, especially at the household levels, leveraging the existing contribution from the Roma community is a matter of necessity at this point. The informal collectors sustain so much of Serbia's recycling at minimal cost to the state, but they are still invisible in the policies and frameworks. Their lack of integration also poses a big limit in information reliability and effectiveness of Serbia's waste statistics, since most of the work done by the Roma goes unreported.

### 3.1.5 Data Reliability and Monitoring

In 2020, only 59% of all the municipalities submitted waste statistics to the Serbian Environmental Protection Agency. The data of those who did submit, have often reporting methodology differences make: it makes it very hard to calculate and compare them properly (SEPA, 2021, p. 4-5, 8). The inconsistent classifications, poor record-keeping, and gaps in municipal monitoring make it borderline if not impossible to establish an accurate baseline. This weakness does damage to both the domestic policymaking and Serbia's EU accession process, where credible, verifiable data is a precondition for getting in compliance with the directives (European Commission, 2020, p. 93).

### 3.2 Sekopak

Sekopak's establishing marked the turning point in the packaging waste management organization in Serbia. It was created by eight of the largest packaging waste producers in Serbia (Carlsberg, Coca Cola, Ball Packaging, Tetra Pak, etc.) Its main function is to be the leading Producer Responsibility Organization (PRO) that enables companies to meet their obligations under the Law of Packaging and Packaging Waste (Official Gazette RS, No.36/09). This legal framework introduced the principle of extended producer responsibility (EPR). It requires companies that annually put out more than a ton of packaging in the market to ensure its collection, recovery, and recycling. This can be done either individually or through an authorized operator. Sekopak was founded to fulfill this role of the operator in Serbia and pull together a large network of importers, producers and distributors.

As one of the key players in helping Serbia align with EU waste legislation, especially PPWD, Sekopak operates under State license and reports directly to the Ministry of Environmental Protection. Sekopak is still the largest and most influential licensed operator, and it helps over a thousand companies fulfill their Extended Producer Responsibility duties (World Bank, 2024, p. 22; PRO Europe, 2025). Its members finance the system through fees that are calculated based on the type of packaging and the amount placed on the market. These funds are then invested in the organization of collection, transportation, treatment, and reporting of packaging waste, making sure that the official targets are met.

In 2020, 362 236 tons of packaging were placed on the Serbian market. Of this, around 226 020 tons were recovered, with recycling accounting for nearly 96% of that volume (World Bank 2024, p. 2). Sekopak alone contributed by recovering close to 97 000 tons of which 90 000 were recycled, demonstrating its dominant role in the sector (World Bank 2024, p. 22). The national targets for the year of 63% recovery and 60% recycling rate were met, making compliance with EU-aligned obligations. However, more recent numbers highlight material specific gaps. In 2023, it was reported that there were nearly 96,500 tons of plastic packaging placed on the market, of which 45,000 tons were PET. Only 15 000 tons of PET waste were recovered for later reuse, indicating that large portion of plastic packaging still escapes formal collection and recycling channels (Vuksanović et al., 2024, p. 3).

Sekopak has tried to address the challenges Serbia is facing regarding recycling through partnerships, awareness raising campaigns, and innovative solutions. Programs such as "Reciklirajmo Zajedno" ("Let's Recycle Together"), cooperative programs with schools, and introducing smart recycling machines such as Reciklomat have as their main goal to increase citizen engagement in everyday

recycling practices. On top of all of this, Sekopak also plays a vital role in policy dialogue where it acts as a mediator between businesses and government authorities while shaping Serbia's path toward compliance with EU circular economy goals.

### 3.3 Serbia's Waste Management Program

The institutional frameworks are starting to put in place policies to address these shortcomings that Serbia is having. The Waste Management Program (2022-2031) sets ambitious national targets in Serbia. It aims to increase recycling to 25% of municipal waste by 2025, 35% by the year 2030, and introducing separate collection of paper, plastics, glass, metals, and textiles by 2029. It also calls for biowaste recycling to reach 20% by 2025 and 40% by 2029. While these goals are a great indicator that Serbia is slowly getting ready for a shift towards the EU benchmarks in the domain of recycling and waste management, they also highlight the size and scale of the task ahead. Even if Serbia achieved its goals by 2030 it would still be well below most EU countries recycling rates today. Even achieving the goal of 25% by the end of 2025 seems unlikely based on the data which suggests the rate of 17% in 2022. Achieving even a 25% recycling rate within a few years will require more investment in infrastructure, awareness campaigns, and more consistent enforcement of extended producer responsibility schemes.

#### Enforcement, Inspections and Corruption

Enforcement of waste management regulations is one of the main problems Serbia has on this topic. The existing corruption and a lack of man-power lead to inconsistent implementation of regulations. So, the fact that Serbia is accepting much of EU legislations and frameworks does not mean that they are getting implemented efficiently.

Formally, the Serbian Environmental Protection Agency (SEPA) and local communal inspectors should be the ones responsible for oversight. However, due to staffing and resource issues this is not the case. There are less than 100 inspectors and they are supposed to cover 145 municipalities. Because of this most of the inspections are infrequent and driven by complaints (NALED, 2021, p. 20). The sheer lack of regular monitoring allows operators to bypass requirements like pre-treatment of municipal waste. The fact that they do not fear inspections drives behaviors that worsen an already bad state of handling waste.

Governance is further undermined by corruption in the country. Allegations of irregularities in the collection and use of eco-fees are widespread. Most of the fees are commonly being diverted to

general budgets rather than to the recycling infrastructure (NALED, 2021, p. 12-13). Producer Responsibility Organizations (PROs), such as Sekopak, have been heavily criticized for not being transparent enough in contracting recyclers. This raised concerns of favoritism and under-reporting for recycling quantities (World Bank, 2020, p. 12-13, 30-31). Strengthening enforcement requires increasing inspection capacity, introducing better monitoring systems, and making sure that judicial systems follow up on violations.

### 3.4 Cultural and Behavioral Dimensions

Citizen engagement in Serbia remains low. Household recycling is negligible mostly because citizens do not have the awareness, infrastructure and incentives to do so (NALED, 2021, p. 6). The occasional educational campaigns are not sufficient for recycling in Serbia to develop, and the lack of infrastructure in most municipalities does not help boost the rates. Behavioral science suggests that in order for a system to be successful it should rely on a combination of convenience, feedback and incentives (Rare's Center for Behavior & the Environment, 2024, p. 5). Projects like Reciklomat (Reverse Vending Machines) that reward consumers for returning beverage containers demonstrate the potential for behavioral change. However, scaling up an idea like Reciklomat often requires strong partnerships between municipalities, producer responsibility organizations (PROs) and private actors (NALED, 2021, p. 39-41).

Looking ahead, Serbia faces a daunting task, but it will be necessary to succeed in the nation's further development and transition to a sustainable future. Even to achieve the 25% recycling target by the end of 2025, the country must rapidly expand its collection rates, invest in sorting and treatment facilities, and improve the monitoring systems (Government of Serbia, 2022, p. 13, 34-35). Without systematic change and reform Serbia will stay reliant on landfilling and the informal collection by the Roma community which will just perpetuate environmental degradation and economic inefficiency.

In order to comply with the EU goals and targets, including the landfilling cap of 10% and 65% packaging recycling target, Serbia must fully commit and start implementing strict practices as soon as possible. This shift demands coupling infrastructure investments with institutional reforms, citizen engagement, and transparent governance. Only after these structural changes have been implemented, can Serbia turn waste management from a huge liability for the country into a driver for sustainable development and circular economy.

## 4. Role of Privately Held Companies in Achieving Sustainable Goals

Private companies play a significant role in shaping the path of sustainable development. In the context of waste management and recycling, their contribution extends a lot further than just basic compliance with the environmental standards put in place. Private companies provide technological innovation, financing, and consumer engagement. Especially in Serbia, where recycling rates are low and public infrastructure underdeveloped, Deposit Refund Schemes (DRS) supported together with Reverse Vending Machines (RVMs) stand out as critical tools for achieving European Union circular economy goals. Most successful DRS systems in Europe show that private companies are almost indispensable in ensuring the cost-effectiveness, efficiency, and long-term viability of these schemes (NALED, 2021, p. 11, 57)

### 4.1 Deposit Refund Systems

Deposit Refund Systems (DRS) are a policy mechanism that is designed to improve collection and later recycling of beverage packaging like plastic bottles, glass bottles, and aluminum cans. With this system in place the buyer pays a small deposit when purchasing a beverage, and when the packaging is returned to the authorized collection point, they are given the deposit back. This model uses monetary incentives by providing financial value to the empty beverage containers to motivate the consumer to return them rather than throwing them away as waste. DRS systems are widely used and recognized as one of the most effective methods of achieving high collection rates of beverage packaging. For example, countries such as Germany, Lithuania and Slovakia consistently report return rates of over 90% (Reloop, 2022; Lithuanian Ministry of Environment, 2018) Beyond increasing recycling volumes, DRS also delivers cleaner material streams and reduce littering.

### 4.2 Reverse Vending Machines

Reverse Vending Machines (RVMs) are the backbone of many modern DRS models. RVMs allow the consumer to return empty beverage containers while making it quick and convenient. They are usually found near supermarkets, petrol stations and some high pedestrian traffic areas, making it easily accessible to most people. RVMs scan and authenticate containers to recognize materials which they are made of, and then they compact them to save space. After this is phase, the machine issues a deposit refund in the form of cash, vouchers or digital credits. This process being automated reduces the burden on retail staff, prevents fraud and makes real time data tracking much easier. The combination of convenience and instant financial reward makes the usage even more attractive. Return rates rise sharply in countries that successfully make a dense and user-friendly network of

RVMs which just demonstrates the role of this powerful tool (European Environment Agency, 2024, p. 15).

#### 4.3 Private Sector as the Operational Backbone

Governments' role is to provide legislation, but the financial and operational burden of putting DRS systems in place is often on private companies. Beverage producers and retailers typically establish producer responsibility organizations (PROs) that operate DRS, fund infrastructure and make sure that information transparency is in place. Retail chains supply the RVM return points, and technology companies such as TOMRA provide the ways to ensure fraud detection and real-time statistics (TOMRA, 2022, n.p. ). Logistics firms then manage the collection and transportation of the materials collected for recycling to the dedicated facilities. This labor division creates a loop that the government authorities are unable to replicate alone.

In Serbia, private initiatives like Recikloamat showcase this dynamic. By deploying RVMs in urban areas, Recikloamat has made recycling a more accessible and attractive option with its digital rewards encouraging participation (Recikloamat, 2023, n.p). Retail partners and the local municipalities gain from the reduced littering and the improvements in waste separating, while the operator is the one collecting valuable data and organizing logistics. This type of model showcases how privately held companies can often help scale sustainable practice initiatives much faster than public agencies.

#### 4.4 Economic Impacts of Private Involvement

Private sector leadership in DRS help produce economic benefits by saving resources for municipalities by shifting a part of the burden from them. High-purity streams of PET and aluminum enable domestic recycling to produce higher value secondary raw materials, while simultaneously reducing the need for imports. Producer responsibility fees, unclaimed deposits and material revenues ensure that the system is in largely self-finance and minimizes the pressure put on the public budgets.

NALED's (National Alliance for Local Economic Development) economic modelling for Serbia, suggests that introducing DRS could generate approximately 1 270 new jobs across collection logistics and recycling (NALED, 2021, p. 47). At the same time the system would be expected to reach a 90% return rate within three years if implemented and designed by following the best practices of other similar countries (NALED, 2021, p. 21). Other comparable countries with great successes in implementing their DRS systems are:

- Lithuania provides perhaps the closest parallel experience as it also had very modest starting conditions, it achieved over 90% return rates in just two years, this was largely due to the private sector involvement and consumer-friendly RVM deployment (Lithuanian Ministry of Environment, 2018, p. 4-9).
- Slovakia implemented its system in 2021 and surpassed 90% return rates by its second year, proving that rapid scaling is possible in a country of similar size and institutional maturity to Serbia (Sensoneo, 2025, n.p.).
- Estonia is frequently cited by NALED as a relevant benchmark for Serbia. They also achieved a rapid rise in collection efficiency through a central, producer-led system, supported by retail participation (NALED, 2021, p. 57).

These experiences show that Serbia should not stray away and be scared of these practices, they are proven to be efficient in countries with similar starting conditions. This was almost all done by the private sector leading the projects, while the government had more of a supporting role.

#### 4.5 Citizen Participation and Behavioural Change

How effective a DRS can be depends largely on consumer participation which we get when we combine convenience, incentives and trust. Private companies are in a good position to design awards and incentives that will be attractive to the users and increase their participation. Especially in the case of RVMs where the machine can give out directly rewards such as cash, vouchers or digital credits.

In Serbia, the recycling awareness is still very low, so the private initiatives such as Reciklomat's or Sekopak's have proven effective in raising awareness (Sekopak, 2022, n.p.) The gamification, discounts, and loyalty points encourage people to take the opportunity to recycle, they make it hard to say no. By normalizing recycling as a part of everyday practice and consumer behaviour the mindset of the population can shift and slowly start making progress in other areas such as household recycling and sorting.

#### Smart Waste Technology other than DRS

The Reciklomat Reverse Vending Machines are not the only projects led by private companies with the goal of bettering the country. While Reciklomat is still probably the most visible one, there are other smart waste technology projects emerging. Sekopak started implementing their "smart bins" with sensors to monitor the fill levels. This makes route optimization and reducing costs a lot easier

(Sekopak, 2022, n.p.). Because of the scarcity of recycling points, university students and startups developed apps to locate the nearest recycling bin. NALED also contributed with their own smart waste tech piece which is a simplified Smart RVM smart bin. These are just few examples that show the steps that can be taken by individuals and public firms even in environments where the government does not seem as interested in solving the issue.

## 5. Case study: Reciklomat

### 5.1 About Reciklomat and its Business Model

Reciklomat is the first Serbian developed and deployed RVM system. However, unlike many Western European RVM models, Reciklomat did not operate under a formal Deposit Refund System. The project was sponsored by Globaltel (a Serbian telecommunications operator) and BusPlus (the electronic fare collection system for public transport), and it was developed by Suprabit. This Reverse Vending Machine system was designed to collect consumer packaging waste and later recycle it. It was able to take in primarily PET, glass, aluminium cans, and Tetra Pak, and it would reward citizens for participation. The rewards for contributing recyclable waste were provided by the sponsors and there was also an option to donate to the Novak Djokovic Foundation (Reciklomat, n.d.).

The first RVMs were put in place in 2021 in the capital of Serbia. The cost of one RVM unit is estimated to be around 8 000 Euros, and its life span is 7 years. Throughout Belgrade there were 25 total Reciklomats placed in 2021. Most of them could be found in busy streets, high population density municipalities, and close to supermarkets and major shops. They were strategically placed in these locations in order to maximize the waste intake. Based on the interviews with Reciklomat representatives some of them even needed to be emptied two or even three times between seven in the morning and noon because of the high traffic. Taking into consideration the capacity of around 300 recyclable units per Reciklomat container, that daily number of collected material is very impressive (S. Terzić, interview, 20<sup>th</sup> August 2025).

During the years that Reciklomat was operating in Serbia it did not have any inflows of money. Municipalities provided only the deployment permits, and no funding. This meant that the whole idea was financed by private sponsors. The project was organized by Globaltel and BusPlus as a way to promote responsible and sustainable business practices, and as a way to further promote their brands and position in the market.

In 2023 the work of Reciklomat had to be stopped in Belgrade due to multiple events that affected the way it operates. However, the Machines are being put to use abroad in Bosnia and Hercegovina with slightly different business models and systems put in place to make it work in that environment.

The reward system of Reciklomat

The consumer side of Reciklomat was revolving around immediate intangible rewards for the most part. This structure positioned it as a marketing and behavioural tool rather than a regulatory compliance tool.

BusPlus (Vreme, 2024, n.p.) was offering

- 5 RSD (equivalent to 0.043 EUR) for every PET bottle
- 4 RSD (equivalent to 0.034 EUR) for Glass packaging
- 3 RSD (equivalent to 0.026 EUR) for Aluminium cans and Tetra Pak

If the users chose the Globatel credits, they were offered an extra 10 RSD (equivalent to 0.086 EUR) per item recycled for its own subscribers. On top of all this, there was an option to donate to Novak Djokovic Foundation for the same exchange rate per item as BusPlus. This foundation specializes in developing early childhood education projects in Serbia.

To put all this in context, the cheapest Globatel (Globatel, n.d.) monthly package is 900 RSD (7.68 EUR at the date of writing this) which means a person could fund their monthly phone bill by recycling 60 plastic bottles in a span of thirty days. In a country like Serbia where minimum wage was lower than 400 euros a month and inflation rose from 7.9% between 2021 to 12.1% in 2023 these ways of saving money could show as very beneficial. (Macrotrends, 2025; Mauve Group, 2023)

BusPlus's idea was that they could motivate the population to use the public transportation more by also motivating them to recycle. As public transportation is also a way of reducing GHG emissions compared to driving a personal vehicle, it was killing two birds with one stone by nudging people to save money by recycling and riding public transportation.

In order to further motivate people to contribute to recycling, the leaderboard system was put in place. This means that every month the people who contributed the most waste collected and were on top of the leaderboard would get more valuable rewards. Some examples are bicycles for first place, and for others who placed in top twenty Bluetooth speakers, headphones, and tickets to cultural events or pools (S. Terzić, interview, 20<sup>th</sup> August 2025).

## Behavioral Economics side of Reciklomat

Reciklomat business model is a perfect example of a company helping build habits and desirable behaviors through nudging. Behavioral economics and nudging are powerful tools that are required in countries like Serbia to make an actual change in achieving sustainable goals. Serbia's problem is not necessarily one sided, not only does it seem like the government is not taking necessary steps to fix the infrastructure, but also the people of the country do not have the habit of sorting waste or recycling developed. Reciklomat provides its RVMs as a solution to this lack of behavior. It being a low friction and convenient way of helping the environment while also benefiting the users is important for raising awareness and building habits. Reciklomat's business model includes:

- Extrinsic reward Nudges - through the payoffs after depositing recyclable units
- Feedback and Visibility - instant confirmation, feedback of transaction and online visibility and counters
- Gamification - by introducing leaderboards it leverages the status of competitors to bring more recyclable material.
- Convenience Nudge - Machines being placed in central and high traffic areas lowers the efforts people need to go through to engage in the behaviour

By looking at the numbers of recycled material in the short time frame that it was active, we can see how many people actually took on this behavior. In the years that it was operational from, 2021 to 2023, Reciklomat collected around 8.5 million units of recyclable packaging. In the figure 3. you can see the numbers based on the type of packaging and material.

TOTAL PACKAGING SINCE THE BEGINING

# 8491641

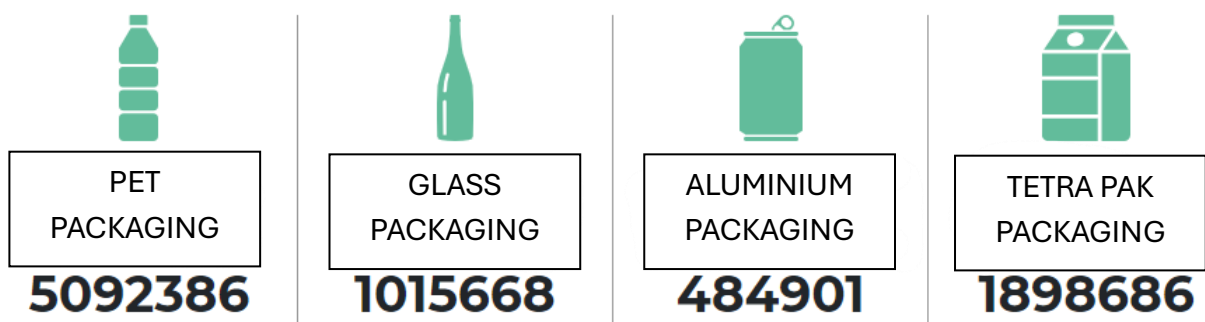


Figure 3. (Source: Reciklomat, Reciklomat number of collected recyclable units from 2021 to 2023)

### Operational Side of Reciklomat

After all the RVMs were placed around Belgrade, the operations were ready to start. The operational flow can be divided into 5 distinctive parts:

1. Deposit and Recognition - Consumers would insert one of the suitable packaging forms for the machine. The machine would then verify and the material, and in case of non-compliance it would reject the item.
2. Recording and Reward Allocation - Once the item is accepted in the system, users are then able to choose which of the rewards they want to claim through their mobile app. Rewards are then instantly credited to the user.
3. Storage - Each collection point had sensors that would track the capacity of containers, and it had triggers at 50%, 75% and 90%. This data would then be transferred to the operator in order to ensure efficient scheduling without overfilling the units.

4. Collection and Logistics - Sekopak was responsible for all the logistics after the collection point. They would empty the machines and transport the collected material to the sorting and recycling facilities.
5. Recycling - After collection, packaging enters the formal recycling stream. Reciklomat itself did not monitor any of post-handover outcomes. As a licensed EPR operator this part was left for Sekopak to do in order to ensure compliance with recycling obligations. (S. Terzić, interview, 20<sup>th</sup> August 2025)

### The end of Reciklomat in Belgrade

During 2023 few different factors were part of the reasons why Reciklomat had to stop its operations.

According to the Reciklomat and Globaltel General Director Sava Terzić, in 2023 a decree of the Government of Republic of Serbia said that Sekopak's recycled material collected directly from public waste containers did not count towards the EPR goals that Sekopak was trying to fulfill (S. Terzić, interview, 20<sup>th</sup> August 2025). This means that the model would have to change to one where Reciklomat would first have to sell the units collected for recycling to the municipal waste management service, and then Sekopak would have to buy the waste from the municipality. This was not profitable for Sekopak so they pulled out of the project.

Even if Reciklomat managed to replace Sekopak for the collection, transportation and recycling part of the business, there are two other issues that prevented the continuation of its work.

The first one is that the Belgrade Mayor, decided to prematurely terminate the contract of BusPlus (Vreme, 2024) . This meant that the first major sponsor of the project stopped having funds to support Reciklomat. Around the same time Globaltel, the second major sponsor, was sold to Telekom Srbija (Telecompaper, 2023). All these sudden changes that affected Reciklomat meant that this project could not continue with its operations.

In the end Reciklomat has not made a significant impact on the amount of recycled packaging material in Serbia. According to Sekopak reports, they annually recycle close to 100 000 tons of material with some fluctuations depending on the year. In the first eight months of its existence Reciklomat collected only a bit more than 100 tons (Sekopak, 2022, n.p.). This is a negligible fraction (0.1%) of the total amount of recycled packaging waste in Serbia. But Reciklomat did something that hasn't been done at this scale yet in Serbia, and that is involving the common people in the recycling. Most

of the other recycling initiatives lasted a lot shorter or were episodic. Reciklomat showed that it is possible making long term sustainable projects even in environments that are not ideal for it.

## Analysis and discussion

The evidence shows us that the Serbia's biggest gap is structural. Landfilling dominates and household waste almost never reaches organized recovery. On top of this enforcement of regulations is also very weak. Informal collectors are the ones stabilizing flows of recycled waste, but this comes at the price of poor work conditions and no data collection since they are not officially a part of the Extended Producer Responsibility yet. In this context, Reciklomat managed to function as a private infrastructure that negligibly increased the recycling numbers of packaging waste.

Reciklomat solved three different issues: capture, cleanliness, and motivation. They made waste collection convenient for many citizens by putting the RVM units in high traffic spots. Machine validation also increased the material purity by having a validation system to sort the four recyclable materials. This helped the recyclers simplify the separation process when receiving the waste. All this aligned with behaviour building through gamification, instant feedback and leaderboards helped convert one-time users into repeat users.

The project reported around 8.5 million units of recyclable waste collected over the operating window of 3 years and 25 collection points all over Belgrade. This means that on average at least a few hundred units of packaging waste went into each of the RVMs on the daily basis. With a unit cost per machine being 8000 euros, and a seven-year expected life span. Even at low volumes this means that capex per returned item stays below one cent. However, the operation costs and rewards dominate the cost curve, and in order to be a profitable model it would require stable funding, and clear regulatory crediting of collected material. The ceasing of operations of Reciklomat in Belgrade was due to systemic and unfortunate events, not because the model was not performing at a satisfactory level.

Informal collection can be integrated in models like these. If the informal collectors got paid by the government and PROs like Sekopak, we could better monitor the data, improve conditions of living for many Roma community people. Introducing models that exclude them might have better collection rates, but in that case a big community in Serbia would lose any way of survival likelihood. This is why it is crucial to get them involved, but in a legal and proper fashion.

What implications does all this have on private businesses?

In order for developing countries to catch up with the rest innovation is required. A developing country government has many other issues that it has to take care of, and many do not understand the severity and urgency of having proper waste management programs and structures in place. The ones who can provide this innovation and capitalize on it are private companies. Reciklomat showed this

with its business model. While most people were saying that people in Serbia would never recycle, they showed the opposite. Through the power of incentives, they helped many build awareness and habits. Reciklomat did not make a noticeable change in the amount of packaging recycled, but by showing that people would recycle when given a chance and a reason to do it they could inspire future companies and the government to give it a try with official DRS systems, and other schemes.

## Conclusion

Serbia's trajectory towards a circular economy and EU entrance is filled with gaps in infrastructure, governance, and public participation. Even though Serbia is trying to adopt the EU directives, recycling rates remain far below required benchmarks and landfilling is still dominant and the default option. The informal sector and Roma community continue to be crucial, but unrecognized by official frameworks, and the weak regulation enforcement and low data collection does not help the case of EU accession of the country.

Reciklomat's case showcased both the possibilities and limitations of private sector initiatives in the environment that is not suited for this type of change. Reciklomat managed to successfully engage the population of Belgrade to incorporate recycling in their lives through their Reverse Vending Machines Model. Although the impact in the total tonnage recovered was small compared to the overall EPR numbers of recycled material, the project proved that behavioural change is achievable and that innovation should be driven by private companies in environments where the infrastructure lags behind. However, the discontinuation of Reciklomat in Belgrade showcases the uncertainty and fragility of these models. With unclear regulatory frameworks and lack of financing structure from municipalities or other bigger sponsors the project was always destined to run into obstacles. There was no legal certainty or integration into EPRs and thus the projects of this size cannot endure all which is thrown at it. In order for this success to be long term a formal DRS structure is required. We can see this in other countries examples where RVMs were a much greater success.

The lessons are clear. Serbia needs regulatory stability, transparent governance, and systemic inclusion of private companies and the informal collecting sector into waste management to reach its obligations under the EU waste directives. RVMs can help accelerate this progress if successfully integrated into the national framework. Reciklomat's contribution to the society came from the public engagement it provided in reshaping recycling practices in a developing EU candidate country.

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## Appendix:

Brief open-ended questions sent to the Reciklomat representatives as part of data gathering:

1. What is the total number of Reciklomats installed and in which cities were they located?

25 Reciklomats in Belgrade.

2. When were they installed, how long were they in use, and what were the main reasons for the cessation of operation and collection?

They were installed in the summer of 2021 and operated until 2023. Due to a new regulation by the Government of the Republic of Serbia, the waste collection from Reciklomats no longer contributed to Sekopak's objectives, so they had to terminate the cooperation. (ask if clarification is needed)

3. What is the total number of deposits collected per machine, per city, and by type of packaging (PET, glass, cans, Tetra Pak)?

A total of 8.5 million units of waste were collected. Of that: 5,092,358 PET packages, 1,015,658 glass packages, 484,901 aluminum packages, and 1,898,686 Tetra Pak packages.

4. Which payout and reward methods did users most frequently choose (e.g., public transport card top-up, mobile credit, gifts, donations)?

Globaltel mobile credit top-up, public transport card top-up, donation to the Novak Đoković Foundation.

5. Are there any data on user demographics (age structure, frequency of use, socio-economic profile)?

None.

6. What is the capital cost per machine and the average expected lifespan?

The cost per machine is €8,000 and they are expected to last 6 to 7 years.

7. What was the financing model: which part was covered by sponsors, the city, extended producer responsibility operators (e.g., Sekopak), and which by advertisers?

The only sponsors were Globaltel and BusPlus. Sekopak was responsible for emptying the Reciklomats. Municipalities and the city did not participate in the project in any way, except by issuing a temporary permit for the installation of the Reciklomats.

8. Were there any additional sources of revenue, such as advertising on the machines or the use of data and analytics services?

There were no additional sources of revenue.

9. What are the verified recycling results: how much of the collected material actually ended up being recycled, and how much was rejected due to irregularities?

After the waste was collected by Sekopak, Reciklomat did not track what happened to it. However, it is believed that all the waste was recycled.