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Abbreviations

AIC	Akaike Information Criteria
ANCI	National Association of Italian Municipalities (It. *Associazione Nazionale Comuni Italiani*)
ARDL	Autoregressive Distributed Lag
ATO	Optimal Territorial Area (It. *ambiti territoriali ottimali*)
CONAI	National Packaging Consortium (It. *Consorzio Nazionale Imballaggi*)
EC	European Commission
EEA	European Economic Area
EIGE	European Institute for Gender Equality
EPR	Extended Producer Responsibility
EUR	Euro
HDPE	High Density Polyethylene
ISPRA	Italian Institute for Environmental Protection and Research (It. *Istituto Superiore per la Protezione e la Ricerca Ambientale*)
IT	Information Technology
LDPE	Low Density Polyethylene
NACE	Statistical classification of economic activities in the European Community (Fr. *Nomenclature statistique des activités économiques dans la Communauté Européenne*)
OECD	Organisation for Economic Cooperation and Development
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
ppm	parts per million
PS	Polystyrene
SSH	Social Sciences and Humanities
SUP Directive	Single Use Plastics Directive
TARI	Waste tax (It. *tassa sui rifuiti*)
UHF RFID	Ultra-High Frequency Radio Frequency Identification
UN	United Nations
UNI	Italian standardization body (It. *Ente Italiano di Normazione*)
WEEE	Waste from Electrical and Electronic Equipment
WEF	World Economic Forum

INTRODUCTION

Deliverable 7.8 "Case study on Italy" is the second among the three case studies that are being prepared within Task 7.3 of the Work Package 7. The document contains the analysis of policies and macroeconomic determinants that affect the recycling rate of plastic packaging in Italy, as well as the assessment of possible gender-related aspects and distributional impacts.

Results of the consumer survey, that took place in January 2022, and involved 1500 respondents from Finland, Italy and Serbia, have also been added separately.

The primary aim of both the Case study on Italy and the Consumer survey, is to serve as inputs for the preparation of the Deliverable 7.10, that would put the three case studies and the consumer survey into the comparative perspective and provide policy recommendations.

Context

The upPE-T project aims to address the problems related to the recyclability of plastics, in particular the PE and PET. Focus is on the plastic packaging, because it represents the largest plastic market in Europe (share of around 40%); and specifically on the food and beverage packaging, which is for the most part made of PE and PET (around 39% PE and 33% PET). Plastic packaging is problematic from the point of view of waste management, because of the issues related to the recyclability of plastic packaging waste (colour, presence of potential contaminants, presence of other material etc.), due to which a portion of separated plastics cannot be recycled, and ends up incinerated or disposed of at landfills; but also because of the unacceptable level of littering, thus causing harm to the environment.

To maximise the application and acceptability of upPE-T solutions, it is vital to understand the impediments to the better management of plastic packaging waste, which could stem from the attitudes and behaviours of consumers, legislative framework, socio-economic specifics, (lack of) political action etc. For that purpose, Task 7.3 within the Work Package 7 envisages the preparation of four deliverables, including three case studies on countries with high, average and low recycling rates, and the comparative analysis summing up the main findings of the case studies and providing policy recommendations. For the selection of countries for the case studies several criteria were defined, and countries that have been chosen include Finland (high packaging recycling rate), Italy (medium rate) and Serbia (low rate). The equality dimension is also integrated, as each of the four deliverables within Task 7.3 would include the assessment of the possible gender-related aspects and the distributional effects. The comparative analysis would also contain the assessment of the attitudes and behaviours of consumers towards sustainable solutions for the treatment of food and beverage plastic packaging.

Structure

Deliverable D7.8 follows the structure of the deliverable D7.7, and contains three main parts.

The first part provides a description of the system that is currently in place for the recycling of plastic packaging waste in Italy. It contains details on the legislative requirements, applied policies, and the operational aspects of the functioning of the system. Firstly, the short overview of the legislation that is relevant for the plastic packaging management is provided, followed by the description of basic requirements that apply to the management of waste. These include description of roles and competencies of different stakeholders, and specifications on requirements for each stage of the waste management process. Then, specifics related to the packaging waste are provided, which are of particular significance for the upPE-T project, as specific requirements often apply to the packaging waste generated by households. Particular attention has been paid to the identified challenges, that

may induce policy changes in the future. Afterwards, description of the EPR system for plastic packaging waste is provided. EPR system for packaging in Italy is very developed, and there are several relevant systems for the management of plastic products and plastic packaging waste. Finally, different policy instruments at the national level that could influence the recycling of packaging waste, by either directly or indirectly affecting the behaviour of consumers or various steps within the waste management stream, have been summarized.

The second part of the document contains the econometric analysis of the determinants that affect the recycling rate of plastic packaging in Italy. The specification of the model is provided, along with the discussion and interpretation of the results.

Third part focuses on the gender dimension and possible distributional effects of the recycling policies. Firstly, based on the available statistical data and secondary sources, an assessment of various gender-related aspects of the recycling and related waste management activities in Italy is provided. Afterwards, attention is paid to the gender mainstreaming in the Italian recycling sector, which includes the specification of the legislative requirements imposed on employers, description of gendered segregation in the labour market and education (that apply to the recycling sector as well), and the overview of gender-sensitive policies in Italian recycling companies. Lastly, a short assessment of the possible distributional impact of the recycling is presented.

Methodology

Methodology applied for deliverable D7.7 was used also for the preparation of D7.8. A mixed methods approach was used, which involves desk research, econometric analysis and survey of companies.

Desk research is necessary to obtain a clear picture of the legislative and policy setting in Italy, as well as socio-economic peculiarities, that could influence the recycling of food and beverage plastic packaging. Sometimes a rather extensive specification of certain legislative requirements and policy solutions is provided; this is justified by the need to encompass all individual components of the system, which would later be put into a comparative perspective, and hopefully point to the policy options that are most effective in supporting and promoting high recycling rates. Desk research is also applied to the assessment of possible gender-related and distributional aspects related to the recycling of plastic packaging waste. The desk research primarily focuses on legislation at the national level, which in details regulates each step in the management of plastic packaging waste, setting the playing field for the actions of authorities, individuals and the private sector. Official reports, mostly prepared by EU institutions, have been another major source for the desk research. Other important sources include official statistical data, provided by Instat and Eurostat, articles published in peer-reviewed journals, and reports of Italian think-tanks, international organisations and NGOs. Finally, websites of both the national authorities and private entities have proved to be an invaluable source.

Econometric analysis is focused on the assessment of determinants of the recycling rate of plastic packaging. Several dozen times series have been examined, to select the ones with satisfactory properties, and different model specifications have been applied, in order to obtain the statistically significant results.

Company survey was conducted, to obtain response from recycling companies on the gender sensitive policies they apply.

A. POLICY SETTING FOR THE RECYCLING OF FOOD AND BEVERAGE PLASTIC PACKAGING IN ITALY

1 Summary

Italy is one of the largest consumers of plastics in the EU. According to the report produced by the think tank *ECCO* (2022), in 2020 the consumption of plastics in Italy amounted to 5,9 million tons, representing a *per capita* consumption of 98,6 kg, second largest in the EEA.

According to the same source, packaging sector is by far the largest user of plastics, with a share of 42% in 2020. Dominant types of plastics were PE (70,2% of LDPE and 62,8% of HDPE was used in the packaging industry) and PET (98,1% of total PET was used for packaging)[1]. Production of biodegradable and compostable plastics was 111 thousand tons, mostly for shopping bags and garbage bags for organic waste (55%) and for agricultural use (20%); the use for food packaging has been modest, comprising 8% of the total use of bioplastics.

Extended producer responsibility is used as a policy tool for the management of post-consumer plastic packaging waste. In Italy, producers and users of packaging are required to participate in EPR schemes, and one of the major obligations is that they are liable to cover at least 80% of the costs of separate collection and treatment of plastic packaging waste. The major player in that regard is consortium Corepla, but there are also other systems that manage certain types of plastic packaging (e.g. bioplastic packaging, or PET bottles).

On average, the performance of the sector and the attainment of the targets could be regarded as satisfactory, and around the EU average. However, substantial regional differences are present, with southern region and islands particularly lagging behind. Italian authorities have been addressing these issues, but the European Commission still expects a more substantial improvement in this regard.

When it comes to encouraging recycling of plastic packaging waste, apart from the EPR system, a mix of different policy instruments is used. These include "hard" and "soft" regulations, as well as taxes, charges and other economic instruments, and activities that aim to increase the awareness and knowledge of individuals, and other stakeholders as well.

2 Outline of key legislation

Legislative Decree No. 152/2006 (Environmental Code, 2006a) is the key piece of legislation dealing with waste, waste management and packaging. Its scope is rather extensive, as it also deals with other topics related to environmental protection (such as air, soil, and water protection and pollution; environmental permits; compensations for environmental damages etc.). For these reasons, it is often referred to as the *Environmental Code*.

The **Environmental Code** transposes the requirements of the EU's Waste Framework Directive (2008/98/EC) and Packaging and Packaging Waste Directive (94/62/EC).[2] The Code contains relevant definitions, prescribes general waste management principles, and in particular elaborates the principle of waste hierarchy. Further on, it defines competences of

[1] PE is mostly used for bags, containers and inner layers of aseptic containers for liquid food, while PET is mostly used for bottles, containers and labels. Source: *ECCO* (2022).

[2] Deliverable D9.14 contains an overview of regulatory setting at the EU level and the requirements imposed on Member States.

different levels of government, guides the organisation of the waste management system, and specifies roles and responsibilities of users and waste management operators (including obligations related to extended producer responsibility). The Code also prescribes the recovery and recycling targets for packaging and municipal waste, calculation rules, and introduces economic instruments at the state level aimed at attaining the targets.

Legislative Decree 196/2021 transposes the SUP Directive (EU 2019/904), thus introducing bans on the marketing of certain single-use plastic products, and defining measures in order to reduce the consumption of the specified products, including plastic packaging items.

A detailed description of the current Italian system for managing plastic packaging waste, which is based upon the provisions of the Environmental Code, is presented in the following headings.

3 Waste management system in Italy

3.1 Terminology

Italy applies definitions specified in the EU's Waste Framework Directive, which are in some cases adapted to its local needs.

The term *waste* is defined as "any substance which the holder discards, or intends or is required to discard" (Article 183 of the Environmental Code). Exemptions from this definition include by-products, and products that have undergone a recovery operation and meet the end-of-waste criteria.

Municipal waste is defined in a comprehensive manner, by specifying all the types of waste that fall within this category:

- Household waste,
- Waste which is in its nature and composition similar to household waste, and is generated by administrative, commercial, public services, artisan and other activities[3],
- Waste from street sweeping and emptying litter bins,
- Litter on roads, riverbanks, beaches and other publicly used areas,
- Waste from cleaning markets and parks, and
- Waste from cemeteries.

It is also stressed that municipal waste does not include waste from productive, agricultural, forestry and fishing activities, waste from septic tanks, sewage systems and wastewater treatment plants.

Waste management encompasses the collection, transport, recovery and disposal of waste, including the supervision of these activities; activities following the closure of disposal sites; and activities carried out by traders or intermediaries[4]. Further on:

- *Waste collection* refers to the picking up of waste, and also includes storage prior to collection and preliminary sorting. Of particular importance is the *separate collection*, which is collection conducted in such a manner that waste streams that are different by type or nature are kept separately.
- *Reuse* is defined as an activity where the product or its components are used again for the same purpose that was initially intended.
- *Waste treatment* encompasses recovery and disposal operations.

[3] The full list of such activities and the types of waste they produce that are considered to be municipal waste is provided in Annexes L-quater and L-quinquies of the Environmental Code.

[4] Traders are companies that purchase and sell waste, while intermediaries include companies that arrange the recovery or disposal of waste on behalf of other entities.

- *Recovery* refers to different operations that result in waste being used to replace other materials[5]. In the case of solid waste, particularly relevant recovery operations are energy recovery and material recovery, while the most common types of material recovery are preparation for reuse and recycling:
  - *Preparation for reuse* encompasses the activities of checking, cleaning, repairing etc. products or its components that have become waste, so that they can be reused without further treatment, while
  - *Recycling* refers to the reprocessing of waste into products, materials or substances which can be used for their original function, or other function other than energy recovery.
- Waste disposal encompasses the landfilling, biodegradation, incineration without energy recovery, and any other treatment operation other than recovery[6].

3.2 Waste management principles and criteria

Environmental Code specifies that waste management is an activity of public interest, and that it must be conducted in such a way that it does not pose danger or threat to human health and to the environment (e.g., by polluting soil or air, endangering flora and fauna, or realising unacceptable levels of noise or odours). In order to achieve this, waste management principles, as well as the criteria that waste management activities need to meet, are specified by the Code.

Waste hierarchy sets out the order of priority of waste management activities, that should ensure the best environmental outcome: 1. Prevention, 2. Preparation for reuse, 3. Recycling, 4. Other types of recovery (e.g. energy recovery), 5. Disposal. National and local authorities, as well as private entities (in particular the ones to which producer responsibilities apply), are assigned various obligations in this regard. For instance, authorities at different levels are required to develop waste prevention plans, containing qualitative and quantitative goals and measures to achieve them. With respect to the reuse, recycling and other recovery activities, authorities are required to adopt measures, aimed at supporting the development of reuse and recycling networks; EPR schemes are required to adopt measures within their competences to ensure that the waste is reused or recycled; while waste operators must eliminate hazardous substances and components from the waste, if it is technically feasible.

It is also worth noting that deviations from the waste hierarchy may apply to specific waste streams, if this presents a better environmental option, and if this possibility is envisaged in relevant planning documents and authorised by competent authorities.

Principles of *responsibility and cooperation* mean that all entities involved in the production or holding of waste, or in waste management activities, are required to make sure that waste is managed in accordance with law.[7]

Treatment plants for municipal waste are required to satisfy the principles of self-sufficiency and proximity. The principle of *self-sufficiency* applies to the disposal of municipal waste, and imposes the requirement that non-hazardous municipal waste should be disposed of in the optimal territorial area within which it was generated. The principle of *proximity* states that the recovery and disposal of municipal waste should be carried out in the plants closest to the place where said waste was generated or collected.

[5] Full list of recovery operations is provided in Annex C of the Environmental Code.

[6] Full list of disposal operations is provided in Annex B of the Environmental Code.

[7] Interpretation drawn from the ruling of the Court of Cassation – for more details refer to https://www.ambiente.it/informazione/focus-on/il-consolidato-principio-della-responsabilita-condivisa-nella-gestione-dei-rifiuti.html.

Without going into more details, Environmental Code also prescribes that waste management activities need to meet the criteria of effectiveness, efficiency, economy, transparency, technical and economic feasibility, participation and provision of information.

A set of general environmental principles also apply to waste management activities:

- *Precautionary* principle aims to ensure the protection of human health and the environment, by imposing the obligation on the waste management operator to instantly inform relevant authorities if the actual or potential danger occurs;
- *Sustainability* principle can be interpreted as a requirement that any action of current generations may not compromise the possibilities of future generations;
- Principle of *proportionality* is specified, but the definition is not provided in the Environmental Code; however, drawn from the context in which it is used, the principle establishes the requirement that the imposed obligations on certain entities or adopted measures should not go beyond what is necessary to achieve the wanted impact;
- *Polluter-pays* principle imposes the requirement that persons liable for the pollution should be required to cover related costs.

Abandonment of waste and its depositing on the ground or in the soil is prohibited. In case this provision is violated, the violator is required to remove the waste and properly dispose of it, to restore the site, and to pay the penalty. Owners or holders of rights on the site in question may also be liable, if their misconduct or negligence is proved.

3.3 Procedural requirements

3.3.1 Competencies of authorities

At the **state level** Ministry for Ecological Transition[8] is the main body that controls and monitors the waste and packaging waste management activities. Namely, they approve and oversee the functioning of EPR schemes for packaging and autonomous waste management systems, and verify achieved results of waste management operators for the purpose of calculating reuse and recycling targets; they monitor the implementation of the national waste prevention plan, and develop measures related to the prevention of waste generation. The Ministry also keeps the register of environmental managers, including waste manager operators, and the register of producers subject to the extended producer responsibility. **ISPRA** (Italian Institute for Environmental Protection and Research – It. *Istituto Superiore per la Protezione e la Ricerca Ambientale*) keeps the national section of the waste cadastre, and calculates indicators at the national level, such as quantities of generated and treated waste, by types of waste, and by types of recovery activity.

At the **subnational level**:

- Regional authorities have the responsibility to regulate waste management activities. They are in charge of issuing authorisations for waste recovery and waste disposal operators, approving projects for new treatment plants, promoting integrated waste management and defining optimal territorial areas (ATOs). Regional authorities also prepare and adopt regional waste management plans, and provide incentives for the reduction and recovery of waste.
- Provincial authorities carry out control, inspection and other administrative activities related to the recovery and disposal of waste within their territories.
- Municipalities are the ones in charge of municipal waste management. They can organise waste management activities, or, more often, delegate these tasks to third parties (e.g. waste management operators). They prescribe procedures for the separate collection, regulate the modalities for the collection and transport of municipal waste, and set minimum standards for the joint collection and transport of packaging waste and

[8] It. *Ministero della Transizione Ecologica*, www.mite.gov.it. Until 2021 the ministry in charge of waste and waste management activities was called Ministry of Environment and Protection of Land and Sea.

other types of waste. Municipalities are also required to ensure the appropriate sanitary and hygienic level of all municipal waste management activities.
- Under exceptional and urgent circumstances, specified by Article 191 of the Environmental Code, regional, provincial or municipal authorities may order the temporary use of special forms of waste management, in order to protect human health and the environment.
- Regional offices of the Unioncamere (Italian Chamber of Commerce) collect waste and packaging waste data from waste operators and other eligible entities, and submit them to ISPRA.

3.3.2 Authorisation and registration

Operation of waste recovery plants and waste disposal sites is subject to authorisation from regional authorities.

Entities that conduct the activities of waste collection, waste transport, waste trading and brokering and site reclamation must register at the Register of environmental managers. The registration is valid for five years, and must be renewed. However, there are exemptions, as some entities need not register as environmental managers – for instance, initial waste producers who carry out collection and transport of their own waste (up to the amount of 30 kg per day); ships that accidently catch marine litter; or companies that are already registered for the collection and transport of hazardous waste, need not submit another registration for the collection and transport of non-hazardous waste.

3.3.3 Registries

The main register in the area of waste management is the *waste cadastre*. Italian waste cadastre is divided into a national section, which is run ISPRA, and regional and provincial sections, ran by regional or provincial environmental protection agencies. Waste cadastre contains data on the quantities and types of waste, on the resulting recovery operations, on the separate collection of municipal waste by types of material, on the costs of separate collection, etc.

The Unioncamere also has a role related to the waste cadastre; namely, waste operators and other eligible entities are required to submit data to regional offices of the Unioncamere annually, and these data are then further delivered to ISPRA and regional and provincial environmental agencies.

3.3.4 Requirements imposed on waste management operators

Keeping records. Waste collection and waste transport operators, recycling companies and other recovery operators, disposal operators, operators of EPR schemes for packaging, as well as waste traders and intermediaries, must keep chronological records of waste loading and unloading operations. These records need to contain data on the quantities of waste, separately by types of waste and by types of treatment operations.

Reporting requirements. Based on the records they are required to keep, aforementioned entities must submit data on generated and treated waste (by types of waste and types of treatment operations) to regional Unioncamere offices annually, which are then included into the waste cadastre. As to packaging waste, National packaging consortium CONAI must collect data from its members and report on the quantity of packaging placed on market and separately collected – total quantities, as well as quantities per different types of materials and different types of packaging.

3.4 Responsibilities for the organisation of waste management activities

3.4.1 Initial waste producer and waste holder

In Italian legislation, the general responsibility to organise waste management falls on the initial waste producer or waste holder. In that regard, term *waste producer* refers to the entity whose activities generate waste or to whom the generation of waste is referable (i.e. initial waste producer), or to the entity whose operations change the nature or composition of waste (i.e. new waste producer); the term *waste holder* refers to the entity that is in possession of waste.

Initial waste producer or waste holder is required to arrange the treatment of waste. They have several options to do this: by arranging the treatment of waste directly; by assigning this task to the waste trader or waste intermediary; by delivering the waste to the waste treatment operator; or by engaging the entity that is in charge of waste collection and transport.

It is important noting that, according to Italian legislation, initial waste producer or waste holder remains to be liable for the treatment of waste even after the waste is handed over to one of the aforementioned intermediaries or operators. Only under the following conditions the initial waste producer or waste holder ceases to be responsible for waste treatment:

- Waste is delivered to the public collection service,
- Waste is delivered to the authorised recovery or disposal operator and the signed form confirming this has been received, or
- Waste is delivered to operators that are authorised to conduct intermediate disposal operations (such as mixing, repackaging or temporary storage before other disposal), in which case these operators become responsible for the proper waste disposal.

3.4.2 Local authorities

Waste policy in Italy is implemented at sub-national level, and both regions, provinces and municipalities play their roles.

Municipalities are the ones that are responsible for the management of municipal waste. However, this does not mean that they are required to carry out waste management activities themselves, they can delegate these responsibilities to other entities. However, they are still required to take care that the system works properly, that waste collection services are sufficiently available, including adequate territorial coverage etc.

From the legislative point of view, management of municipal waste should be organised within broader territories, which are referred to as *optimal territorial areas* (It. *ambiti territoriali ottimali* – ATO). Optimal territorial areas are established at the regional level, often including several municipalities. When determining borders of ATOs different criteria should be considered, such as the road and rail network, existing waste management plants, demographic parameters, administrative territorial divisions etc.

Preferably, integrated municipal waste management should be established within ATOs, which means that all waste management activities are conducted by one operator within the borders of ATO. In such a case, legislation specifies that awarded operator is expected to provide the service for a period of at least 15 years. A contract between the regional authority and the operators specifies, *inter alia*, the modalities of overseeing and controlling the integrated municipal waste management operations, obligation to comply and submit required data, penalties, level of efficiency and reliability of the service, etc.

Alternatively, instead of the integrated system, individual waste management activities could be awarded to different operators, separately for the collection, for disposal, and for other services.

So far, the boundaries of ATOs have been established in all regions. However, there remain certain issues in some areas; for instance, governing bodies have not yet been established for some ATOs, not all municipalities are represented in governing bodies, or some of the waste management activities are conducted disregarding the established boundaries of ATOs (Invitalia, 2019). Also, some regions have chosen to divide ATOs into sub-regional structures – sub-ATOs (referred to sometimes as SADs – It. *Sub Ambito Distrettuale*), within which certain or most of the waste management operations are actually conducted. Sometimes, boundaries of sub-ATOs correspond with municipal boundaries.

According to the *Waste Monitor Database* (Invitalia, 2022b), there are currently 64 ATOs and 300 sub-ATOs, served by 888 waste management operators. Typology of waste management operators is diverse: there are large companies, who often conduct the integrated waste cycle management, and there are many small and medium companies, often engaged in only one type of activity (e.g., waste collection, transport, or treatment and disposal services). In 2018 more than 60% of waste management operators were private companies, while the remaining nearly 40% were publicly owned (in the majority of cases owned by municipal administrations).

3.4.3 Producer

Producers are generally held liable for the waste associated with products they manufacture, according to the "polluter-pays" principle. This obligation of producers is referred to as *extended producer responsibility* (EPR). Producers are therefore responsible for the collection and treatment of their products – they can organise some of these activities themselves or, more often, compensate costs of other entities that carry out these activities.

According to the *Environmental Code*, extended producer responsibility is established with the aim to make producers of products financially, or financially and organisationally, responsible for the waste management of their products.

Producer responsibility imposes various requirements on producers:

- Producers must align their waste management objectives with the principle of waste hierarchy, and should aim to meet the targets specified by the EU. They are also required to publicly disclose information on the attainment of their waste management objectives.
- They need to have sufficient financial and/or organisational resources to meet the imposed requirements.
- Relating to the organisation, producers must establish a waste collection system, with the adequate geographic coverage. They must also provide adequate information to consumers, waste operators and other entities about the available collection systems or reuse centres, as well as about the waste prevention measures.
- As regards financial obligations, producers must cover at least 80% of the following costs[9]:
  - Collection and transport of the separately collected waste,
  - Sorting and treatment of waste (i.e. reuse and recycling), to the extent that is necessary to achieve the targets set out by the EU,
  - Provision of information to consumers and waste operators,
  - Keeping records and providing information to the authorities, as specified by legislation;
  - On the other hand, the financial contribution of producers should not exceed the costs that are necessary to provide above-mentioned services.
- As regards reporting and disclosure of information, producers are required to regularly submit following documents and information to the National Register of Producers:

[9] Environmental Code specifies that producers must cover at least 80% of the mentioned costs, provided that the remainder is covered by the initial producer or distributors.

  - Information on the system they use to meet the producer obligations (e.g. whether that is the autonomous system, or they participate in one of the EPR schemes);
  - Data on the quantities of products placed on the market and the quantities of collected and treated waste;
  - Annual prevention and management plans;
  - Annual management reports, containing information on the applied methods for the collection and treatment of waste, attainment of recycling objectives (with explanations in case the objectives have not been met), costs of different waste management activities, possible revenues from the reuse activities etc.
- Producers must put in place self-monitoring mechanisms, related to their financial management, coverage of costs of the waste management activities, and compliance with the requirements on data collection and reporting.
- In the case of EPR schemes, additional reporting and disclosure requirements are imposed. Namely, operator of the schemes must submit the annual balance sheet to the National Register of Producers, and must publicly disclose information on participating members, financial contributions paid by members, and procurement procedures for the selection of waste operators.

In Italy, all producers who are subject to extended producer responsibilities must register at the National Register of Producers, which is kept by the Ministry for Ecological Transition. This applies to foreign producers as well – they are therefore required to designate a national representative.

The Ministry also makes sure that roles and responsibilities of producers and other participating entities (such as local authorities or waste management operators) are clearly defined, and that the principles of fairness and proportionality apply related to the fulfilment of imposed obligations (for instance, that the contribution of a producer to the coverage of waste management costs is in line with his market share).

3.5 Separate collection of municipal waste

In Italy, separate collection of municipal waste is obligatory for the following materials: paper, metal, plastic, glass, wood, textiles (as of 2022), organic waste (as of 2022), packaging, WEEE, waste batteries and accumulators, and bulky waste (incl. furniture and mattresses). Regional authorities or municipalities are the ones that guarantee the management of separately collected municipal waste. For that purpose, they sign agreements with producers organisations (referred to as consortia) that are established for different types of materials, who are then responsible for the further treatment of separately collected waste (agreements for packaging waste are in more detail elaborated within points 4.3.3, 5.1.1 and 5.1.2).

Environmental Code stipulates that separately collected municipal waste must not be mixed with other waste or other materials. However, different materials may be collected jointly, if that is technically and economically feasible, and if the quality of recycling is not compromised.

When it comes to the actual system for the collection of municipal waste, in Italy the most widely used method is collection by street bins. *Ronchi et al.* (2020) report that nearly two-thirds of Italian population is served by street bins (13% exclusively, and 51% mainly), while the remainder relies on the door-to-door collection (19% exclusively, and 16% mainly).

3.6 Treatment and landfilling of municipal waste

For the disposal of municipal waste, the self-sufficiency and proximity principles apply. Self-sufficiency means that waste must be disposed of within the same region where it was generated. The only exception may apply if, due to the declared state of emergency caused

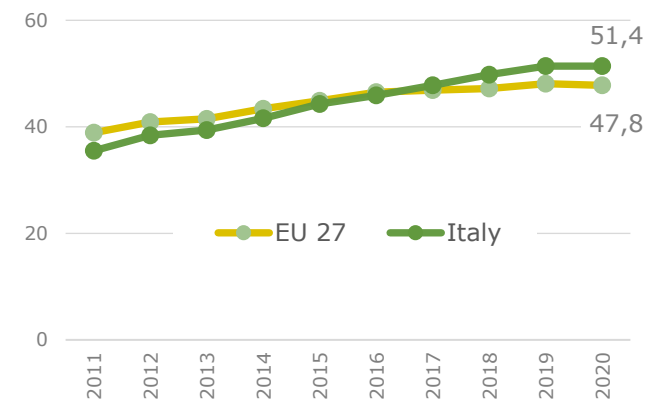
by the natural disaster, it is necessary to send municipal waste outside of the region. Proximity principle means that collected waste should be sent to the nearest recovery or disposal plant that is appropriate, in terms of the type of waste or type of treatment. Also, in order to facilitate the treatment of separately collected municipal waste, the circulation of such waste within the national territory is free, if it is conducted by companies that are registered within the National Register of Environmental Managers.

According to the *Waste Monitor Database* (Invitalia, 2022b), there are currently 673 treatment plants for municipal waste in Italy. Most of them (359) deal with the organic fraction, 132 refer to mechanical-biological treatment, and there are 51 incinerators and 131 landfills. According to the same source, as much as 20% of the total municipal waste ends up in landfills, while 24% is incinerated or co-incinerated.

Talking about disposal of waste, one must mention that *illegal and irregular landfills* have been a widespread problem in Italy. The government has more actively committed to cleaning them after a 2014 ruling of the Court of Justice of the EU, that imposed financial penalties to Italy[10]. However, the problem is not easy to solve, as it is often part of broader organised crime activities, referred to as "ecomafia". It seems that the European Commission is not satisfied with how Italy has handled the situation so far, because in their September 2022 report (European Commission, 2022a) they acknowledge that Italy does not fully comply with the EU legislative requirements on landfills, and that there are still non-complying landfills which have not been closed as required. For that reason, EC issued a call on Italy in April 2022 to comply, or else the Commission may decide to refer again to the Court of Justice.

Graph 1 **Recycling rate of municipal waste**

In %



Data source: Eurostat online database (dataset CEI_WM011)

The recycling rate of municipal waste can be deemed as satisfactory, as in 2020 it stood at 51,4%, and was higher than the EU average (*Graph 1*). However, this percentage indicates at the same time that a substantial portion of municipal waste has not been separately collected and recycled, but that it has leaked into mixed waste. For this reason, European Commission in its latest report (European Commission, 2022a) calls on new measures that would improve the separate collection.

To put into a comparative perspective, Italian municipal recycling rate has been around the EU average – up to 2016 slightly below, and afterwards slightly above the average. This tendency can be regarded as satisfactory. However, one must have in mind that Italy

[10] Court of Justice found that Italy did not fulfil its obligations under relevant EU waste-related directives, and that it also failed to comply with the judgment from 2007 (related to Case C-135/05 Commission vs. Italy). More specifically, the judgment stated that Italy had consistently failed to ensure the treatment and disposal of waste in accordance with the Waste Directive, the proper functioning of the permit system, and termination of illegal operations. For instance, during the proceedings it was stated that, at that point, 198 sites did not conform with the Waste Framework Directive, 14 of them did not comply with the directive regulating hazardous waste, and also two landfills were not conforming with the requirements of the directive regulating landfills.

Due to this, the judgment ordered Italy to pay EUR 40 million penalty, and to keep paying decreasing penalties every six months, until it complies with the 2007 judgment. The initial semi-annual payment was EUR 42.8 million, and deductions have been applied for every hazardous site brought into conformity (deduction of EUR 400 thousand per site) and for every other site brought into conformity (deduction of EUR 200 thousand per site). Source: (Court of Justice of the EU, 2014).

has used a less stringent methodology for the calculation of municipal recycling rates. If the new stricter rules are applied, than presented recycling rates would have been lower by several percentage points[11].

4 Specifics related to the packaging waste management

4.1 Definition and requirements for packaging

4.1.1 Definition of packaging

Definition of packaging is set out at the EU level, in the Directive on Packaging and Packaging Waste (94/62/EC). Italian authorities have transposed the definition in the Environmental Code.

Packaging is defined as a product that is used to contain other goods, to protect them, to facilitate their handling and delivery to the user, and to present them. Distinction is made between:

- *Sales packaging or primary packaging*, which is a packaging containing a product at a point of sale to the final user;
- *Grouped packaging or secondary packaging* – packaging that contains a group of products at the point of sale, which can be removed without affecting the characteristics of products; and
- *Transport packaging or tertiary packaging*, which is packaging that facilitates the handling and transport of products or grouped packaging, and helps avoid damage. In that regard, it is specified that containers are not considered as packaging.

The above definitions are complemented with *additional criteria* and illustrative examples, contained in Annex E of the Environmental Code:

- Packaging is an item that satisfies the above definitions, unless it is an integral part of the product, and is intended to be used, consumed and disposed of together with the product it contains.
  Illustrative examples for objects considered as packaging are boxes for sweets; envelopes for magazines; wraps, trays and other materials used as sterile barriers to preserve the product; or capsules for beverages (coffee, chocolate, milk) which are left empty after use. On the other hand, examples of objects that are not considered as packaging are tea bags; cheese wax coating; sausage skins; coffee capsules, coffee filters and aluminium bags for coffee that are disposed of together with the used coffee.
- Packaging is also an item that is designed and intended to be filled at the point of sale, provided that it fulfils the packaging function.
  Illustrative examples of objects considered as packaging are packaging objects that are intended to be filled at the point of sale; paper or plastic bags; disposable plates and cups; sandwich bags; or aluminium foil. While examples of objects not considered packaging include disposable cutlery; wrapping paper sold separately; or baking paper that is sold separately.
- Components of packaging and ancillary elements integrated into packaging are considered to be packaging. Ancillary elements directly attached or hung on the product are also considered as packaging if they fulfil the packaging function; unless they are an

[11] Ministry of the Ecological Transition (previously Ministry of Environment) explains that Italy has used methodology 2, which takes into account only certain materials when calculating municipal recycling rate – in Italian cases these are paper, metal, plastic, wood and organic waste. With this methodology, according to them, the municipal waste recycling rate in 2018 was 50,8%. However, as of 2025 total volume of municipal waste must be taken into account, which corresponds with the current methodology 4; applying this methodology would result in a lower recycling rate in 2018, at 45,2%. Source: (Italian Ministry of the Environment, 2021).

integral part of the product, and are intended to be consumed and disposed of together with the product.
Illustrative examples of object considered as packaging are labels attached to products; or mechanical grinders in non-refillable packaging which are filled with the main products (e.g. pepper mill containing pepper).

4.1.2 Requirements for packaging

Packaging is required to comply with the essential requirements specified in EU's Packaging and Packaging waste directive. These requirements are listed in Annex F of the Environmental Code.

- Requirements related to the manufacturing and composition of packaging imply that:
  - The packaging is produced in such a way that its volume and weight are minimal, while it guarantees the safety, hygiene and acceptability;
  - The packaging may be reused or recovered (e.g. recycled), in line with waste hierarchy, to minimize impact on the environment;
  - The presence of hazardous metals and other hazardous substances is limited to the minimum[12].
- Requirements related to the reusability must be met simultaneously:
  - The physical properties allow repetitive use under normal conditions,
  - The treatment of used packaging complies with the requirements related to the work safety, and
  - Recoverable packaging which is no longer used and becomes waste must meet requirements for recoverable packaging.
- Requirements for recoverable packaging mean that packaging must be recoverable in the form of:
  - *Material recycling* – more precisely, packaging must be produced in such a way that it allows for recycling of a certain percentage of its weight. This percentage is determined at the EU level, and depends on the type of material;
  - Recoverable in the form of *energy recovery* - which means that it must have a minimum calorific value in order to be used for energy recovery;
  - Recoverable in the form of *compost* – which means that it must be sufficiently biodegradable, so that it does not hinder the composting process to which the packaging has been introduced;
  - Or it must be *biodegradable* – which means that it can undergo physical, chemical, thermal or biological decomposition, eventually decomposing into carbon dioxide, biomass and water. For this purpose, oxo degradable plastics is not considered to be biodegradable.

4.1.3 Labelling of packaging

Environmental Code prescribes obligatory environmental labelling for packaging. This obligation was introduced with the 2020 amendments to the Environmental Code, and is to be applied as of 1 January 2023. The use of other types of labels, other than environmental labels, remains voluntary.

In line with the environmental labelling obligation, producers are required to label packaging in accordance with the technical standards of *UNI*, which means that information on the handling of packaging and its reusability and recyclability properties must be indicated;

[12] The content of heavy metals in packaging is limited by the EU's Packaging and Packaging Waste Directive (94/62/EC), so that concentration levels of lead, mercury, cadmium and hexavalent chromium are limited to 100 ppm by weight. Certain exception may apply – in the case of plastic packaging, (Commission Decision 2009/292/EC) allows that the above specified limits may be exceeded for plastic crates and pallets, if these are introduced and kept in closed product loops.

also, labels must contain information on used substances, in accordance with the (Regulation (EC) 1272/2008). More guidance and clarifications related to the labelling requirements are provided in the *CONAI* website.

Regarding the packaging that contains plastics, labelling of materials used in packaging should be conducted in the following manner, in line with the (European Commission, 1997):

- Polyethylene terephthalate: abbreviation PET, numerical mark 1,
- High-density polyethylene: abbreviation HDPE, numerical mark 2,
- Polyvinyl chloride: abbreviation PVC, numerical mark 3,
- Low-density polyethylene: abbreviation LDPE, numerical mark 4,
- Polypropylene: abbreviation PP, numerical mark 5,
- Polystyrene: abbreviation PS, numerical mark 6.

Regarding the marking of composites and other materials that are not specified in the Commission Decision, rules are not clear, and *CONAI* provides its advice on that. (CONAI, 2022a)

4.2 Principles and criteria of the packaging waste management

Besides the principles and criteria related to general waste management activities (refer to point 3.2), Environmental Code prescribes additional principles that apply to the packaging waste management.

The *principle of prevention at source* favours the decrease in the production and use of packaging, promotes the use of clean technologies in the production of packaging, and encourages the production and use of reusable packaging.

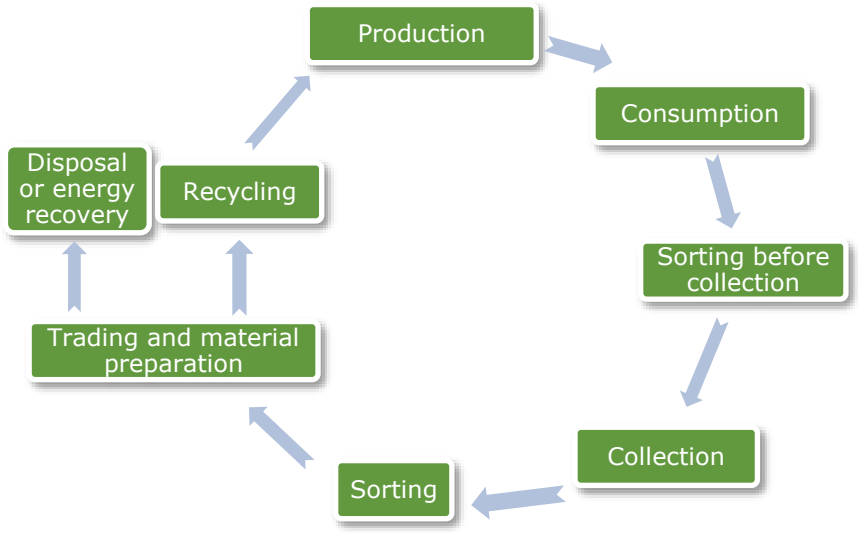
Recycling and other recovery activities are favoured, especially by encouraging the separate collection of packaging waste, and the promotion of the use of materials obtained from the recycled packaging. Improved recovery of the packaging waste at the same time contributes to the reduction in the disposal of packaging waste.

The application of the *polluter-pays principle* and the *shared responsibility principle* in the area of packaging waste, imposes the requirement on operators to cooperate and to promote measures aimed at prevention, reuse, recycling and recovery of packaging waste.

4.3 Organisation of the packaging waste management

Based on the analysis of *Hestin, Faninger & Milios* (2015), the operations within the system for packaging waste management are graphically represented in *Diagram 1*.

Diagram 1 **Waste management activities for the separately collected packaging waste**



Source: abridged from Hestin, Faninger & Milios (2015)

4.3.1 Responsibilities of different entities

Producers and users of packaging are responsible for the management of packaging and packaging waste. According to *CONAI* (2022a):

. ▪ *Producers of packaging* encompass:

- ▫ Producers and importers of raw materials used in packaging,
- ▫ Producers and importers of semi-finished products used in packaging, and
- ▫ Producers, importers and sellers of empty packaging;

▪ *Users of packaging* include:

- ▫ Buyers, fillers and retailers of empty packaging,
- ▫ Retailers and importers of full packaging (i.e. of packaged goods) and
- ▫ Self-producers of packaging – these are entities that produce packaging to pack their own goods.

Dalberg Advisors (2019) consider that one of the success factors of the Italian EPR scheme is that legal responsibility for packaging waste management falls not only on producers, but also on users of packaging.

General obligations imposed on producers are applicable (e.g., acceptance of waste, subsequent waste management, financial and reporting obligations – refer to point 3.4.3 for more details), but there are also additional obligations that are specific for packaging.

First and foremost, producers and users are required to bear costs of the related waste management activities. More specifically, they have the obligation to cover the following costs:

- ▪ At least 80% of the management costs of public services related to the separate collection of packaging waste. These costs are to be reimbursed to municipalities or delegated third parties (e.g. municipal waste operators);
- ▪ Costs related to the organisation of collection points for returned secondary and third packaging, where industrial and commercial entities can deliver their own waste free of charge – but only if market services are not reasonably available;

- Costs of and the subsequent transport, sorting and preliminary recovery operations of separately collected packaging waste;
- Costs of providing adequate information on the prevention, reuse, and available collection and return systems to waste holders;
- Costs related to the collection and reporting of data (data on the products placed on the market, and on collected and treated waste).

In relation to financial obligations, Italian producers of packaging have contributed to the costs of the separate collection of municipal waste for more than 20 years. Namely, in 1999 the packaging producers' organisation *CONAI* for the first time signed framework contract with the *Association of Italian Municipalities* (ANCI), regulating mutual responsibilities regarding the separate collection of packaging waste (Watkins, et al., 2017). Details on the current cooperation of *CONAI* and Italian municipalities are given in point 5.1.1.

The role of *regional authorities and municipalities* is also significant. Environmental Code stipulates that the separate collection of packaging waste generated by households is the responsibility of these bodies; in particular, they must ensure that separate collection is available within the entire territory, and that producers and EPR systems have access to the collection infrastructure.

In any case, producers remain liable to finance at least 80% of costs of packaging waste management activities of regional and municipal authorities, and are required to transfer the funds to the budgets of these public entities.

4.3.2 Management systems for packaging waste

In order to meet their producer obligations, producers must set up or join a management system for packaging waste. For that purpose, they can choose to:

- Join the National Packaging Consortium *CONAI*, in which case they also join material consortia within *CONAI*, which are established for different types of packaging materials (plastic, glass, aluminium etc.);
- To set up autonomous systems for the collection and management of packaging waste, which must cover national territory, or
- Establish the return system for their packaging, which must also cover the national territory.

Producers can establish autonomous collection or return systems on their own or jointly with other producers. Before establishment, an approval from the Ministry of Ecological Transition must be obtained. The application, *inter alia*, must contain the plan of the network, and sufficient proofs that the system would be efficient and cost-effective, and that the prescribed targets and standards would be achieved.

As for the users, membership in the National Packaging Consortium *CONAI* is compulsory for them.

4.3.2.1 Guidelines for management systems

Environmental Code defines common organisation and management rules that apply both to the *CONAI* system and to autonomous systems for packaging waste. These rules apply also to systems for the collection of PE waste other than packaging, and to systems for the management of other categories of special waste (batteries and accumulators, tyres, waste electrical and electronic equipment etc.).

When it comes to the establishment and operation, these systems must be established as separate legal entities from their members, and operate on a non-profit basis. They are required to operate in line with the principles of transparency and non-discrimination – for instance, they must be open for membership to all eligible parties.

Most importantly, management systems must have sufficient financial means to finance their activities and meet their dues. Therefore, they may determine the environmental contribution to be paid by participating members. In this case, they are required to disclose

information on the methodology for the calculation of the contribution, on any exemptions, as well as how the proceeds from the environmental contribution have been used.

Management systems are required to actively engage in the prevention of waste generation. For that purpose, they must prepare multiannual programs and annual waste prevention plans, and must report annually to the Ministry for Ecological Transition about the achieved results (products placed on market, collected and treated waste etc.), as well as to justify any deviations from the plan.

Apart from disclosing information on the environmental contribution, management systems are subject to other reporting and disclosure requirements: they are required to provide adequate information to waste holders (e.g., on the prevention and reuse measures, on the existing return and collection systems, and on the proper handling of waste); they must disclose information on participating members, and on the procedures for the selection of waste management operators.

4.3.3 Framework program agreements

According to the Environmental Code, *CONAI* and autonomous systems for the management of packaging waste need to sign framework program agreements with the relevant public administration bodies (National Association of Italian Municipalities ANCI, or Union of Italian Province UPI). Agreement needs to specify the methods of the collection of packaging waste, obligations and sanctions imposed on the contracting parties, and also how the costs of the packaging waste management would be covered.

The description of the contents of the ANCI-CONAI Framework Agreement is provided in point 5.1.1.2.

4.4 Collection of packaging waste

4.4.1 Separate collection and transport of packaging waste

As previously pointed in point 3.5, separate collection is obligatory for several categories of municipal waste, including packaging, plastic products other than packaging, and as of 2022 also for compostable plastic packaging. It is worth reminding that municipal waste encompasses waste generated by households, but also similar types of waste generated by public, administrative and certain commercial activities.

The *responsibility to organise the separate collection of municipal waste falls on municipalities or delegated third parties*, while financial obligations for the most part pertain to producers, as they are required to bear at least 80% of related waste management activities.

In the case of packaging waste generated by households, Environmental Code stipulates that regional authorities and municipalities must organise the separate collection in the entire territory, and also make sure that producers have access to the collection infrastructure on the equal basis. Also, relevant information to end-users of packaging and to the consumers must be provided:

- About the available return, collection and recovery systems;
- Role of end users and consumers in the processes of reuse, recovery and recycling of packaging and packaging waste;
- Meaning of labels;
- Significant elements of regional plans and of management programs for packaging and packaging waste;
- Negative impact of plastic bags on the environment, and the measures to mitigate this impact;
- Use of biodegradable and compostable packaging;
- Impact of oxo-degradable packaging.

Corepla is the main consortium in charge for the management of separately collected post-consumer plastic packaging waste. Other relevant players are recently established *Biorepack*, which deals with biodegradable and compostable plastic packaging, and autonomous system *Coripet*, which takes care of PET bottles.

In the case of *plastic packaging that does not constitute municipal waste*, such as packaging generated by industrial or commercial waste (i.e. secondary and tertiary packaging), users are required to deliver it to specialized recovery or recycling companies. *Corepla* is not directly engaged in the collection of industrial waste, however, it provides a network of recycling operators, referred to as *platforms*, where companies can deliver their plastic packaging free of charge. Currently there are three platforms, for general secondary and tertiary plastic packaging (platform PIA), and platforms specialized in industrial plastic tanks and drums (PIFU) and expended PS packaging (PEPS) (Corepla, 2022a). Information on locations of the sites provided on websites of both *Corepla* and *CONAI*. According to (CONAI, 2022c), there is a total of around 500 sites where secondary and tertiary packaging can be delivered, out of which 46 accept plastics.

4.4.2 Deposit-return system for beverage packaging

The 2021 amendments to the Environmental Decree allow for the introduction of deposit-return systems. It is stipulated that deposit-return systems may be established for the beverage packaging made of plastics, glass and metal. As in the case of other autonomous management systems, producers may decide to establish these systems individually or collectively. In any case, these systems are required to be non-profit entities that operate as separate legal entities from their members.

The main benefit from the establishment of return systems is to increase the proportion of reusable packaging. Legislation therefore imposes the requirement that such systems need to specify annual qualitative and quantitative targets, including the minimum percentage of reusable packaging placed on the market.

Apart from management systems guidelines describe within point 4.3.2.1, additional requirements imposed on these systems include the obligation to provide information on the amount of deposit for each type of packaging, and on the procedures for paying back the deposit to consumers; to organise awareness campaigns for consumers; and also to disclose information on any incentives granted to retailers who participate in their system.

However, in practice, no return system has been established yet. One of the obstacles, according to the *Circular Economy Network* (2022), is the lack of secondary legislation that would regulate operational aspects of deposit-return systems. They warn that this would not be an easy task, as there would be overlapping with some of the existing legislation.

Other prerequisites are also missing. According to *Ronchi et al.* (2020), introduction of a deposit-return system for PET bottles would require substantial investment costs (purchase of vending machines, establishment of the IT system etc.), estimated at nearly EUR 700 million[13]. There would also be important decisions to be made beforehand – for instance, whether the system would be centralized, with one operator, or decentralized; who would be the legal owner of vending machines, and who would be the owner of collected bottles; whether a new legal entity (operator of the system) would be established, or existing consortia managing PET bottles would be restructured and/or liquidated, etc.

[13] Estimate of the investment costs of the introduction of the deposit-return system for PET bottles assumes that 29 thousand vending machines need to be installed (EUR 640 million), that a sufficient number of bring back centres must be established (EUR 10 million), and that a reliable IT system for verifying returned bottles must be put in place (nearly EUR 40 million). In addition, there would be costs incurred on a yearly basis, such as handling costs (registration of retailers, the flow of the deposit etc), estimated at around EUR 240 million annually, and transport costs, estimated at around EUR 123 million annually. Source: *Ronchi et al.* (2020).

4.5 Targets and achieved recycling rates for packaging waste

4.5.1 Re-use and recycling targets

Recycling targets for packaging are determined for total packaging, as well as for different packaging materials:

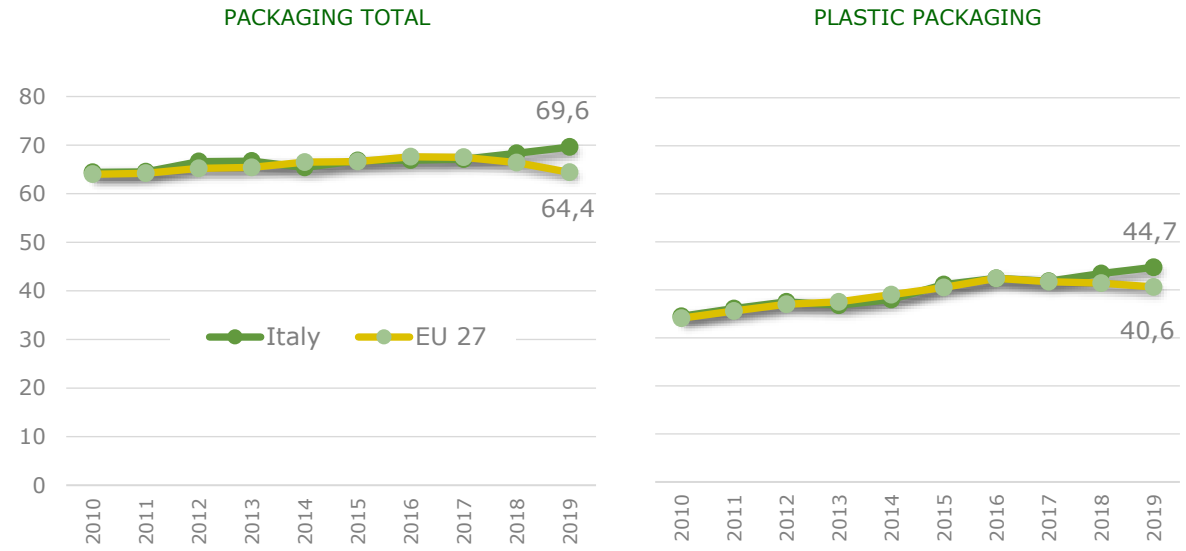
- For total packaging:
  - Recycling target to be achieved by the end of 2025 is at least 65% by weight of total packaging,
  - Recycling target to be achieved by the end of 2030 is set at 70%;
- For plastic packaging:
  - Recycling target to be achieved by the end of 2025 stands at 50%,
  - Recycling target to be achieved by the end of 2030 is 55%;
- Reused packaging can also be taken into account to achieve the recycling targets. In this case so-called *adjusted targets* are used, which are calculated by subtracting the share of reused packaging[14] from the above-mentioned recycling rates[15].

4.5.2 Achieved recycling rates

Based on latest available data provided by *Eurostat* (2022), Italy achieved following results:

Graph 2 **Recycling rates for packaging waste**

In %



Data source: Eurostat online database (dataset ENV_WASPACR)

[14] The method for the calculation of adjusted targets is to subtract the average share of reused packaging in total packaging placed on the market over the previous three years, up to the maximum of 5%, from the recycling targets specified for 2025 and 2030 – the same procedure applies for total packaging targets and material-specific targets. For more details refer to Environmental Code, Annex E, paragraph 1.

[15] When it comes to the reuse, *Rigamonti, Biganzoli, & Grosso* (2019) conducted an analysis of the types of packaging that are reused, and found that reused plastic packaging in Italy mostly refers to industrial and commercial use (secondary and tertiary packaging), and less commonly to consumer packaging (i.e. primary packaging). They found that the types of plastic packaging that are reused in Italy include such products as intermediate bulk containers, bottle carriers, drums, pallets, collapsible crates and mini bins for fruits and vegetables, detergent containers, and durable bags.

- Recycling rate for total packaging in 2019 was nearly 70% (presented in the left panel of *Graph 2*). It should be noted that in the meantime new methodology for the calculation of achieved recycling rates has been introduced, so that, although it may seem that Italy has already surpassed the 2025 target of 65%, these data are actually not comparable, since the 2025 target would have to be measured according to the new methodology;
- Recycling rate for plastic packaging in 2019 was 44.7% (right panel of *Graph 2*).

Just as an illustration, *CONAI* (2022c) data on reused packaging show a steady growth (with the exception of 2020 because of the pandemic), so that in 2021 8% of total packaging placed on the market was reused. *Ronchi et al.* (2020) provide an estimate for the recycling rate of PET bottles. Namely, they estimate than in 2018 separate collection of PET beverage bottles was 55,2%, while the recycling rate 45,6%. According to them, the best performer in terms of separate collection and recycling rate are soft drinks.

In respect to the recycling rate of plastic packaging, Italy has been around the EU average over the previous decade. Moreover, in the last couple of years it managed to slightly surpass the EU average.

However, it is important noting that, although on average Italian performance is satisfactory, *there are major regional differences*, and some areas are substantially lagging behind. Latest European Commission's *Environmental Implementation Review for Italy*, released in September 2022 (European Commission, 2022a), warrants that the centre and the south of the country are still laggers, and that proper waste management is still not put in place everywhere. For instance, they point that, despite all the measures, there are still 29 irregular landfills for which Italy is still paying fines, and 75% of these landfills are located in the South. A report prepared by *Dalberg Advisors* (2019) shows that in Sicily and some other southern regions only a third of all municipal waste is separately collected (e.g. in Palermo in Sicily recycling rate of municipal waste was only 17%); large cities (including Naples and Rome) also have separate collection rates that are worse than the national average.

Explanation of factors behind differences in separate collection rates among municipalities is offered by *Agovino, Cerciello, & Musella* (2019). Based on the analysis covering 90% of Italian municipalities, they find that the quality of local institutions is the main explanatory factor for separate waste collection; other relevant factors include morphology of the territory, consumption of cultural goods and the income level of population[16]. This is supported by the findings of a recent paper by *Romano et al.* (2022), which indicates that the main explanatory factor of regional differences in separate collection rates is the political factor; in other words, they find that political failures are the main source of inefficiency in separate waste collection in underperforming regions.

4.6 Incineration and landfilling of plastic packaging waste

According to *Pettinao et al.* (2021), around 45% of plastic packaging is incinerated. Most of it is known under the name *plasmix*, a name used for non-recyclable separately collected plastic packaging, while the reminder refers to unsorted plastic packaging, which is contained in mixed municipal waste.

[16] Authors' explanation of the mentioned factors is the following: less effective waste management is associated with municipalities with second-rate institutions and mountainous municipalities; while better performance in separate waste collection is associated with higher cultural consumption (assumed to indicate pro-environmental stance) and with higher per capita income.

4.7 Overview of provisions applying to single-use plastic products

At this point it would be worthwhile providing a short overview of the rules that apply to single-use plastic products. This is relevant, because some of these products represent plastic packaging; and even those that are not packaging, may be collected or treated jointly with plastic packaging waste.

Relevant legislative act is (Legislative Decree 196/2021), which transposes the EU's SUP Directive (EU 2019/904). It represents a *lex specialis* in relation to the Environmental Code or other related acts, since in the case of a possible conflict, provisions of the Legislative Decree 196/2021 prevail.

Single-use plastic products, for the purpose of this legislation, are defined as products that are entirely or partly made of plastics (except for products made of unmodified natural polymers) and which are not intended for multiple uses. Different measures are put in place for these products.

Reduction in consumption is envisaged for beverage cups (including their caps and lids) and food containers containing food which is intended for immediate consumption without further preparation (such as cooking or heating), and where the food is typically consumed from the container. It is specified that the reduction is to be achieved by 2026, but no targets have been established so far. The reduction is envisaged to be accomplished by the means of establishing program agreements and contracts among authorities at different levels and relevant public and private entities, related to the following:

- Preparation and implementation of sectoral plans for the reduction in the consumption of these products,
- Promotion and development of technologies that prevent and reduce the generation of waste of these products and optimize their collection and recovery,
- Incentives for the producers of these products to switch to the production of alternatives or reusable products,
- Promotion of reusable or durable alternatives (such as serving beverages on tap, or use of durable or reusable packaging for the immediate consumption of food),
- Information and awareness-raising campaigns related to use of reusable alternatives,
- Support and promotion of economic models that provide the delivery, collection and cleaning of reusable products,
- Monitoring data related to these products, *inter alia* for the purpose of establishing quantitative reduction targets,
- Other activities are also envisaged, such as collection of data for the purpose of Life Cycle Assessments, elaboration of relevant standards, and the development of technologies for the collection and recycling of the mentioned single-use plastic products.

Placing on the market is prohibited for the following plastic products: cotton buds, cutlery, plates, straws and coffee stirrers, balloon sticks, food and beverage containers made of expended polystyrene, and products made of oxo-degradable plastic. Exemptions may apply under circumstances specified by legislation, e.g. in the case of products made of biodegradable and compostable plastics, and provided that there are no reusable alternatives; for products that are managed within controlled circuits (e.g. in healthcare facilities); or if the products are used in large gatherings of people. Legislative Decree also clarifies that products that had already been placed on the market can be sold until they are exhausted.

Product requirements apply for beverage containers of up to 3 litres and PET beverage bottles. The requirement imposed for the former is that plastic caps and lids must be attached to them, while in the case of latter obligatory recycled PET content is prescribed[17].

[17] From 2025 PET bottles will have to contain at least 25% of recycled plastics, and from 2030 this would increase to 30%.

For beverage containers of up to 3 litres obligatory *separate collection* is prescribed, as well as the separate collection targets – 77% by 2025, and 90% by 2029.

Marking requirements pertain to certain plastic products, including beverage cups. In that regard, these products must contain labels, in order to inform consumers about the appropriate waste management options, and about the plastic content and its negative impact on the environment.

Extended producer responsibility is to be established, at latest by 31 December 2024, for the following products:

- Food containers (such as boxes) containing food which is intended for immediate consumption without further preparation (such as cooking or heating), and where the food is typically consumed from the container,
- Packets and wrappers made of flexible plastics, containing food intended for immediate consumption without further preparation,
- Beverage containers with a capacity of up to 3 litres, including their caps and lids,
- Beverage cups, including their covers and lids, and
- Lightweight plastic carrier bags.

Producers are obliged to meet general EPR requirements, and to cover the costs specified by the Environmental Code (refer to point 3.4.3 for details). However, additional financial obligations are imposed on them with this Legislative Decree, such as to cover the costs of the cleaning of the litter, to cover the costs of the collection of products that end up in the system for the collection of municipal waste, and also to cover related treatment costs.

Finally, *awareness-raising measures* should be put in place. For that purpose Ministry of ecological transition is required to adopt a strategy to combat plastic pollution, while the Ministry of Education is envisaged to adopt and implement a plan for the educational activities related to single-use plastic products.

4.8 Transboundary shipment of plastic packaging waste

Transboundary shipment of waste is regulated by the EU Regulation 1013/2006 on shipment of waste. Environmental Code contains additional provisions, that regulate the shipment of waste with Vatican and San Marino, the obligation of operators to be registered at the national register of environmental managers, and the financial guarantees and charges that are to be paid by operators.

Rules that apply to the shipments of plastic packaging waste are summarized below (European Commission, 2021a):

- *Non-hazardous plastic waste*:
  - Within the EEA non-hazardous plastic waste can be shipped for recovery, while shipments for the purpose of disposal are subject to prior notification. The same rules apply to the shipments with Switzerland.
  - In the case of other OECD countries, the provisions related to the free shipments for recovery are applied; however, for the purpose of disposal only imports may be possible (subject to prior notification), while the exports are prohibited.
  - Finally, in the case of non-OECD countries imports are allowed for the purpose of recovery, while imports for disposal are subject to notification. As regards exports, exports for the purpose of recovery are allowed only to the countries that are on the relevant list, compiled by the OECD, while exports for the purpose of disposal are prohibited.
- When it comes to *hazardous plastic waste and plastic waste that is hard to recycle*, their shipments have been subject to limitations as of 1 January 2021. The purpose of these limitations is to make EU member states accountable for the unrecyclable waste they generate, instead of transferring it to less developed countries which often apply

unsustainable treatment practices. For that reason, the exports of hazardous plastic waste to the countries outside of the EEA has been completely banned; while the imports of this type of waste, as well as exports and imports of the plastic waste that is hard to recycle, has been subject to prior notification.

According to data reported in accordance with the EU Regulation 1013/2006 on shipment of waste (https://ec.europa.eu/eurostat/web/waste/data), Italy has not conducted any transboundary shipments of plastic packaging waste. Still, plastic packaging may have been included in the shipments of mixed packaging waste and mixed municipal waste. When these types of waste are observed, one can note that Italy has imported these two categories of waste from San Marino, mostly for incineration, and to a lesser extent for recycling purposes. On several instances Italy has also exported mixed municipal waste, mostly to Austria where it was incinerated.

4.9 Remaining challenges related to the plastic packaging waste

A number of recent reports and articles draws attention to remaining issues, which could provide basis for future policy changes.

One of the main problems in the area of waste management are *territorial imbalances*. They refer to the uneven territorial distribution of treatment plants, but sometimes even to the availability of proper separate collection services (Circular Economy Network, 2021). *Ministry of ecological transition* (2021) has acknowledged that it would be necessary to address infrastructure shortages in some areas and construct treatment plants; however, this would not be an easy task, since, according to the *European Commission* (2019), financial gaps in the area of waste management are substantial. Another proposed measure, that would be cheaper to achieve, is to simplify complex and long-lasting administrative procedures related to the construction of treatment plants and obtaining licences for certain waste management operations (as suggested by *Circular Economy Network* (2021) and *Pettinao et al.* (2021)).

Illegal trafficking and landfilling of waste are still present. Italy has been paying fines since 2014, because it has not resolved the issue of illegal landfilling. Despite all the measures that have been undertaken, *European Commission* (2022b) is of the opinion that Italy has failed to comply with all of the obligations, and warrants that it may again refer the case to the Court of Justice of the EU.

When it comes to plastic packaging waste, one of the issues is *leakage of plastics into mixed municipal waste*. According to available data, plastics is the most common material in the multi-material collection (representing 40% of multi-material collection in 2018) (Ronchi, Leoni, Pettinao, & Albani, 2020), and, out of the total plastic waste generated, 13% (around 0,45 million tons) remains uncollected (Dalberg Advisors, 2019). Some of the solutions would be to improve separate collection of plastic packaging, and also to do more to promote waste prevention. As a case for waste prevention, think-tank *ECCO* (2022) estimates that, out of the total 2,5 million tons of plastics used for packaging in 2020, as much as 0,7 million tons could have been saved by eliminating excessive packaging. Government is aware of these issues, and *Ministry of ecological transition* (2021b) acknowledges that it would be necessary to increase the separate collection in the entire territory, and also to review the current division of responsibilities among the national level, regions, provinces, optimal territorial areas and municipalities. One of the recently introduced measures that could increase separate collection, is removal of the limit of recycled content that bottles in contact with food can contain (under the condition that the recycled material originates from the plastics that was used for food packaging) (ECCO, 2022).

Another problem, related to the previous one, is the *leakage of plastic packaging waste into the environment*. EU and national authorities have undertaken various measures in this regard (most notably, bans and limitations introduced by the SUP Directive); however

these measures are yet to be fully implemented and to bear results. Particularly problematic is marine pollution caused by plastic packaging waste. A report by *Dalberg Advisors* (2019) provides a comprehensive overview of this problem. According to them, marine plastic pollution in Italy is for the most part caused by coastal activities (in particular poor waste management in coastal municipalities, and also tourism activities[18]); a small portion of marine pollution is transported by rivers, and one part is litter from abroad washed onto the Italian coast. It is reported that Italy is particularly susceptible to marine pollution, due to its long coastline and the central position in the Mediterranean: it is estimated that on average 5,3 kg of plastic waste is washed per kilometre of the Italian coastline on a daily basis[19]. According to the survey cited in the same report, coastal plastic litter is mostly comprised of plastic fragments (17%), and also plastic lids (8%), cotton buds (8%), PS pieces (8%), plastic bottles and food containers (6%) and plastic cups, straws and cutlery (4%).

Marine plastic pollution causes disruptions and additional costs to the economy, in particular to fisheries, marine transport, and port facilities. For that reason, Italy has been the first country in the EU to transpose the EU Directive 2019/883 regulating the delivery and acceptance of waste from ships in port facilities, and also to introduce provisions according to which accidently caught waste in fishing nets can be delivered to port facilities free of charge[20]. However, these pieces of legislation have been recently introduced, and their provisions are yet to be fully implemented.

Finally, it should be mentioned that there are opinions that a potential confrontation may occur with the European Commission, related to the *implementation of the SUP Directive*. Namely, experts of *Covington & Burling* (2022) find several instances of divergence between the EU's SUP Directive (EU 2019/904) and the Italian implementing law (Legislative Decree 196/2021), which could potentially be challenged by the European Commission. Divergences refer to the following: definition of plastics[21]; delay in the introduction of a ban on certain SUP products[22]; and exemption of certain biodegradable and compostable plastic materials from the ban[23].

[18] Leakage of plastics into the environment is further aggravated in summer months, when tourist-related activities increase waste generation by around 30%. Source: (Dalberg Advisors, 2019).

[19] Regions most affected by marine pollution are southern regions and Adriatic coast; for instance, it is estimated that on average around 12 kg of plastic waste washes per kilometre of the Venetian coastline each day. Source: (Dalberg Advisors, 2019).

[20] For more details refer to the Legislative Decree 197/2021, and to the so-called "Salva Mare" Law 60/2022.

[21] Namely, Italian legislative decree exempts from the definition of plastic products (and from the SUP Directive requirements) plastic coatings weighing less than 10% of the weight of the product; according to *Covington & Burling* (2022), SUP Directive does not provide such exemptions, it actually stipulates that any material (such as paper or cardboard) that contains plastic coating is considered to be plastic product or product partly made of plastics.

[22] Italian legislative decree allows that the products placed on the market before the entry into force of the ban, can remain in the market until they are exhausted.

[23] Namely, Italian legislative decree prescribes that SUP products that contain at least 40% of bioplastics (60% as of 2024) may be exempted from SUP restrictions under certain conditions, such as the lack of available reusable alternatives, or if available alternatives do not provide comparable level of food safety, or if the product is used for particular types of food or beverages. Source: (Covington & Burling, 2022).

5 Functioning of EPR schemes for post-consumer plastic packaging in Italy

5.1 Main operators

5.1.1 National Packaging Consortium CONAI

EPR for packaging waste in Italy is applied through *CONAI*, which stands for the National Packaging Consortium (It. *Consorzio nazionale imballaggi*). It was established in 1997, with legislative Decree 22/97 (so-called Ronchi Decree). *CONAI* represents a producer organisation with compulsory membership for all users of packaging, and for all producers of packaging who do not operate, individually or collectively, their own collection or return systems. Only small producers and users, with annual turnover below EUR 500 thousand, are not obliged to join the consortium; however, they can apply for membership on a voluntary basis. *CONAI* is one of the largest EPR systems in Europe, and in 2022 more than 750 thousand companies participate in it (CONAI, 2022a).

CONAI is in fact an umbrella organisation, within which producer organisations (referred to as *consortia*) are established for different types of packaging material. Members who join *CONAI* may be also required to join one or more material consortia. Material consortium in charge of plastic packaging is *Corepla*, and the one that deals with bioplastics is *Biorepack*[24].

CONAI conducts various roles ((Environmental Code, 2006a), (CONAI, 2022c)):

- Elaborates, updates and reports on the general program for the prevention and management of packaging and packaging waste;
- Signs framework agreements with ANCI, and provides guidance on the contents of agreements between material consortia and individual municipalities or delegated third parties;
- Promotes and coordinates the separate collection of packaging waste;
- Determines and imposes the *CONAI* environmental contribution to its members, thus ensuring compliance with the "polluter pays" principle;
- Allocates to producers and users compensations for charges for the recycling and recovery of packaging delivered to the separate collection service, proportionally to the volume of packaging placed on the market (net of the reused packaging); on an ancillary basis, it also allocates compensations related to the costs of the management of secondary and tertiary packaging;
- Participates in the determination of optimal territorial areas (ATOs);
- Ensures links and cooperation among consortia established for each of the packaging materials, other collection systems, public authorities, and other economic operators;
- Organizes various information, awareness-raising and training campaigns, e.g., on the implementation of the general programme, on the impact of plastic bags, environmental education etc;
- Acquires data related to the flow of packaging materials within the national territory, and reports on these data to public authorities. In particular, *CONAI* is required to report on the recycling and recovery of packaging and on the use of plastic bags to the National Waste Cadastre;
- Takes care that the recycling targets for packaging waste are achieved;
- Promotes the market for secondary raw materials;

[24] Producer organisations for other types of packaging are *Ricrea* for steel, *Cial* for aluminium, *Comieco* for paper and cardboard, *Rilegno* for wood and *Coreve* for glass. Source: (CONAI, 2022a)

- Conducts other activities, e.g., studies and research activities, training and green jobs (trainings of journalists, jobs for new graduates, webinars for civil servants) etc.

Some of these activities are in more detail elaborated below.

5.1.1.1 Financing

The scheme run by *CONAI* applies the self-financing system (Watkins, et al., 2017).

The most important source of revenues is the *CONAI environmental contribution* (referred to as CAC – It. *Contributo Ambientale CONAI*). The primary use of the *CONAI* environmental contribution is to compensate municipalities for the costs of separate collection of primary packaging. For that purpose, *CONAI* distributes collected funds to material-specific consortia, which than transfer required amounts to individual municipalities. Environmental Code envisages that *CONAI* environmental contribution can also be used, on an ancillary basis, to fund the costs of collection and treatment of secondary and tertiary packaging. Finally, a small portion of the contribution can be used to finance operating costs of the *CONAI* and the material consortia.

The *CONAI* environmental contribution is paid by members[25], and is determined depending on the weight and the type of packaging placed on market, and as of 2018 also on the recyclability of packaging. In that regard, *CONAI* was one of the first EPR schemes in Europe to introduce the eco-modulation of the contribution, aimed at encouraging the recyclability of packaging, by assigning lower contributions to the types of packaging that are easier to recycle[26]. When it comes to plastic packaging, several bends are applied (amounts valid as of 1 July 2022) (CONAI, 2022a):

- Level A1 – includes plastic packaging waste, excluding flexible PE, mostly industrial and commercial, with effective and consolidated separate collection and recycling chain: the contribution is set at EUR 60 per ton;
- Level A2 – flexible PE packaging waste, mostly industrial and commercial, but also from separate collection of municipal waste, with effective and consolidated sorting and recycling chain: EUR 150 per ton;
- Level B1 – plastic packaging waste, mostly from households, with effective and consolidated sorting and recycling chain: EUR 20 per ton;
- Level B2 – other sortable or recyclable plastic packaging waste: EUR 410 per ton;
- Level C – plastic packaging waste that is not sortable and recyclable with current technologies, or packaging with experimental sorting or recycling: EUR 560 per ton;
- Bioplastics – EUR 29 per ton.

Amounts of contributions are subject to revision. In order to adjust them to market developments, they have been changed several times since eco-modulation was introduced in 2018. The latest change applies as of 1 July 2022, when most of the amounts applicable to plastic packaging have decreased, thanks to positive collection trends and a substantial increase in revenues from the sale of collected material. The sharpest reduction was applied to Level B1 plastic packaging (i.e. separately collected plastic packaging waste from households), from EUR 149 to EUR 20 per ton. As opposed to that, there were no changes in the amount of contribution that applies to Level A2 packaging (industrial and commercial flexible PE packaging, and also from separate collection of municipal waste)[27].

[25] Environmental contribution is not paid by all members; broadly speaking, it is paid mostly by entities that place packaging on the market. For details refer to (CONAI, 2022b).

[26] According to *CONAI* (2022c), factors that are considered when determining fees for different bends are durability, repairability, sortability, reusability and recyclability of the packaging, presence of hazardous materials, costs incurred by *CONAI* members, proceeds from the sale of secondary material in the market, and general economic aspects.

[27] The changes in the *CONAI* environmental contributions per tonne of plastic packaging that apply as of 1 July 2022 are as follows: Level A1 – reduction from EUR 104 to EUR 60; Level A2 – no change; Level B1 – reduction

Other revenues of *CONAI* include participation fee, which is paid by new members, and proceeds from other activities, if available.

5.1.1.2 ANCI-CONAI Framework Agreement

One of the legal obligations of *CONAI* is to sign framework agreement with a relevant public administration body. Such agreement needs to specify methods for the collection of packaging waste, obligations of contracting parties, and also how local bodies would be compensated for the increased costs of waste management activities, caused by separate collection of packaging waste.

In order to meet these obligations, *CONAI* signs 5-year agreements with the National Association of Italian Municipalities (It. *Associazione Nazionale Comuni Italiani – ANCI*). First such agreement was signed in 1999, and the current one covers the period 2020-2024.

The ANCI-CONAI Framework agreement (2020a) sets out general obligations and commitments of contracting parties, and provides basis for the establishment of operational agreements (referred to as conventions) between municipalities and material consortia within *CONAI*. The Agreement provides an extensive elaboration of goals, obligations and mutual commitments (e.g., reference to national and EU legislation, reporting obligations, provisions related to the quality of collected packaging waste, sharing of information etc.).

With respect to municipalities, they are legally required to organise separate collection of different fractions of waste; however, they are free to choose whether they would deliver separately collected packaging waste to the system run by *CONAI*, or to other (autonomous) collection systems, or directly to recyclers. If they chose to cooperate with material consortia of *CONAI*, they must sign, directly or through a delegated third party, operational agreements (referred to as *conventions*) with each consortium they chose to work with. This way, municipalities commit to delivering all collected packaging waste of specified type to that consortium. *CONAI*, on its side, guarantees that material consortia would accept delivered waste, and that municipalities or delegated third parties would be compensated for the incurred costs of the separate collection of delivered waste. In 2019 99,15% of the total number of municipalities in Italy (and 100% of municipalities with more than 20 thousand inhabitants), had signed agreements with at least one of the *CONAI* material consortia (ANCI; CONAI, 2020b).

ANCI-CONAI Framework Agreement contains detailed provisions and guidance related to the contents of conventions to be signed between municipalities and material consortia. Technical aspects are guided by Technical Annexes of the Framework Agreement, such as the minimum qualitative requirements for collected waste, criteria for deciding about the designated sorting centres that accept delivered waste, procedures for verifying the quality of the material etc. Technical annexes are prepared separately for each of the six packaging materials. In the case of plastic packaging waste, parties to the convention are the municipality and *Corepla*. By signing the convention, municipality commits to delivering collected plastic packaging waste to the sorting centres designated by *Corepla*[28]. There are four plastic waste flows specified by the Technical Annex on plastics, and different rules and different amounts of fees apply to them (CONAI, 2022a):

- Flow A – single-material flow collected from municipal waste: in 2022 the fee is set at EUR 317,62 per ton,
- Flow B - single-material flow collected from municipal waste with the content of non-household waste over 20%: EUR 83,85 per ton,

from EUR 149 to EUR 20; Level B2 – reduction from EUR 520 to EUR 410; Level C – reduction from EUR 642 to EUR 560; and for bioplastics – no change. Lack of change of contribution for Level A2 plastic packaging has been justified by higher costs of *Corepla*, because of the increase in the presence of A2 packaging in municipal waste. Source: (CONAI, 2022a).

[28] However, not all types of plastic packaging may be conferred to *Corepla* - for instance, *Corepla* would not accept plastic waste pertaining to *Coripet* or other autonomous systems.

- Flow C – single-material flow from municipal waste relating to containers for liquids: EUR 413,01 per ton, and
- Flow D - multi-material stream collected from municipal waste: EUR 309,86 per ton.

Framework Agreement envisages that both *ANCI* and *CONAI* commit to carrying out various activities in order to promote and encourage separate collection of packaging waste. Planned activities include the following (ANCI-CONAI Framework Agreement, 2020a):

- Development and operation of the ANCI-CONAI database on separate waste collection, to be funded by *CONAI* with EUR 650 thousand annually.
- Promoting and supporting new models for the separate collection of packaging waste, especially in the areas that leg behind. *CONAI* commits to allocating up to EUR 3 million annually for these activities.
- Organising required trainings for municipal administration, particularly on the issues of waste management, explaining the contents of the Framework Agreement, dissemination of best practices etc.; *CONAI* dedicates up to EUR 200 thousand annually for these activities.
- Supporting local communication campaigns on separate collection of waste; *CONAI* dedicates EUR 1,5 million for these campaigns.
- Other planned joint activities of *ANCI* and *CONAI* also include the mapping and sharing of best practices, developing the tools and indicators for defining costs borne by producers and users (related to the transposition of the EU's Waste Framework Directive) etc.

5.1.1.3 Prevention activities

Each year *CONAI* is required to prepare "General program for the prevention and management of packaging and packaging waste". The program specifies recycling and recovery targets to be achieved in the 5 years' time, separately for each type of packaging material, and also a plan of measures to achieve the targets and to meet other objectives (e.g., to decrease waste generation, to increase the share of recyclable packaging, and to improve the durability of packaging). According to *CONAI* (2022a), two types of waste prevention measures are applied. The first type are structural measures, that aim to encourage the use of packaging solutions that are easier to reuse and to recycle, such as modulations of

Box 1
"THINKING ABOUT THE FUTURE" ("PENSARE FUTURO") PROJECT
The aim of the project is to promote prevention activities and eco-design among *CONAI* members. This is done by sharing relevant information, providing training, and also by developing different tools in order to help their members embrace more sustainable packaging solutions. Here are examples of some of such activities and tools.
EcoD Tool (www.ecotoolconai.org) is the online tool that provides comparisons of alternative packaging solutions, in terms of their environmental impact. After logging in to the dedicated website, members first fill in data related to alternative solutions they wish to compare (type of material, weight, size, type of packaging), and then they obtain assessments of CO2 reduction, global warming potential and water footprint for each of the specified packaging alternatives, based on a simplified LCA analysis.
E-Pack is a knowledge sharing service on eco-design and design for recycling. There are two channels for distribution of information and knowledge, first are publications, produced in collaboration with the Italian Packaging Institute, and the other is a dedicated email service epack@conai.org, *via* which members can request information and explanations related to eco-design. Just as an illustration, e-mail queries grew from around 100 per year in the period 2014-2017, to as much as 6 200 in 2021, driven by the scheduled introduction of new environmental labelling (which has been postponed until 2023).
Eco-design call. In 2013 *CONAI* introduced a reward for eco-design. Each year a call is opened for companies to submit eco-design innovations. All submitted cases that meet prescribed criteria earn financial incentives. In 2021, out of the total of 326 cases, 109 companies were rewarded, and prize of EUR 500 thousand was split among them based on the sustainability evaluations of their products.
Online service related to mandatory **environmental labelling of packaging** has been developed. A website https://www.etichetta-conai.com/ contains various resources including guidance, explanations, best practices etc., and an online tool to provide members with information what to include in their labels.

Source: https://www.conai.org/prevenzione-eco-design/pensare-futuro/ and *CONAI* (2022c)

the *CONAI* environmental contribution. The other measure is awareness raising initiatives, undertaken in order to promote sustainable solutions for packaging. An example of such initiatives is "Pensare Futuro" ("Thinking about the future") project (*Box 1*).

5.1.1.4 Results

In 2021, out of the total 14,4 million tons of packaging placed on the market, estimated 10,5 million tons was sent to recycling – the share of *CONAI* members was 50%, while the rest mostly referred to independent market operators. In regard to plastic packaging, out of the total 2,3 million tons that were placed on the market, 1,3 million tons was sent for recycling, and the share of *CONAI* members in this was 60% (57% Corepla and 3% Biorepack). (CONAI, 2022c)

When it comes to the cooperation with municipalities, in 2021 *CONAI* system served 7 583 municipalities. A total of 5,4 million tons of packaging were delivered by municipalities, out of which 1,5 million tons referred to plastic packaging waste. Total fees paid to compensate costs of municipalities amounted to EUR 727 million. Also, EUR 1,1 million was spent on supporting local projects. (CONAI, 2022c)

As regards financial results, in 2021 revenues were EUR 1,686 billion (1,168 *CONAI* environmental contribution, 475 million sales of materials, and the remainder were other revenues), and expenses were EUR 1,304 billion (57% costs of separate collection, 34% recycling and recovery operations, 6% management of material consortia, and 3% management of *CONAI*). (CONAI, 2022c)

5.1.2 Corepla

Corepla is the National Consortium for the Collection and Recycling of Plastic Packaging (It. *Consorzio Nazionale per la Raccolta, il Riciclaggio e il Recupero degli Imballaggi in Plastica*). It was formed in 1997, with the Legislative Decree 22/1997, and is now part of the *CONAI* system.

Companies that may participate in *Corepla* are divided in 4 categories (CONAI, 2022b):

- Category A (referred to as *producers*) encompasses producers and importers of raw polymers for the production of plastic packaging,
- Category B (referred to as *transformers*) refers to producers or importers of empty plastic packaging[29],
- Category C (referred to as *self-producers*) includes users who produce plastic packaging for their own products and importers of packaged goods, and
- Category D (referred to as *recyclers and recoverers*) covers companies that recycle or recover plastic packaging.

Membership in *Corepla* is obligatory for entities that belong to categories A or B, and voluntary for entities from categories C and D. In 2021 there was a total of 2 502 companies participating in *Corepla* (Corepla, 2022a).

The main task of *Corepla* is to help its members meet their producer obligations related to plastic packaging. In doing so, one of the main activities is cooperation with municipalities. As described in previous point, *Corepla* signs conventions with municipalities who are interested to deliver separately collected plastic packaging waste to sorting centres operating within *Corepla*. These conventions are guided by the ANCI-CONAI Framework Agreement. In 2021 *Corepla* had 914 active conventions covering 7 583 municipalities (96% of all Italian municipalities), with the population of more than 58 million (Corepla, 2022b).

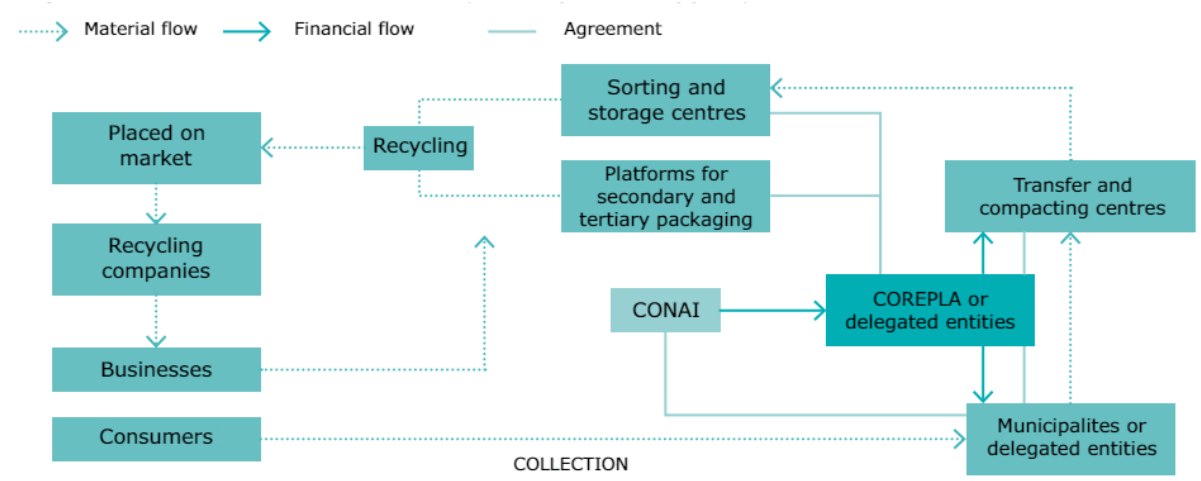
In order to ensure the recycling and recovery of plastic packaging, *Corepla* also cooperates with treatment plants:

[29] More precisely, Category B encompasses producers and importers of empty packaging made entirely or mainly of plastic, or of semi-finished products used in the production of plastic packaging.

- *Corepla* signs contractual agreements with plants that carry out sorting of plastics by different types of polymers. These companies act as *selection and sorting centres* (CSS, It. *Centri di selezione*) on behalf of *Corepla*, and municipalities or designated third parties are usually required to deliver collected plastic packaging to them. It is important noting that sorting is carried out on behalf of *Corepla*, which means that sorted material remains to be the property of *Corepla*, and the plant is paid for the work done (Corepla, 2022a). Based on data from the *Corepla* web site, it has agreements with 33 sorting centres across the country.
- *Corepla* also cooperates with plants that do the pre-sorting and cleaning of the plastic waste. They act as district centres, to which separately collected municipal waste can be delivered instead to sorting centres, if that it is stipulated by the agreement with the municipality. However, *Corepla* does not have direct contractual relations with district centres, so that municipalities and entities operating within *Corepla* may enter into such arrangements with them (Corepla, 2022a).

Scheme of the plastic packaging management chain is presented in *Diagram 2*.

Diagram 2 **Plastic packaging management chain in Italy**



Source: translated from Pettinao, Leoni, Cancelli, Navach, & Cesaretti (2021)

There are two main sources of financing for *Corepla*. One are proceeds from the *CONAI* environmental contribution on plastic packaging, and the other are revenues from the sale of sorted plastic waste to recyclers or recoverers.

According to data provided by *Corepla* (2022b), that refer to quantities pertaining both to *Corepla* and to autonomous systems, the total volume of plastic packaging placed on market in 2021 was 1862 kt, representing a y-o-y decrease of 2,7%. In the total packaging placed on the Italian market, division between flexible and rigid packaging has been fairly stable over the years, with around 57% referring to rigid, and the remaining 43% to flexible packaging. Dominant material was PE (43%), followed by PET (24%) and PP (20%) – therefore, PE and PET make up more than two thirds of total plastic packaging placed on Italian market. The share of bioplastics is only 3,5%, but it has steadily increased over the years. Collected waste is mostly generated by households, and comparable administrative, public and commercial activities, since 63% of the total volume refers to municipal plastic packaging waste. When it comes to the function of packaging, figures are comparable to the previous ones, as 69% of the total volume refers to primary packaging, tertiary packaging makes up 24%, while secondary packaging (mostly plastic wraps) constitutes less than 7%.

As regards financial results of *Corepla*, in 2021 their total revenues were EUR 925,6 million – out of this, 740,8 million came from the *CONAI* environmental contribution, 140,0 million

from sales of materials, and 14,0 million from other sources. Both major sources of revenues increased in relation to the previous year[30]. (Corepla, 2022b)

Total costs of the system are also substantial: in 2021 they amounted to EUR 732,8 million – the largest portions were spent on the separate collection (375,0 million), sorting (172,7 million) and energy recovery (71,7 million), while other notable expenses refer to the operating costs of the consortium (37,0 million), recycling costs (34,2 million) and landfilling (25,5 million). (Corepla, 2022b).

5.1.3 Biorepack

Biorepack is the consortium that manages biodegradable and compostable plastic packaging (more precisely, the packaging that is certified according to standard EN 13432), and sends it to the recycling of organic waste. It was established in 2018, being the first producer organisation in Europe in charge of the organic recycling of bioplastics. As of the end of 2020 it has become part of the *CONAI* system (CONAI, 2022c). It has gained in prominence with the introduction of the mandatory recycling of biowaste as of 2022, that also applies to biodegradable and compostable plastic packaging.

Membership in *Biorepack* is obligatory for the following entities (CONAI, 2022b): i) producers and importers of biodegradable and compostable biopolymers, ii) producers and processors of biodegradable and compostable plastic packaging and related semi-finished products, and iii) importers of empty biodegradable and compostable plastic packaging and related semi-finished products. Producers and importers of biopolymers are referred to as "producers" and latter two groups are referred to as "processors".

There are also entities for which membership in *Biorepack* is voluntary. These include (CONAI, 2022b): i) retailers, distributors, fillers and users of the before mentioned products, ii) importers of goods packaged in biodegradable and compostable plastics, iii) entities that provide their customers with such packaging, and iv) recyclers who treat biodegradable and compostable plastic packaging together with the organic fraction of the municipal waste.

Main source of revenues are the proceeds from the *CONAI* environmental contribution. *Biorepack* activities are in early stages, and it is envisaged that in the early years substantial costs would relate to the support to municipalities that wish to carry out the separate collection of bioplastics (e.g. costs of the equipment), the training of waste management operators, extensive communication activities, and also financing of innovative projects for the recycling of bioplastics. (Biorepack, 2022b)

As of 2022, there are 202 companies participating in *Biorepack*, including 4 producers of biopolymers, 185 producers and importers of empty packaging made of bioplastics, 11 users of packaging made of bioplastics, and 2 recyclers of bioplastics (Biorepack, 2022a).

Biorepack has established its own targets, and these are to achieve the recycling rate of 50% for packaging made of bioplastic by 2025, and the recycling rate of 55% by 2030 (Biorepack, 2022a).

5.1.4 PolieCo – National Consortium for the Recycling of PE Waste

In Italy, EPR responsibilities apply to all categories of PE products. In the case of PE products other than packaging, *PolieCo* – which is short for National Consortium for the Recycling of PE Waste (It. *Consorzio nazionale per il riciclaggio di rifiuti di beni in polietilene*) – is established.

[30] According to *Corepla*, proceeds from the environmental contribution increased in 2021 mostly thanks to increased contributions for B1 and C bends, while revenues from the sales of material increased due to higher prices. For instance, average selling prices of PET increased from EUR 271 in 2020 to EUR 537 in 2021, while the price of HDPE in the same period increased from EUR 218 to 599. Source: *Corepla* (2022b).

Environmental Code stipulates that producers, importers, users, distributors, recyclers and recoverers of PE products are required to participate in *PolieCo* or, alternatively, establish their own autonomous collection or return systems for PE products that would cover the whole national territory. It is envisaged that producers and importers of raw materials for the production of PE products, and companies that collect, store and transport PE products, can also participate in the consortium.

It is often difficult to distinguish which goods are considered as PE-based goods, and thus are the responsibility of *PolieCo*, and which ones are considered as packaging, and are the responsibility of *Corepla*. *PolieCo* provides a list of criteria, and also a non-exhaustive list of examples[31]. For instance, PE-based products include all household and office items that are not packaging – such as children's toys, baby bottles, kitchen utensils, buckets and other cleaning items, pens, multi-purpose bags, envelopes for documents or for courier shipments etc. Other than this, PE-based products are also storage items in industry and agriculture (boxes, transport containers, shelves etc.); furniture (benches, chairs, tables); tubes, insulating and other products used in civil engineering; items used for the collection of waste (street bins, street baskets, dumpsters etc.); boats, fishing nets and other products for nautical use; diverse sport products (nets, kayaks and canoes, ski shoes etc.); protection equipment (helmets, suits, gloves); suitcases, screws and many other types of products. (PolieCo, 2022)

5.1.5 Autonomous systems

5.1.5.1 Coripet

Coripet is an autonomous system for the collection of PET bottles. It was established in 2018 by several beverage producers, producers of PET bottles and recyclers. In 2021 there were 57 members, with 43% of the total market share for PET beverage containers. This number includes 47 beverage companies (including some of the major soft drink producers in Italy, such as Sanpellegrinno, Parmalat, Coca Cola HBC, Conserve Italia, Ferrarelle), 4 recyclers and 6 converters (Coripet, 2022b).

The intention of *Coripet* is to establish a closed supply chain, so-called "bottle-to-bottle" chain, where PET bottles placed on the market by consortium members are collected and recycled, and the recycled PET is then used for the production of new bottles (Coripet, 2022a).

There are two main sources of revenue – contributions paid by members and proceeds from the auction sale of collected PET bottles. The contribution, which is called *Coripet Recycling Contribution*, is determined based on the quantities and types of PET beverage containers placed on the market. The amount of contribution applicable as of 1 August 2022 is as follows (Coripet, 2022a):

- EUR 160 per ton for: water dispensers; preforms, bottles, and other containers; attached caps; and for raw materials;
- EUR 465 per ton for: caps and lids (other than those attached to the bottle); and for bottle labels.

Contributions are for the most part used to compensate municipalities for the incurred costs of the separate collection of PET bottles, and also to cover the costs of the system of eco-compactors. *Coripet* has signed an agreement with ANCI in May 2020 for a one-year period, which was renewed in March 2021. The agreement regulates the separate collection of PET beverage bottles and installation of compactors of PET bottles. Based on this agreement, *Coripet* has signed local conventions with individual municipalities; at the end of 2021 676 local conventions were signed, covering around 6 600 municipalities, i.e. 86% of the total number of municipalities. As for the eco-compactors, which represent another

[31] For a list of criteria and examples, refer to the *PolieCo* website: http://catalogo.polieco.it/

way of collecting PET bottles, in 2021 there were 442 of them throughout the country. (Coripet, 2022b)

Regarding the achieved financial results in 2021, revenues amounted to around EUR 114 million; it is interesting that proceeds from the sale of PET bottles on the secondary market (EUR 69 million) were higher than collected contributions (EUR 41 million), due to exceptionally high market prices. Expenses were around EUR 110 million, out of which nearly EUR 52 million were fees paid to municipalities, and EUR 30 million was paid to sorting and recycling operators (Coripet, 2022b).

As any other autonomous system, they are required to prepare prevention and management plans and management reports every year, and send them to *CONAI*.

5.1.5.2 PARI, CONIP and Ecopolietilene

PARI and *CONIP* are two systems that manage secondary and tertiary packaging; therefore they are not intended to collect packaging from final consumers. They both provide close-loop processes – in the case of *PARI* for one producer *Aliplast*, and in the case of *CONIP* for all companies that participate in it. *Ecopolietilene*, on the other hand, does not deal with packaging, but with PE products in general, so, in a certain sense, it represents a competitor to *PolieCo*.

PARI

PARI (short for Plan for the Autonomous Management of Packaging Waste – It. *Piano per la gestione Autonoma dei Rifiuti di Imballaggio*) is an autonomous system for the collection of flexible PE packaging waste, established by the major plastic production and recycling company *Aliplast SpA*. It started operating in 2008, firstly on an experimental basis.

The aim of the system is to collect and recover flexible LDPE packaging produced by *Aliplast*. For the most part it is tertiary packaging, such as protective industrial and transport packaging, and to a lesser extent secondary packaging. Main collection channels are direct contacts with waste producers, or through independent waste operators who intercept *PARI* packaging during the collection or sorting processes. Although *PARI* packaging is not primary packaging, and thus is not intended to be used by households, there are instances that *PARI* packaging ends up in municipal waste. For this reason, another possible channel for collection is to single out *PARI* packaging from the separately collected municipal waste (Aliplast, 2022).

CONIP

CONIP (short for the National Consortium for Plastic Packaging – It. *Consorzio Nazionale Imballaggi in Plastica*) is an autonomous system for the collection and recycling of plastic boxes, crates and pallets.

Its members constitute a network of producers, recyclers and waste collectors to which industrial, commercial and agricultural companies can deliver crates and pallets free of charge. (CONIP, 2022)

Ecopolietilene

Ecopolietilene consortium was established in 2017, and was recognized in 2020. It is an autonomous system for the waste management of PE products other than packaging. In 2021 they had 117 members, including manufacturers of PE goods, retail chains and importers. (Sistema Ecolight, 2022)

5.2 Separate collection

In 2021 a total of 1476 kt of plastic waste was separately collected in Italy, representing a y-o-y increase of 3%. Out of this, 1335 kt (90,5%) refers to plastic packaging, while the

reminder encompasses fractions collected together with plastic packaging. (Corepla, 2022b)

Corepla

For the most part, separate collection of plastic packaging is carried out by public service. As described previously, *Corepla* enters into a contractual agreement with an interested municipality (or a delegated third party), based on which separately collected plastic packaging waste is delivered to a sorting centre specified by *Corepla*, and the municipality is in turn compensated for the costs of separate collection. It is important therefore that each agreement (called "convention") specifies exactly to which selection and sorting centre or district centre waste must be delivered. The full list of such locations is available on the *Corepla* and *CONAI* websites. Based on this information, there are currently 33 sorting centres that have agreements with *Corepla* to carry out the sorting operations, and there is also a large number of district centres to which separately collected plastic packaging can be brought beforehand, for the purpose of pre-sorting and cleaning (Corepla, 2022a).

When it comes to plastic packaging that is not collected by public service, which for the most part is secondary and tertiary plastic packaging generated by commercial and industrial activities, *Corepla* has a subsidiary role in its collection. This means that, if the market services for the collection are not sufficiently available, *Corepla* helps companies take care of generated plastic packaging waste. *Corepla* is not directly engaged in these activities, but provides networks of recyclers and other treatment operators, to whom companies can deliver their plastic packaging waste free of charge (Corepla, 2022a). These networks are referred to as *platforms*, and there are currently three such platforms: PIA (It. *Piattaforme Commercio Industria*) for plastic packaging waste from industrial and commercial activities, PIFU for industrial drums and tanks made of rigid plastic and PEPS for packaging made of expended PS. Based on information from the *Corepla management report* (Corepla, 2022b), in 2021 there were 46 operators participating in PIA, 33 in PIFU and 30 in PEPS.

Corepla is currently experimenting with other methods for the collection of plastic packaging, in particular for the collection of PET bottles. They are piloting the use of automated machines, so-called *eco-compactors*, including the ones purchased by municipalities from funds of the *Mangiaplatstica* project of the Ministry of Ecological Transition. Consumers can return PET bottles for beverages to eco-compactors; and by identifying with the health insurance card, they are awarded the so-called eco-points, which can be used as coupons or discounts in participating stores, or can be kept to receive prizes. Bottles and caps must be inserted into the automated machine separately, and the machine than compacts the bottles. Collected bottles are delivered to *Corepla*, which than takes care of their further treatment. Currently, there are

Image 1 **Eco compactor for plastic bottles that belongs to Corepla system**

Source: https://smart.comune.genova.it/

over 100 installed eco-compactors, and locations of eco-compactors are available on the *Corepla* website (https://www.corepla.it/ecocompattatori-0).

Corepla is also engaged in a project aimed at collecting PET beverage bottles from business premises. *RiVending* is a joint project of *Corepla*, Italian association for automatic distribution *Confida* and National union of plastic transformers *Unioplast*. It works in a simple way: cardboard containers are placed next to vending machines for beverages, with holes of different sizes suitable for the disposal of PS coffee stirrers and cups and PET bottles (*Image* 2). The plastic waste, that falls into a bag, is collected by waste collection operator and delivered to *Corepla*, which takes care for the further treatment. (Corepla, 2022a)

Image 2 **Container for the collection of PET bottles within the *RiVending* project**

Source: https://rivending.eu/

Corepla is aware that, for the successful separate collection, it is of crucial importance that consumers obtain proper instructions. Here is the advice available at the *Corepla* website (Corepla, 2022a):

- Packaging should be empty;
- Whenever possible, packaging should be crashed or squeezed. For instance, it is recommended that bottles are flattened on the longer side, and that the cap remains on the bottle;
- Biodegradable and compostable packaging must not be sorted with plastics, but in line with the instructions provided on the label;
- Likewise, plastic items that are not packaging must not be sorted with plastics, but either put into mixed waste, or disposed of according to rules that apply in the municipality in question. To help consumers distinguish which plastic products are considered as packaging, and which are not, *Corepla* provides illustrative examples shown in *Image 3*.

Image 3 **Illustrative examples of plastic packaging products that are collected through separate collection**

Source: (Corepla, 2022a)

With respect to the achieved results, separate collection of plastic waste managed through the *Corepla* network reached 1305 kt in 2021, out of which

1180 kt referred to plastic packaging (the remainder being plastic products that are not packaging). (Corepla, 2022b)

Biorepack

Separate collection is conducted through public service, and conventions with interested municipalities are signed, just like in the case of *Corepla*.

Biorepack provides relevant instructions to the consumers, in particular on the mandatory separate collection of organic waste as of 1 January 2022, and also on the proper things to do (Biorepack, 2022a):

- All organic waste (including biodegradable and compostable packaging) must be placed in bags which are biodegradable and compostable according to the EN 13432 standard. Further, it is advised not to fill such bags too much, and also that containers where these bags are placed must provide for proper ventilation (e.g. they must be perforated);
- Biodegradable and compostable plastic packaging certified according to the EN 13432 standard must also be placed into such bags;
- Non-packaging plastic items that satisfy the above criterion, such as cutlery, plates and other single-use plastic items, can also be jointly collected.

There appears to be an issue with the false labelling of biodegradable and compostable packaging, and *Biorepack* tries to address this problem. One of the activities is to provide information on the properties and labelling of packaging that meets required criteria. Another activity is a platform on their website, where consumers and legal entities can report suspected cases of violations. (Biorepack, 2022a)

Coripet

In the case of *Coripet*, majority of PET bottles are also collected through cooperation with municipalities. PET bottles that belong to *Coripet* are for the most part sorted from separately collected packaging waste, and then delivered to platforms managed by *Coripet*.

Experimental collection using eco-compactors has also started in some municipalities. Eco compactors may be purchased and managed by *Coripet*, or they can belong to municipalities. In 2021 there was a total of 442 eco-compactors in use by the *Coripet* system (Coripet, 2022b). Consumers can benefit by receiving discounts that they can use in partner stores. To manage their discounts, and also to find the nearest eco compactor, they need to install a *Coreopla* mobile application. The map of eco compactors is also available at the *Coripet* website.

In 2021 135 kt of PET bottles was separately collected through the *Coripet* system. (Coripet, 2022b)

Image 4 **Eco compactor for PET bottles that belongs to the *Coripet* system**

Source: https://www.comune.inzago.mi.it/

5.3 Recycling

Corepla

After the process of cleaning and sorting, collected packaging waste is differentiated into as much as 30 different streams. They include different PET products (transparent, blue and other PET bottles, trays etc.), HDPE and LDPE products (various flexible packaging made of HDPE and packaging films of different colours and thickness), as well as various PP, PS, and mixed polyolefins packaging waste. Waste organized into such product groups is placed on the market and sold to recyclers. There are two ways of selling the products, by auctions, and by direct orders and contracts. To be eligible, recycling companies must have a plant that is authorized as a recycling facility, that is placed in the EU, and that holds required ISO 9001 and 14001 certifications. *Corepla* sends collected plastic waste to 88 recycling plants, 74% of which are located in Italy. (Corepla, 2022a)

In 2021 684 kt of plastic packaging was sent for recycling by *Corepla*, representing an increase in relation to 2020, when 625 kt was recycled. Most of it relates to mixed packaging (222 kt), PET (160 kt) and films (142 kt). The volume of recycled PET has decreased, due to the increase in the share managed through the *Coripet* system. (Corepla, 2022b)

Attention should be drawn to the activities of *Corepla* related to chemical recycling. Namely, in cooperation with the chemical company *Versalis* and engineering company *S.R.S.*, which developed pyrolysis technology for the depolymerization of plasmix. As a result of the pilot application of this technology, nearly 1 kt of plasmix was subject to chemical recycling in 2021. It is also announced that *Versalis* would build the plant with the annual capacity to recycle 150 kt of plasmix. (Corepla, 2022b)

Biorepack

Main recycling products are compost and biogas (which is comprised of methane and carbon dioxide). Compost is obtained from aerobic treatment plants, biogas is the product of anaerobic treatment plants, and both of these can be produced in integrated plants. According to *Biorepack*, treatment of compostable packaging in Italy results in the production of 2 million tons of compost annually. This compost is used for the improvement of soil (in agriculture, horticulture, household use etc.). (Biorepack, 2022a)

Coripet

The *Coripet* system is established with the intention to create a closed supply chain, where collected bottles would be recycled, and the obtained rPET would be used for the production of bottles again. In 2021 135 kt of PET bottles were sent for recycling, which makes up a recycling rate of PET bottles of 64%. (Coripet, 2022b)

5.4 Energy recovery and disposal

Types of packaging that are impossible, or very expensive, to recycle are sent to incineration plants with energy recovery. Such waste, that cannot be mechanically recycled, is often called *plasmix*, which is short for *PLAStic MIX waste*. The remainder, which cannot be used for energy recovery (e.g., due to low calorific value, contamination etc.) is incinerated without energy recovery, or disposed of in landfills.

According to *Pettinao et al.* (2021), around 45% of plastic packaging in Italy is incinerated. However, they state that incineration, both in cement factories and incineration plants with energy recovery, is usually expansive and operationally difficult, because of impurities.

Corepla

In the case of *Corepla*, packaging waste that cannot be recycled includes unrecyclable plastic packaging that is separately collected and also unsorted plastic packaging, which is

contained in mixed waste. In 2022 44 energy recoverers are using unrecyclable waste for energy recovery (Corepla, 2022a).

Plasmix often has lower calorific value, and for the most part is used as a secondary solid fuel in the production of cement. According to *Corepla* (2022b), in 2021 86% of plasmix was used as fuel in cement factories, both in Italy and in other EU Member States. The remainder can be used for energy recovery only in modern highly efficient plants, which are mostly located in the North. It is announced that in 2022 *Corepla* would experimentally commence auctioning part of the plasmix (15% of annual quantities) (Corepla, 2022a).

Ultimately, smaller amounts of plasmix are end up in landfills (around 143 thousand t in 2021) (2022b).

Coripet

According to available data, in 2021 19% of collected PET bottles within the *Coripet* systems were sent to energy recovery. (Coripet, 2022b) This is a substantially smaller share than in the case of *Corepla*. However, it must be borne in mind that *Coripet* is focused only on the collection of PET bottles, which is easier to recycle, while *Corepla* must collect all types of plastic packaging (including composites, and types of plastics that are less recyclable than PET).

6 Overview of policy instruments at the national level

In the following paragraphs a summary of various measures that have impact on the recycling of post-consumer food and beverage plastic packaging waste in Italy, is presented. These measures are classified into four broad categories, according to the classification applied in the EC's "Better Regulation Guidelines" and the accompanying toolbox (European Commission, 2021b):

- Legally binding rules. These are the so-called "hard" regulations, which are obligatory for the entities who are subject to them.
- "Soft" regulation. These instruments include diverse measures, which are more flexible than the binding instruments. For instance, they can include recommendations of authorities, voluntary agreements and practices, technical requirements etc.
- Economic instruments. Various measures that affect the costs and prices of goods and services are classified here, so in their nature they are market-based instruments. They encompass such measures as taxes, fees, penalties, subsidies, and also deposit-refund or producer responsibility schemes.
- Education and information. These measures aim to provide better information and better understanding of relevant issues by citizens, businesses, and other entities. They can include campaigns, trainings, disclosure requirements etc.

6.1 Binding legal rules

6.1.1 Bans on plastic products

According to the report produced by *Dalberg Advisors* (2019), Italy has been one of the front-runners in applying bans on the use of certain plastic products. Namely, already in 2011 Italy introduced ban on non-biodegradable carrier bags in 2011, and as of 2018 the ban was widened to encompass ultra-lightweight plastic bags used for foodstuff in markets[32]. Then, in 2019 it was the first country to introduce ban on non-biodegradable and

[32] Environmental Code generally forbids the placing of plastic bags on the market. Exceptions may apply only to:
i) biodegradable and compostable plastic bags,
ii) ultralightweight plastic bags with at least 60% of renewable raw material, and

non-compostable plastic cotton buds. And again, in 2020 it was one of the first to introduce ban on micro plastics in cosmetics (which are mostly used for rinse-off purposes). Local authorities have introduced even stricter bans in certain cases, so that, according to the same authors, the use of plastic bags, plates and cutlery is completely forbidden in the island of Capri, while the use of plastic bottles is forbidden in the area of Cinque Terre.

However, these bans have not always been effective. For instance, think tank *ECCO* (2022) reports that there exists a shadow market for non-complying plastic bags – it is estimated that in 2020 they comprised around 20% of total usage of shopping bags.

6.1.2 Bans related to the management of packaging waste

Environmental code forbids the disposal of recovered packaging at landfills.

It is also forbidden to put tertiary packaging into the municipal waste collection system. As for the secondary packaging, under certain circumstances it may be put into the municipal waste collection system, but only if it is separated.

6.1.3 Targets

Environmental Code sets out the following targets for the preparation for reuse and recycling of municipal waste, in accordance with EU legislation: 55% by weight by the end of 2025, 60% by the end of 2030 and 65% by the end of 2035. These represent the minimal rates to be reached, and regions are free to decide upon even higher recycling targets.

In the case of packaging waste, recycling targets are specified separately for total packaging and for different types of packaging materials:

- For total packaging, recycling targets are set at 65% by weight by the end of 2025, and 70& by the end of 2030;
- In the case of plastic packaging, recycling targets are 50% by the end of 2025, and 55% by the end of 2030;
- The share of reused packaging can be subtracted from the above-mentioned packaging recycling targets (up to the maximum of 5%), in which case we refer to the *adjusted targets* for the recycling of packaging waste.

6.1.4 Calculation methods for measuring recycling rates

Not only the level of targets, but also the method for their calculation, presents a measure aimed at increasing the separate collection. In other words, the weight of waste counted for the purpose of measuring recycling rate can vary depending on the point at which the waste is measured, or whether impurities are allowed.

The rules on the calculation of recycling targets are set at the EU level, and they were changed in 2018. The intention was to move the calculation point closer to the point at which the recycling effectively takes place. Member States were left a transitional period (until July 2021) to transpose these rules into their national legislation.

Italy has incorporated rules on the calculation of recycling rates into the Environmental Code. Calculation rules that are most relevant for municipal and packaging waste are the following:

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ii) reusable plastic bags, provided that they satisfy prescribed criteria: i) reusable bags used as transport packaging in shops that sell foodstuff must contain at least 30% of recycled material, and must have the thickness of walls of at least 200 microns if handles are outside, and 100 microns if handles are inside the bag; ii) reusable bags used as transport packaging in shops that sell products other than food must contain at least 10% of recycled material, and the minimal thickness of walls must be 100 microns if the handles are outside of the bag, i.e. 60 microns if the handles are inside.

In addition to these bans, further limitations are prescribed; namely, bags that satisfy above mentioned criteria must not be provided free of charge, and sales price of a bag must be stated in the receipt of the product.

- Recycled waste refers to the weight of waste that has undergone sorting and other preliminary operations, at the point where it enters the recycling operation. The possibility to measure recycled waste at the point where it leaves the sorting operation is also envisaged, provided that such waste is subsequently recycled, and any materials removed by further operations are subtracted;
- Waste that has achieved the end-of-waste status can also be counted for the purpose of measuring achieved recycling targets, provided that such waste is reprocessed, and not destined for incineration, backfilling or landfilling;
- Biodegradable waste entering aerobic or anaerobic treatment can be counted as recycled provided that conditions specified by the Environmental Code are met (e.g. the output of the treatment is compost or other product that can be used as material or substance);
- It is possible to include waste sent for recovery or recycling to other EU Member State; waste shipped to a non-EU country may be counted only if it can be proved that the treatment complies with the EU requirements;
- When it comes to the packaging, quantity of packaging waste produced is considered to be equivalent to the quantity of packaging placed on the market in the given year;
- In the case of municipal waste, waste prepared for the reuse refers to the weight of products and components that have been checked, cleaned, repaired, and thus prepared for reuse, without requiring further treatment.

6.2 Economic instruments

6.2.1 Landfill tax

Landfill tax is introduced by the law that regulates public finance rationalization measures (Law 549/1995). The tax is levied on solid waste that is disposed of in landfills or delivered to incineration plants without energy recovery. By charging disposal activities, the tax indirectly encourages the recovery of waste.

The tax is determined and administered by regional authorities, with minimum and maximum bends set by law[33]. Environmental Code determines that a part of the proceeds from the landfill tax is to be used to finance waste prevention measures and incentives for recycling and other recovery operations[34]. What is deemed as problematic is that tax rates vary substantially across regions, from EUR 5,2 in Campania to EUR 28,5 in Piedmont (Dalberg Advisors, 2019). EC (2022a) has therefore on several instances called for the harmonization of regional rates, and an increase in the overall level of landfill tax rates.

In addition to discouraging the disposal of waste in landfills, landfill tax is also used to stimulate separate collection of municipal waste. Namely, Environmental Code envisages 30-70% deductions from the landfill tax for municipalities that achieve higher recycling rates of municipal waste than the national target[35]. Conversely, for municipalities that are

[33] The prescribed bends depend on the type of the landfill. In the case of landfills for inert waste the landfill tax may be in the range of EUR 0.001-0.01 per kg of disposed waste, while in the case of landfills for hazardous and non-hazardous waste the tax may be in the range of EUR 0.00517-0.02582 per kg of disposed waste. When the waste is delivered to incineration plants without energy recovery, then 20% of the previously specified bends is applicable. Source: (Law 549/1995).

[34] (Law 549/1995) stipulates that the proceeds from the landfill tax pertain to regions, and can be used for the following purposes: i) one part is divided among the municipalities where the landfills and incineration plants without energy recovery are located, and can be used for various environmental purposes (e.g., for environmental protection measures, for integrated management of municipal waste etc.); ii) remainder is the revenue of special regional funds, that finance regional waste prevention measures, incentives and other measures to promote recycling and recovery, reclamation operations etc.

[35] Deductions from the landfill tax for municipalities that achieve higher recycling rates of municipal waste than the national average are presented in the table below.

underachievers a 20% surcharge to the landfill tax is applied[36]; the proceeds from this surcharge pertain to above-mentioned regional funds, and can be used to finance waste prevention and waste recovery measures[37].

6.2.2 Waste management charges

Households are required to pay a waste tax called TARI (It. *tassa sui rifiuti*), which is used to finance the activities of waste collection and waste disposal.

As a rule, TARI is calculated based on the number of members of a household and on the surface area of the dwelling. This means that household's costs for waste management services are fixed and are not related to the amount of generated waste. Consequently, this method does not provide incentives for consumers to change their behaviour. (Italian Ministry of Ecological Transition, 2021)

Some municipalities have introduced punctual "pay-as-you-throw" system, which is referred to as TARIP. In this case there is a fixed component, calculated based on the surface area and the size of the household, and a variable component, which is determined based on the volume and type of generated waste, and the frequency of emptying containers. *Messina & Tomasi* (2020) report that the setup of TARIP systems varies across municipalities, related to what is measured (volume or weight of waste), how it is measured (by the number of bags, or by weighing waste in trucks or collection centres), whether only mixed waste or also separately collected waste is counted, the use of technology (e.g., microchipped bags, containers equipped with transponders) etc. These authors also find that municipalities with a punctual tariff are more efficient that those that apply TARI, since they achieve higher separate collection rates, and their waste management costs are lower[38].

For instance, in the case of the waste management operator *COVAR 14*, that serves municipalities in the Piemonte Region, households who wish to participate in TARIP have their containers marked with a barcode and equipped with UHF RFID transponders. When the container is to be emptied, the consumer activates the transponder and the operator is notified. The system is operational as of 2022. Participation in TARIP is not obligatory, however, waste charges for households who stick to TARI have increased substantially. (COVAR 14, 2022)

It is worth noting that obligation to pay TARI may be reduced or exempted under certain conditions, e.g., in the case of dwellings and other premises for seasonal use, apartments

Exceeding the national target by:	Corresponding reduction in the landfill tax:
0.01-10 %	30 %
10 %	40 %
15 %	50 %
20 %	60 %
25 %	70 %

Source: (Environmental Code), Article 205.

[36] The surcharge does not apply to municipalities that have obtained derogation from the obligation to achieve targets, or which have a low level of per capita waste generation.

[37] More specifically, the landfill tax surcharge can be used to finance the following measures: waste reduction activities envisaged by regional waste plans; incentives for the purchase of products and recycled materials; co-financing of plants; and information campaigns to increase the knowledge of general public about the prevention and separate collection. Source: (Environmental Code), Article 205.

[38] According to *Messina & Tomasi* (2020), in 2018 only around 10% of Italian municipalities applied TARIP. The vast majority of them was located in the northern-eastern parts of the country, and often encompassed smaller municipalities. Although they do not observe any major differences in waste generation between TARIP and TARI municipalities, there are differences in the rate of separate collection (nearly 80% for TARIP municipalities as opposed to 60% in TARI municipalities), and in the average *per capita* waste management costs (130 EUR in TARIP vs. 150 EUR in TARI municipalities).

with one inhabitant, or apartments whose owners live abroad (Italian Ministry of Ecological Transition, 2021).

6.2.3 Tax on the consumption of single-use plastic products ("Plastic tax")

Italy is going to introduce a tax on single-use plastic products, referred to as MACSI (short for single-use plastic products - It. *manufatti in plastica con singolo impiego*). Its introduction, initially envisaged for 2020, has been postponed several times due to disruptions caused by the COVID-19 pandemic, and at this point it is scheduled to be introduced as of January 2023 (2022 Budget Law n. 234/2021).

The tax is set at EUR 0,45 per kg of single-use plastic products placed on the market. For this purpose, single-use plastic products are defined as those that are, completely or partly, composed of fossil-based plastics, that are used for the packaging of products, and that are not intended for repetitive use[39]. Exemptions refer to medical devices and single-use plastic products made from compostable plastics and from recycled plastics. The tax pertains to both domestically produced and imported products.

Proceeds from this tax are expected to be used to pay the recently introduced own source revenue at the EU level (which is also referred to as the "plastic tax", while it is actually charged on the non-treated plastic waste[40]).

6.2.4 Costs related to producer responsibility

As previously elaborated in point 3.4.3, in line with general extended producer responsibilities, producers of packaging are required to cover at least 80% of the related waste management costs. More precisely, these costs refer to the separate collection of packaging waste, transport of collected waste, reuse and recycling activities, as well as costs related to the provision of instructions and other relevant information to consumers and waste operators, and the costs of keeping records in line with legislative requirements.

6.2.5 Incentives

Various incentives have been put in place, that directly or indirectly influence the recycling of post-consumer plastic packaging waste. Legal basis is provided by the Environmental Code, which envisages that incentives can be introduced to encourage the production and purchase of products made from post-consumer plastic pacakging or from the recovery of waste.

Here are examples of some of the measures at the national level, including the existing ones, but also the ones that expired recently. Sources of information are the Catalogue of Environmental Subsidies (Italian Ministry of Ecological Transition, 2021), Report on Circular Economy in 2022 (Circular Economy Network, 2022), and the Invitalia website (Invitalia, 2022a).

Subsidies

- Purchase of eco-compactors for PET bottles. In 2021 Ministry of Ecological Transition launched a *Mangiaplastica* project, providing subsidies to municipalities for the purchase of eco-compactors for PET bottles. Funds are available for the purchase of one

[39] The tax also applies to plastic products that hold above mentioned single-use plastic products, and to semi finished plastics that is used to produce above mentioned single-use plastic products. Source: (2022 Budget Law n. 234/2021).

[40] European Council has introduced a new category of own source revenues of the EU budget as of 1 January 2021, which represents national contributions of Member States, based on the amount of non-recycled plastic packaging. The contribution is calculated by applying a rate of EUR 0.80 per kg of non-recycled plastic packaging waste in each of the Member States.

For more details on the newly introduced contribution refer to Council Decision 2020/2053 (on the system of own revenues of the EU) and Council Regulation 2021/770 (containing details on the calculation, procedure, reductions and other relevant aspects related to this new revenue).

eco-compactor for each 100 thousand citizens, amounting to EUR 15 thousand for medium-sized and EUR 30 thousand for large eco-compactors. Total budget for 2022 is EUR 5 million.

- Installation of systems for the return of beverage containers. A EUR 10,000 subsidy is provided for economic entities (producers, importers, distributors etc.) operating within Environmental Economic Zones (ZEA), who introduce the vacuum system for the return of beverage containers. They are also required to pay buyers who return packaging a rebate equal to 25% of the price of packaging, but are awarded a tax credit of the double amount of the granted rebates. The measure was introduced by the 2021 Budget Law, and is in place in both 2021 and 2022, or until the designated amount of EUR 5 million is exhausted.
- Stimulating bulk packaging. Ministry of Ecological Transition has provided incentives to stimulate bulk packaging. Namely, producers who introduced the services of refilling packaging containers with the product (usually detergents and personal hygiene products) are eligible for retroactive contributions of up to EUR 5 thousand, to cover the incurred costs. The incentives apply to producers who introduced such systems in 2020 and 2021.
- Investments in circular economy. In a September 2021 call of the Ministry of Ecological Transition, subsidies were available for investments in plants, among others, for the improvement and mechanisation of the systems for the separate collection of municipal waste, and for the construction of new and modernisation of existing plants for the treatment of separately collected municipal waste. The same call also provided funding to innovative flagship projects; those that were eligible included the construction of plants for mechanical and chemical recycling of plastics.

  Also, subsidized loans are available for SMEs in less developed regions – eligible activities include treatment and transformation of waste, reuse of materials, smart packaging, use of recovered materials in packaging, or systems for the sorting of light materials waste in order to increase their recovery and recycling.

Tax credits

- Rationalization of the use of plastic containers for water. A 50% tax credit is offered, related to the expenses of the purchase and installation of filters, cooling and related systems for tap water. The intention is to rationalize the use of water and plastic containers for water. The credit is available up to the amount of EUR 1,000 for physical persons and up to EUR 5,000 form business entities, for purchases in the period 2021-2023.
- Use of recycled materials. Tax credit of 25% was available by the Ministry of Ecological Transition for the purchase of components and products consisting of at least 75% of recycled waste. The measure was introduced by the 2019 Budget Law, and was abolished as of 30 June 2022.
- Use of sustainable packaging. A 36% tax credit for companies was in place in 2019 and 2020, to stimulate the use of sustainable packaging. The credit was available for the purchase of biodegradable or compostable packaging, or products made from materials obtained from the separate collection of plastic packaging, or from the separate collection of paper or aluminium. Max annual amount per one company was EUR 20,000.
- Technological upgrading. In 2020 a tax credit was available for the producers of single-use plastic products, to help them shift to the production of biodegradable and compostable products. The tax credit amounted to 10% of the incurred expenses of the technological transition towards biodegradable and compostable products. The maximum amount of the tax credit per beneficiary was EUR 20,000.

6.3 "Soft" regulation

6.3.1 Green procurement

Green procurement has become obligatory in Italy as of 2016, making Italy one of the leaders in the application of green procurement (European Commission, 2019). Now, it presents one of the main environmental instruments in Italy (Italian Ministry of the Environment, 2021).

Green procurement works in such a way that minimum environmental criteria are prescribed for specific product groups, and all public procurements of these products of services must obey these criteria. What is important is that this obligation applies to all procurements, disregarding the value or the type of contract (for instance, it applies also to direct purchases). (Italian Ministry of the Environment, 2021)

An example of a product group for which minimum environmental criteria support the use of recycled plastics is furniture. *Minimum Environmental Criteria for the Procurement of New Furniture* (Italian Ministry of Ecological Transition, 2022b), adopted in 2022, prescribe that, if the plastic content makes up at least 20% of the weight of procured furniture, then at least 30% of that plastic content must be either recycled plastic or bioplastic. Similar percentage of recycled plastic or bioplastic must also be contained in the plastic packaging used to pack furniture. In addition to these obligatory criteria, the use of recycled plastics is encouraged in other ways: for instance, bidders who offer furniture with textiles containing recycled plastics, are awarded bonus scores. There are also additional general sustainability criteria, such as that it is the obligation of the bidder to collect packaging upon the delivery of furniture, and make sure that it is reused or recycled.

6.3.2 Environmental labelling

As of 1 January 2023 packaging will have to contain environmental labels. The obligation pertains to producers, which will have to indicate information related to the proper handling of waste and its reusability and recyclability, as well as information on the substances contained in the packaging. The use of other types of labelling remains voluntary.

6.3.3 Self-monitoring

According to the Environmental Code, producers are required to put in place self-monitoring mechanisms related to the financial management and the collection and reporting of data. With respect to the financial management, self-monitoring is related to the overall financial performance, and in particular to the compliance with the requirement to cover at least 80% of the costs of separate collection and related waste management activities.

6.3.4 Eco certification

There are several nationwide eco certification schemes available in Italy, which are used by companies to communicate their environmentally friendly practices. All of them are voluntary. For instance, "Made Green in Italy" was introduced by the Ministry of the Environment in 2018, and is intended for companies to evaluate and communicate their environmental footprint (Unioncamere, 2019).

As regards plastic packaging, one can mention the "*Ecospiagge per Tutti*" (*Eco beaches for everyone*) certification scheme, which is described in *Box 2*.

Box 2
"ECOSPIAGGE PER TUTTI" CERTIFICATION

"EcoSpiagge pert Tutti" was established in 2019 by the NGOs *Legambiente* and *Village for All*. The eco certificate is awarded to beaches that adopt environmentally sustainable measures, and that guarantee adequate access and services to persons with disabilities, families with small children, seniors, and generally persons with special needs. When it comes to the waste, separate collection of waste must be available, the beach facilities should prefer the use of smaller packaging and the packaging that is durable, reusable or recyclable etc.

Source: (Legeambiente, 2022)

6.4 Information and education

Sometimes lack of knowledge or information is a key impediment for attaining certain goal. Information and education instruments can therefore be very important. They encompass a variety of measures, whose ultimate aim is to increase the knowledge and awareness of individuals, companies, associations, and other relevant stakeholders.

Information and publicity campaigns are often used in order to promote certain activity, or to inform the general public. According to available data, Ministry of Ecological Transition plans to spend EUR 30 million by 2026 on information and awareness-raising campaigns related to environment, including topics such as ecological transition, circular economy and sustainable development (Italian Ministry of Ecological Transition, 2022a). An example of one of the previous campaigns is provided in *Box 3*.

Box 3
"PLASTIC FREE" CAMPAIGN

In 2018 Ministry of the Environment launched a "Plastic Free" campaign, with the aim of promoting abolishment of single-use plastics. This was a lead-by-example campaign, during which different measures were undertaken in order to abolish the use of single-use plastic products from the Ministry's headquarters. For instance, water dispensers were abolished, plastic water bottles were replaced by aluminium water bottles, which were distributed to employees free-of-charge, plastic cups for hot beverages were replaced by paper ones, and plastic stirrers with wooden ones. The Ministry called for other public and private entities to commit to stop using single-use plastics as well, and to share their actions and experiences with the wider audience.

Source: (Italian Ministry of Ecological Transition, 2022c)

Educational and training curricula. Environmental Code envisages that some of the measures to apply waste hierarchy for packaging waste also include integration of topics such as waste prevention, separate collection, or avoiding littering, to educational and training curricula. For instance, Ministry of Education runs the *RiGenerazione Scuola* plan, with the aim to integrate various projects and activities in schools related to sustainable development. More on this is available in the dedicated website https://www.istruzione.it/ri-generazione-scuola/.

This plan includes two *Corepla* projects. Namely, *Corepla* is involved in educational activities, and has diverse activities for pupils of different ages, that includes both online contents (videos, online games), training courses, competitions etc. Two of *Corepla's* activites included in the *RiGenerazione Scuola* plan are campaigns "Recycle it" (It. *Riciclala*!) and "Plastic idea to clean the future" (It. *Idea Plastica per pulire il Futuro*)[41]. (Corepla, 2022a)

Disclosure requirements relate to the legally prescribed obligation of certain entities to make relevant information publicly available. This is in fact a mix of a legally binding rule and information instrument; however, it has been classified within this group of instruments, since its main objective is to provide relevant information to the general public. An example of the disclosure requirement relates to the obligation of the EPR system operator to provide a list of participating companies, as well as information on the calculation of contributions paid by members, and the procedures for the selection of waste management operators.

[41] https://www.corepla.it/scuola/campagne-scuola

B. ECONOMETRIC ANALYSIS OF RECYCLING RATES OF PLASTIC PACKAGING WASTE IN ITALY

1 Main findings

Several dozen time series with satisfactory economic properties were considered as explanatory variables, however only three of them were found to be significant. Therefore, macroeconomic determinants that have a statistically significant impact on the recycling rate of plastic packaging in Italy are generation of packaging waste, employment and investments in the waste sector. More specifically, generation of packaging waste is negatively correlated with the recycling rate, insofar as the 1% increase in the generation is expected to result in a 1,06% decrease in the plastic packaging recycling rate in the long run. Other two factors are positively correlated, so that a 1% increases in the employment and investment in the waste sector would result in respectively 2,05% and 0,28% increases in plastic packaging recycling rates.

2 Specification of the model

For determination of factors that affect the waste recycling rates of plastic packaging we used the autoregressive distributed lag *(ARDL) model.* It is acknowledged as one of the most flexible methods in the econometric analysis. Moreover, the fact that the ARDL method may tolerate different lags in different variables makes the method very attractive, versatile and flexible. ARDL models are linear time series models in which both the dependent and independent variables are related not only contemporaneously, but across lagged values as well.

In particular, if y_t is the dependent variable and $x_1,\ldots x_k$ are k explanatory variables, a general ARDL(p,$q_1,\ldots,q_k$) model is given by:

$$y_t = a_0 + a_1 t + \sum_{i=1}^{p} \psi_i y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{j,l_j} x_{j,t-l_j} + \epsilon_t$$

where ϵ_t are the usual innovations, a_0 is a constant term, and a_1,ψ_i and β_{j,l_j} are respectively the coefficients associated with a linear trend, lags of y_t, and lags of the k regressors $x_{j,t}$ for j=1,…k.

Although ARDL models have been used in econometrics for decades, they have gained popularity in recent years as a method of examining cointegrating relationships between variables through the work of *Pesaran and Shin* (1999), while its further development is due to *Pesaran, Shin and Smith* (2001).

For determination of factors that affect *waste recycling rates of plastic packaging WR_RATESPP* as dependent variable y_t, we used three independent variables $x_{j,t}$:

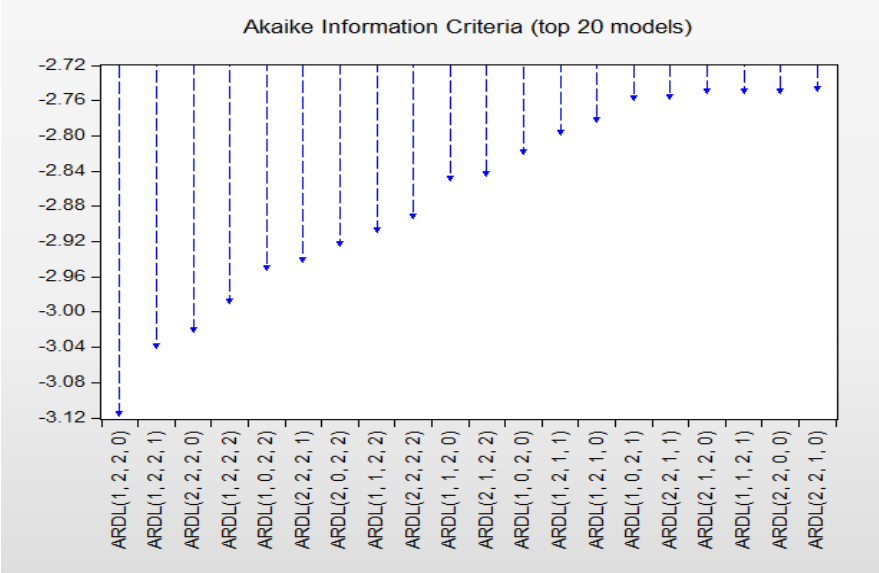
1. *WR_TP* – waste packaging generated in tonnes, as general indicator of all policies aimed at reducing the generation of packaging waste;
2. *INV* – investment in mil. EUR in activity Sewerage, waste management, remediation activities (NACE rev2 economic classification[42]) as indicator of investment for both, private and government sector;

[42] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-07-015

3. *EMPL* – number of employees according in sector Sewerage, waste management, remediation activities (NACE rev2 economic classification) as indicator of level of production capacities.[43]

3 Results

First, we checked stationarity of all independent time series, as well as for dependent variable with Augmented Dickey-Fuller test.[44] The results show that all variables are stationary at first difference $I(1)$ at 5% level.[45] Based on Akaike Information Criteria (AIC), 54 ARDL models are evaluated, with different lag structure. Below is presented results for top 20 models.



As the most robust model was chosen ARDL (1, 2, 2, 0) .

Dependent Variable: LOG(WR_RATESPP)
Method: ARDL
Sample (adjusted): 5 24
Included observations: 20 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): LOG(WR_TP) LOG(EMPL) LOG(INV)
Fixed regressors: C
Number of models evalulated: 54
Selected Model: ARDL(1, 2, 2, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG(WR_RATESPP (-1))	0.092403	0.193945	0.476442	0.6431
LOG(WR_TP)	-0.322701	0.383995	-0.840379	0.4186
LOG(WR_TP (-1))	0.038809	0.433602	0.089504	0.9303
LOG(WR_TP (-2))	-0.676063	0.306135	-2.208384	0.0494
LOG(EMPL)	0.236120	0.749306	0.315118	0.7586

[43] Source of data for both, dependent and independent variables is EUROSTAT database. Data are for period 1997-2018. https://ec.europa.eu/eurostat/data/database

[44] All econometric calculations were performed in EViews 10.

[45] Results of ADF test are presented in Annex 1 of the Part B.

LOG(EMPL(-1))	0.137288	0.833598	0.164694	0.8722
LOG(EMPL(-2))	1.484511	0.607305	2.444425	0.0326
LOG(INV)	0.250326	0.121380	2.062329	0.0636
C	7.425741	5.899324	1.258744	0.2342

R-squared	0.988503	Mean dependent var	3.395504
Adjusted R-squared	0.980141	S.D. dependent var	0.310892
S.E. of regression	0.043812	Akaike info criterion	-3.115660
Sum squared resid	0.021114	Schwarz criterion	-2.667581
Log likelihood	40.15660	Hannan-Quinn criter.	-3.028191
F-statistic	118.2163	Durbin-Watson stat	1.866090
Prob(F-statistic)	0.000000		

According *Pesaran, Shin and Smith* (2001) we performed the Bounds test equation in order to test long run relationship between variables:

ARDL Long Run Form and Bounds Test
Dependent Variable: DLOG(WR_RATESPP)
Selected Model: ARDL(1, 2, 2, 0)
Case 2: Restricted Constant and No Trend
Sample: 1 26
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.425741	5.899324	1.258744	0.2342
LOG(WR_RATESPP (-1))	-0.907597	0.193945	-4.679666	0.0007
LOG(WR_TP (-1))	-0.959956	0.417921	-2.296979	0.0423
LOG(EMPL(-1))	1.857920	0.533927	3.479729	0.0052
LOG(INV)	0.250326	0.121380	2.062329	0.0636
DLOG(WR_TP)	-0.322701	0.383995	-0.840379	0.4186
DLOG(WR_TP (-1))	0.676063	0.306135	2.208384	0.0494
DLOG(EMPL)	0.236120	0.749306	0.315118	0.7586
DLOG(EMPL(-1))	-1.484511	0.607305	-2.444425	0.0326

The Null Hypothesis (No): There is no long-run relationship.

The Alternative Hypothesis (N1): There is long-run relationship.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.599185	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	20		Finite Sample: n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Taking into account that F-statistics value (in absolute terms) are significantly above the critical values we rejected the Null Hypothesis (Ho) and accept alternative (H1), which means that there is long-run relationship among variables in specified model.

Finally, we derived long run coefficients and run Error Correction Regression (ECM).

Long run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(WR_TP)	-1.057690	0.471985	-2.240939	0.0466
LOG(EMPL)	2.047076	0.253516	8.074745	0.0000
LOG(INV)	0.275812	0.134313	2.053504	0.0646
C	8.181764	6.925999	1.181312	0.2624

CointEq(-1) = LOG(WR_RATESPP) - (-1.0577*
*LOG(WASTE_GENERATED_T_PACKAG) + 2.0471*LOG(EMPL) +
0.2758*LOG(INV) + 8.1818)

ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(WR_TP)	-0.322701	0.246093	-1.311298	0.2165
DLOG(WR_TP (-1))	0.676063	0.221937	3.046198	0.0111
DLOG(EMPL)	0.236120	0.417157	0.566022	0.5827
DLOG(EMPL(-1))	-1.484511	0.457606	-3.244079	0.0078
CointEq(-1)*	-0.907597	0.126088	-7.198099	0.0000

R-squared	0.848820	Mean dependent var	0.067742
Adjusted R-squared	0.808505	S.D. dependent var	0.085736
S.E. of regression	0.037518	Akaike info criterion	-3.515660
Sum squared resid	0.021114	Schwarz criterion	-3.266727
Log likelihood	40.15660	Hannan-Quinn criter.	-3.467066
Durbin-Watson stat	1.866090		

The interpretation of long run coefficients is as follow:

- 1% of increase in generating packaging waste decreases the recycling rate of plastic packaging for 1.06% in a long run;
- 1% of increase in employment in waste sector increases the recycling rate of plastic packaging for 2.05% in a long run;
- 1% of increase in investment in waste sector increases the recycling rate of plastic packaging for 0.28% in a long run;

The coefficient of the CointEq(-1) is negative and statistically significant, which is another evidence of cointegration among variables. The values -0.907597 means the system corrects its previous period at a speed of convergence of 90.08% percent per annum.

At the end, within the selected model we checked the residual diagnostic in order to avoid spurious regression. Residuals should be normally distributed, not serially correlated and not heteroscedastic. All of these requirements are fulfilled.[46] According to the CUSUM test the model is stable.[47]

[46] The results of tests are presented in Annex 2.

[47] The results of test are presented in Annex 3

4 Annexes

4.1 Stationarity checking

Variable 1

Null Hypothesis: D(WR_TP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.456212	0.0109
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

Variable 2

Null Hypothesis: D(EMPL) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.743995	0.0053
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

Variable 3

Null Hypothesis: D(INV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=5)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.262333	0.0144
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

Variable 4

Null Hypothesis: D(WR_RATESPP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.671748	0.0010
Test critical values:	1% level	-4.498307	
	5% level	-3.658446	
	10% level	-3.268973	

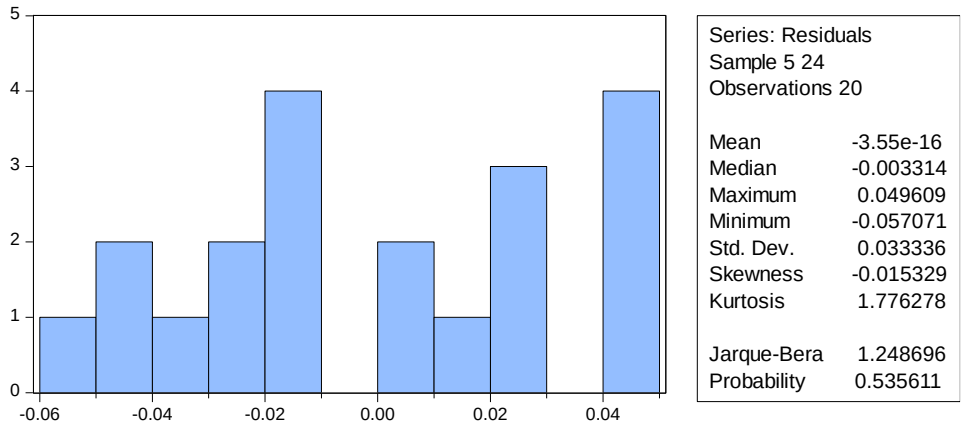
4.2 Residual diagnostics

- Normality test

  Null hypothesis: Residuals are normally distributed

  Alternative: Residuals are not normally distributed

Jarque-Bera test value is 1.2487 and corresponding p-value is above 0.05 which means that we cannot reject the Null hypothesis, we accept it. Conclusion is that residuals are normally distributed.



- Autocorrelation test

  Null hypothesis: Residuals are not serially correlated

  Alternative: Residuals are serially correlated

Breusch-Godfrey Serial Correlation LM test value is 1.91 and corresponding p-value is above 0.05, which means that we cannot reject the Null hypothesis, we accept it. Conclusion is that residuals are not serially correlated.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.475313	Prob. F(2,9)	0.6365
Obs*R-squared	1.910685	Prob. Chi-Square(2)	0.3847

- Heteroscedasticity test

  Null hypothesis: Residuals are not heteroskedastic

  Alternative: Residuals are heteroskedastic

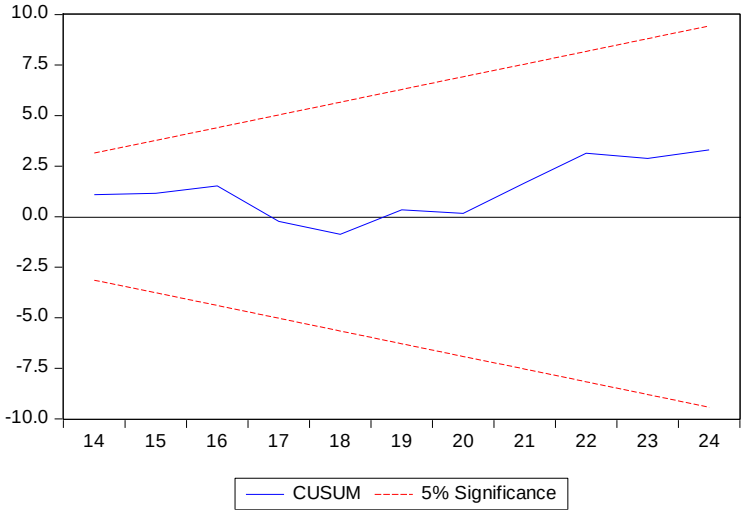
Breusch-Pagan-Godfrey test value is 8.48 and corresponding p-value is above 0.05, which means that we cannot reject the Null hypothesis, we accept it. Conclusion is that residuals are not heteroskedastic

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.012252	Prob. F(8,11)	0.4788
Obs*R-squared	8.480480	Prob. Chi-Square(8)	0.3880
Scaled explained SS	0.995711	Prob. Chi-Square(8)	0.9983

4.3 Stability test

CUSUM test indicates the absence of the instability of coefficients because the plot of CUSUM fall inside the critical bands of the 5% confidence interval.



C. UNDERSTANDING THE GENDER DIMENSION AND DISTRIBUTIONAL EFFECTS RELATED TO THE RECYCLING OF PLASTIC PACKAGING IN ITALY

1 Assessing gender dimension

1.1 Evidence on possible gender-related aspects of plastic packaging recycling policies in Italy

There is growing evidence that waste management activities in households are not gender neutral. Due to various reasons, such as different family roles, different decision-making powers in the society, economic (in)dependence, gendered jobs and educational choices etc., attitudes and behaviours of men and women often differ. Overview of relevant literature, focusing in particular on differences in attitudes and behaviours of men and women in developed countries, and also on different effects how waste management activities can influence their wellbeing, is provided in Deliverable D7.7 (point C.1.1.1). Here is a short overview of the most significant aspects:

- Purchasing decisions in households are dominantly made by women, which would imply that they are often in a position to choose between different types and properties of food and beverage packaging (e.g., plastics or other materials, recyclable or single-use plastics, transparent or coloured plastics etc.).
- Men and women have different tasks related to household waste management, and women are more involved in unpaid waste disposal work within the household.
- There also exist different perceptions on waste disposal: for instance, men and women may exhibit different preferences towards sorting and recycling, different perceptions on the frequency of waste disposal, or on the distances one needs to travel to dispose of waste.
- Even the amount of generated waste may differ, as some research suggests that women tend to make more household waste than men.
- In some countries women are more willing to pay for waste-related services than men.
- Women are more engaged in local communities, but have lower access to local decision-making institutions, so female preferences may be neglected when relevant decisions are made, e.g. on waste infrastructure.
- Women tend to have higher level of environmental awareness: they are often more willing to recycle, to purchase more sustainable products, or to pay attention to eco-labelling.
- Gender inequality is present in the labour market in all countries, which may also relate to the employment in recycling and other waste management activities. In this regard, women may have lower wages, and may be more exposed to discrimination and harassment at the workplace. Also, there often exists gendered division of jobs in the waste management activities, so that women tend to be more engaged in waste sorting and administrative activities, while men work with machinery.

Italy has been one of the European laggers in terms of gender equality. Global Gender Gap index puts Italy at the European bottom (with particularly low scores related to economic empowerment) (WEF, 2022), and the EU's Gender Equality Index shows that Italy is below the EU average (score of 63,8% in 2019, compared to EU average of 68%) (EIGE, 2021).

Statistical data or research findings on gendered differences related to the recycling and waste treatment in Italy are scarce; however, existing findings confirm some of the general tendencies described in the preceding paragraphs.

Household responsibilities. Italian women are overwhelmingly more engaged in cooking and other housework: according to 2016 data (Istat; Eurostat, 2020), these activities were conducted on a daily basis by 81% of Italian women, and by only 20% of Italian men.

Financial independence. Pay gap between women and men in Italy is present, but at the first sight it does not seem substantial: in 2019 average hourly earnings of women were by around 5% lower than in the case of men (Istat; Eurostat, 2020)[48]. However, given that only slightly more than a half of women is employed, and that they tend to be excessively more engaged in part-time and occasional work, it would be worthwhile comparing monthly or annual wages, and not only hourly; however, these data are not available. Older women are in a particularly disadvantageous position. A pension gap is substantial, and women aged 65 years or more on average receive 30% lower pensions than men of the same age[49]. Additionally, it is more difficult for women to meet all the requirements in order to get pensions, so that as much as 20% of women above statutory pensionable age does not receive pension; as a contrast, 100% of men above pensionable age do receive pensions[50].

Environmental awareness. According to OECD (2020), women in some OECD countries, including Italy, were found to consider environmental problems as more urgent than men.

Decision-making powers. Level of political empowerment of women in Italy, based on available indicators, is somewhere around the EU average. According to EIGE (2021), women made up 35% of MPs in Italy[51] (EU average was 31,5%) and 21% of members of regional councils (EU average was 29%); when it comes to the national government, 9 out of 24 ministers are currently held by women, which makes the share of 38%[52]. With the introduction of electoral quotas, participation of women in the national parliament has increased, thus putting them in the position to be able to initiate, discuss and decide on waste related policies and measures. Representation at the local level, where operational decisions about the waste management activities and investments are made, is substantially lower.

Regarding the economic decision-making, powers of women in Italy are unsatisfactory, as only 27% of managerial positions in the Italian economy in 2020 were held by women (in this regard, Italy is one of the bottom 4 EU Member States) (Istat; Eurostat, 2020). In order to improve female powers, quotas for the minimum representation of the underrepresented sex in corporate boards were introduced (set at 40% by legislation). Due to this, share of women in corporate boards reached 38% in 2021, which is one of the highest in the EU (EIGE, 2021).

1.2 Gender sensitive policies in the Italian recycling sector

1.2.1 Different position of women and men in the Italian labour market

Gender inequality in the Italian labour market is present and persistent. Labour market indicators for both sexes are lagging behind the EU average, and actually diverging from

[48] The EU average for the pay gap was 14%, and for the worst performing Member State (Estonia) it was as much as 22%. In that regard, Italy is among the three EU countries with the lowest pay gap.

[49] Source: Eurostat online database (dataset ILC_PNP13).

[50] Source: https://data.unwomen.org/country/italy.

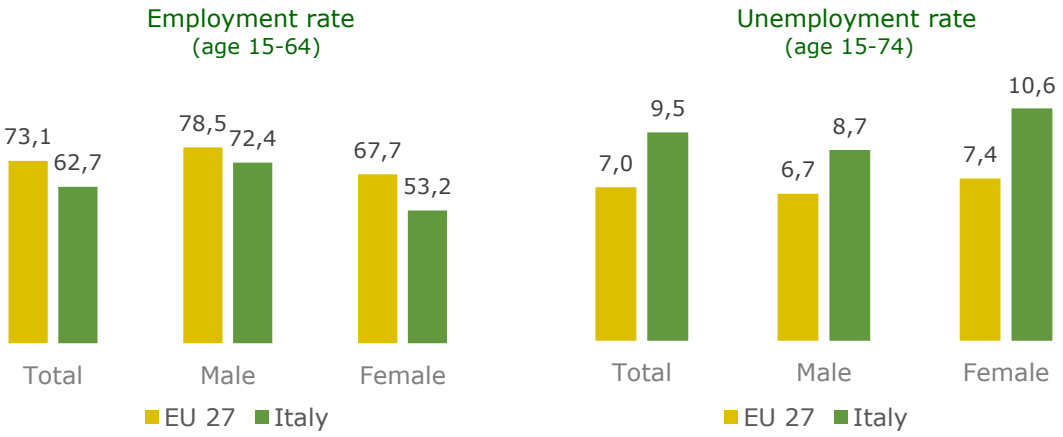
[51] With the introduction of electoral quotas of 40%, participation of women in the national parliament has increased.

Quotas are not a must; however, budget payments to parties whose electoral lists contain less than 40% of the under-represented sex are decreased, and that money is transferred to parties with 40% or more of underrepresented sex. Source: Legislative Decree 149/2013.

[52] Source: authors' calculations based on data from the Italian Government's website as of 14 September 2022 (https://www.governo.it/en/ministers-and-undersecretaries).

it over the previous decade; however, in case of women the situation is particularly unfavourable. Female participation in the labour market is very low, as only a half of working age women are employed (*Graph 3*); this percentage is persistently around 20 percentage points below the male participation. Although both employment and unemployment rates for women have slightly improved over the last ten years, this has been lower than in other countries, so the gap between Italy and the EU average has widened.

Graph 3 **Employment and unemployment rates by gender**
In 2021, in %



Data source: Eurostat online database (datasets LFSI_EMP_A and UNE_RT_A)

One of the reasons for low employment rate of women may be family role stereotypes which are still strong in Italy. According to data for 2013-14, 54% of men and 47% of women thought that it was better for a man to work (earn money) and for a woman to take care of the family (Istat, 2019). Traditional roles are stronger in southern regions, where such an opinion was supported by more than 60% of men and 50% of women. Other factors contributing to low employment rates of women are also often the lack of childcare services, rigid work arrangements and unfavourable prospects for career advancements (OECD, 2019).

A particular point of concern is that employed women tend to be disproportionally more than men engaged in part-time work. In 2019 as much as a third of employed women worked part-time, compared to just 8% of men (Istat; Eurostat, 2020). This is slightly worse than the EU average. However, part-time work combined with other factors, such as the low female participation rate, makes Italy the worst performing EU Member State in terms of the full-time equivalent employment rate for women (EIGE, 2021). A 2020 UN report (UN Statistical Department and DESA, 2020) warns that, although part-time work arrangements provide flexibility, their downsides include lower wages, lower job security, as well as less training and promotion opportunities. For these reasons, part-time engagement of women is one of the factors that explain the persistent gap in wages between men and women.

Gender segregation is present in the choice of jobs as well. There are some sectors which are dominated by women, most notably education and healthcare – in 2021 women made up 76% of employees in education and 72% in health and social work. On the other hand, share of women in total employment in the construction sector was only 7%; other male-dominated sectors, where the share of women does not exceed 20%, include mining and

quarrying, water supply and waste management, and transportation and storage.[53] Disaggregated data for the recycling sector are not available.

Such a composition of jobs is very much interconnected with the educational choices of Italian men and women. When it comes to tertiary education, over the period 2015-2020 women accounted for 80% of graduates in education, and 70% of graduates in art and humanities; their share in healthcare was 66%. On the other side, less than a fifth of graduates in information and communication technologies, and less than a third of graduates in engineering were women. [54]

1.2.2 Legislative requirements imposed on employers

Italian government has undertaken various policies and measures in order to address the problem of gender segregation in the labour market, and to reduce imbalances. Recently, gender equality has been established as one of the priorities of the National Recovery and Resilience Plan (It. *Piano Nazionale di Ripresa e Resilienza* - PNRR) (Italian Government, 2021b), and legislative and policy changes have been introduced over the course of 2021 and 2022.

Main gender equality act is *Code of Equal Opportunities Between Men and Women* (Italian Government, 2006b), which was adopted in 2006. The act introduces policies to eliminate discrimination, and to promote equal treatment and opportunities between men and women. Three main areas covered by this act are family life, economic relations (work, access to goods and services, entrepreneurial activity), and electoral equal opportunities.

The Code prohibits any kind of discrimination and sexual harassment at work, including access to work, training, promotion or working conditions. Both direct discrimination (i.e. discrimination or less favourable treatment on the bases of person's gender) and indirect forms of discrimination (putting persons of certain gender in a disadvantaged position compared to persons of other gender) are prohibited; harassment and sexual harassment are also considered as discrimination. As of December 2021 putting a person in a disadvantaged position or limiting work opportunities, including prospects for advancement, due to pregnancy, maternity or paternity, or other family reasons (including adaptive ones), are also considered to form discrimination at work. Justified exceptions may only refer to particularly heavy work conditions. The Code particularly addresses the problem of unequal pay, by stipulating that criteria for determination of wages must be same for men and women.

Discriminated persons may present a case before a court or other competent body, and it is the burden of the employer to prove that there was no discrimination. If discrimination is proved, the employer must pay compensation to the damaged person, and may be also subject to paying additional penalties, of up to EUR 50 thousand.

The Code also contains provisions to promote equal opportunities. In that regard, private employers with more than 50 employees are required to submit reports on the gender equality situation in their company every two years; companies with less than 50 employees can also prepare such reports on a voluntary basis. These reports must contain following information:

- details on the numbers of male and female employees, including number of pregnant employees, newly employed workers by gender, placements on different positions, and distribution of full-time and part-time contracts by gender;
- details on wages of male and female employees, including details on renumerations, bonuses, in kind benefits and other components of the wage;

[53] Source of data in this paragraph: authors' calculation based on data from the Eurostat online database (dataset LFSA_EGAN2).

[54] Source of data in this paragraph: authors' calculation based on data from the Eurostat online database (dataset EDUC_UOE_GRAD02).

- information on different procedures and measures, such as selection and recruitment procedures, criteria for training and career advancements, measures to promote reconciliation of work and family life etc.

As of 2022 a certification of gender equality in companies was introduced. Namely, certificates can be obtained to prove that the company has adopted policies and measures aimed at addressing gender imbalances, providing equal opportunities for career advancement, providing equal pay, and protecting motherhood. Italian standardization body UNI (It. *Ente Italiano di Normazione*) has issued a reference practice UNI / PdR 125: 2022, which contains minimum parameters that companies must meet in order to obtain gender equality certificates (Italian Government, 2022). Companies who obtain equality certificates in 2022 can benefit from a 1% reduction in annual contributions (up to a maximum of EUR 50 thousand) (Renga, 2022).

Another relevant piece of legislation is *Legislative Decree on the protection and support of motherhood and fatherhood* (Italian Government, 2001). It covers a wide range of issues, including prohibition of discrimination of pregnant women and mothers of new-born children, regulation of maternity, paternity and paternal leaves and related allowances. Amendments introduced in August 2022, with the main aim of implementing EU Directive 2019/1158, contribute to the gender mainstreaming in employment. In that regard, fathers are obliged to take a fully paid paternity leave of at least 10 days (20 days in the case of multiple births), on top of the possibility to share parental leave with mothers.

1.2.3 Promotion of gender equality in the Italian recycling sector

1.2.3.1 Survey design

The UpPE-T project envisages the conduction of a survey among the recycling industry firms. The survey should assess the gender aspects at the firm level, with the aim of proposing measures to improve the gender balance, in case imbalances are detected.

An important aspect related to the design of the survey was that the methodology needed to be applicable to all three case study countries (Finland, Italy and Serbia), in order to obtain comparable data. This implies that survey questions should be more general, and would not be able to grasp possible particularities of each of the countries. For that purpose, it was decided that the gender assessment contains an overview of the legislative requirements, that would provide a view into the possible country-specific provisions.

The questionnaire was developed in the following form:

1. What is the number of female employees in your company? (as % of the total number of employees)

2. What is the number of women at managerial positions in your company? (as % of the total number of managerial positions)

3. Do you think that the current gender structure in your company is appropriate? Do you expect any changes in the future in that regard (please specify which changes)?

4. Do pregnant employees and employees with children have some benefits in your company that other employees do not have? (mark all that apply)

- They have more paid vacation days

- They can take sick leave in the case of illness of children

- They can use flexible work hours

- They can use flexible work locations (including work from home)

- We adjust the working norms and expectations for pregnant women and mothers with toddlers

- We support breastfeeding at work (e.g., by arranging breastfeeding rooms, allowing mothers to take time off to nurse babies, or some other way)

- Other (please specify)

5. Is gender pay gap present in your company (i.e. women with same qualifications and experience are paid less than their male counterparts)?

6. If there exists gender pay gap in your company, could you please describe the measures that you have undertaken (or plan to undertake) to narrow this gap?

7. Has your company adopted a policy of equal opportunities, to insure non-discrimination at recruitment?

8. Has your company adopted an anti-harassment policy (including sexual and gender harassment)?

9. Additional comments you might have:.

When it comes to the distribution of the questionnaire, it was decided to use online tools, supported and/or enhanced by a telephone call (i.e. to send questions by email, and also call a selected contact person).

Related to the sample of firms to be included, it proved to be particularly challenging to reach persons available or interested to answer, partly because the number of plastic recycling firms is not huge, but also because the subject was not considered a priority.

1.2.3.2 Survey results

In Italy 190 firms related to the plastic recycling industry were identified. Given the results of the very first survey on Finnish companies, an effort was made to find additional ways to obtain accurate contacts of the relevant persons in each of the firms.

An attempt was made to reach out 143 of them by mail, using addresses published in Internet. This action was supported by representative sector's organisations, who provided selected mail contacts: emails were sent to general managers, heads of human resources departments and contact persons. Nevertheless the availability in helping us and supporting the survey, the efforts provided little effective results.

Further attempts were therefore made by phone calling. Phone calls let to reach 5 of them, available in answering the questionnaire and wishing to remain anonymous.

The results are the following:

	QUESTION	Company 1	Company 2	Company 3	Company 4	Company 5
1	What is the number of female employees in your company? (as % of the total number of employees)	50%	50%	14,29%	80%	60%
2	What is the number of women at managerial positions in your company? (as % of the total number of managerial positions)	0	66,66%	0	42,86%	30%
3a	Do you think that the current gender structure in your company is appropriate?	yes	yes	yes	yes	yes
3b	Do you expect any changes in the future in that regard (please specify which changes)?	no	no	no	Yes (new CEO will be woman)	no

4	Do pregnant employees and employees with children have some benefits in your company that other employees do not have? (mark all that apply)					
	a They have more paid vacation days	-	-	-	-	-
	b They can take sick leave in the case of illness of children	-	+	+	+	-
	c They can use flexible work hours	+	+	+	+	+
	d They can use flexible work locations (including work from home)	-	+	+	+	-
	e We adjust the working norms and expectations for pregnant women and mothers with toddlers	+	+	+	+	+
	f We support breastfeeding at work (e.g., by arranging breastfeeding rooms, allowing mothers to take time off to nurse babies, or some other way)	-	+	+	+	-
5	Is gender pay gap present in your company (i.e. women with same qualifications and experience are paid less than their male counterparts)	No pay gap	No pay gap	No pay gap	No pay gap	No pay gap
6	If there exists gender pay gap in your company, could you please describe the measures that you have undertaken (or plan to undertake) to narrow this gap?	-	-	-	-	-
7	Has your company adopted a policy of equal opportunities, to insure non-discrimination at recruitment?	no	yes	yes	yes	no
8	Has your company adopted an anti-harassment policy (including sexual and gender harassment)?	no	yes	yes	yes	no
9	Other	-	-	-	-	-

In short, it can be observed that employment numbers and managerial positions are not uniform, gender structure is considered appropriate, and employees with children have some benefits. It is stated that gender pay gap does not exist and, in 3 on 5 companies, both the policy of equal opportunities and the anti-harassment policy have been adopted.

2 Assessing distributional effects

Distributional effects refer to the unequal distribution of costs/benefits of certain policies and activities within the society. For instance, environmental policies may have comparatively more unfavourable effect (in terms of higher costs and more adverse consequences, or less benefits) on certain segments of population, such as lower-income households or individuals, younger and older citizens, persons with lower levels of education, minorities, migrants, persons with disabilities etc.

Extensive overview of literature related to possible distributional effects of waste management and recycling policies and activities, was prepared within Deliverable D7.7 (point C.2). In this point, we provide short overview of the main channels, and put focus on distributional effects in Italy, based on available statistical data and reports and articles.

Regressive effect of environmental policies means that environmental taxes and other environmental policies are expected to affect low-income households and individuals more adversely than wealthier ones, because they are required to pay more relative to their income, or because they get less of the benefits.

Pass-through effect of environmental policies means that costs of their implementation are often passed on final consumers. In that regard, it could be expected that the introduction

of the plastic tax, or higher financial contributions of packaging producers, would be passed on consumers through higher prices of packaging and final products. Effect on low-income households should particularly be evaluated, in order to avoid deterioration of their purchasing powers.

Employment potential of the recycling activities. Recycling and other circular economy activities are expected to contribute to the increase in employment and to the change in the composition of employment. Various aspects have been identified in literature. For instance, jobs in recycling industry are diverse, and both high-skilled and manual labour is in demand. Effects on regional and local employment are possible, since most of the activities in the recycling chain are conducted within a narrower territory. Also, it is anticipated that the nature of jobs would change, as some are expected to disappear or decrease, while new ones could emerge; however, possible disruptions in the labour market could occur, so it would be necessary to timely anticipate and address them. On the negative side, more attention should be given to improving working conditions in the recycling industry, especially in the sorting activities, which often bear various health and safety risks and are low paid; protection of informal workers should also be given due attention.

Considering Italy, it already has a strong circular economy: according to *Circular Economy Network* (2022), in 2018 nearly 520 thousand persons worked in circular economy, i.e. 2,04% of the total number of employed (EU average was 1,71%). Emerging activities also seem to be vibrant: *ECCO* (2022) reports that in 2020 there were around 280 companies producing biodegradable and compostable plastics; they had almost 3 thousand employees which achieved production of 111 thousand tons, with a turnover of EUR 815 million.

Sustainable Development Foundation (2019) estimates that, if necessary circular economy policies are put in place, in 2025 nearly 150 thousand new jobs (direct, indirect and induced jobs) could be created, out of which 45 thousand could refer to the reuse and recycling of municipal waste. Out of the estimated new jobs in circular economy, around a third refers to high-skilled jobs.

When it comes specifically to recycling, *Hestin, Faninger, & Milios* (2015) estimate that the employment potential of attaining the prescribed targets in Italy could be 10 500 additional direct jobs by 2025.

However, there is also evidence on unfavourable effects of separate collection and recycling on working conditions of workers engaged in the collection of waste. *Alhaique* (2014) reports that the introduction of separate collection has put a lot of pressure on workers, as they are required to collect more at the same number of employees and the same budget. The author also claims that these workers have been more subject to musculoskeletal diseases and that the occurrence of fatal incidents is more often among them[55].

Informal recycling. Italy is one of the EU Member States with the highest occurrence of informal waste management activities. According to *Scheinberg et al.* (2016), there have been around 60-80 thousand informal waste operators in Rome and other major city. They mostly collect and sell second-hand items (e.g. at streets or flea markets), but occasionally some of them also collect metal or plastic waste.

Decision-making powers of young people. Political powers of young people in Italy are restrained, since they do not have access to the key decision-making institutions in Italy. Namely, minimum ages are established for persons to be eligible to run for Italian Parliament – 25 years of age for the Chamber of Deputies, and 40 years for the Senate. Representation of young people in the policy dialogue is achieved through the National youth council, which is consulted regarding policies that the government deems appropriate; however, its participation is not obligatory, and it is as a rule consulted on youth-related

[55] In period 2009-2011 the occurrence of fatal accidents among street sweepers was 133 per 1000, which was five times more often than on average. Source: *Alhaique* (2014).

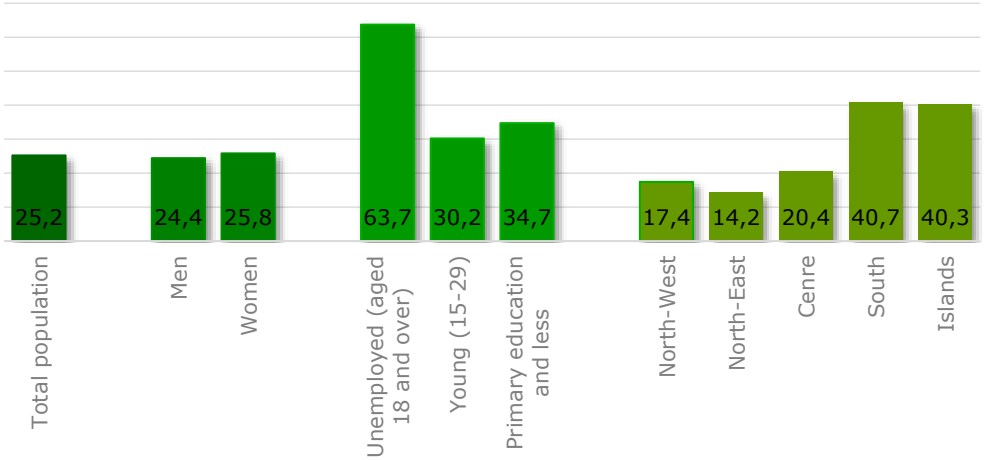
issues, while the participation in the dialogue related to broader policies is lacking. (European Education and Culture Executive Agency, 2022).

Profile of vulnerable population in Italy. Persons at risk of poverty are likely to be susceptible to adverse distributional effects of environmental provinces. Overall, every fourth person in Italy is at risk of poverty. Breakdown by different categories of population is presented in *Graph 4*. Based on available demographic indicators, most vulnerable are unemployed persons: in 2021 64% of unemployed were at a risk of poverty. However, with proper policies in place (including trainings in order to obtain required skills), they are also the ones who could possibly benefit from the anticipated increase in demand in the plastic recycling sector and in circular economy. Young people are also very vulnerable (more than 30% of population aged 15-29 years at risk of poverty), and also persons with low educational attainment.

What is peculiar for Italy are large regional differences, with substantial portions of persons at risk of poverty in southern regions and in islands.

Graph 4 **Persons at risk of poverty or social exclusion in Italy**

Share in respective population groups (in %), 2021



Data source: Eurostat online database (datasets ilc_peps)

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