PAPER, GLASS, PLASTIC AND METAL WASTE CHAINS

Traceability of the MUNICIPAL SOLID WASTE streams

CERTIFICATION OF THE MATERIAL RECOVERY FROM VERITAS GROUP’S SEPARATE COLLECTIONS
2018 THE RESILIENCE OF A SYSTEM

The criticality in the management of recycled materials that occurred for some waste chains in 2017 continued, intermittently, in 2018. The reasons were widely discussed in the previous report, although other issues emerged afterwards, also characterizing 2019 as a difficult year.

In planning future actions, it will therefore be useful to evaluate the contingent situation in a pragmatic way and with intellectual honesty, avoiding falling in the trivializations, sugar-coating and artifices the public discourse on Circular Economy often incurs.

From a general point of view the data made public by the competent bodies tell us that Italy exports about 3 million tons of special waste per year deriving from industry, craft, etc.; of these, 1 million tons consist of hazardous waste. Waste derived from the treatment of separately collected municipal waste is also considered in the “special” category. Add to these, 500,000 tons of municipal waste tout court. An important stream going abroad, determining a significant environmental cost and a no less significant economic cost, around 1 billion euros per year that burdens the whole community. Resorting to landfill, albeit in decline, still weighs for 40% on a national scale.

In guiding the transition towards a circular economy, the EU fixed targets for 2035 to contain landfill disposal to 10% and to increase recovery: at least 65% of material and the remaining part of energy; albeit favoring the recycling of secondary raw materials, the valorization of non-recoverable undifferentiated municipal waste is considered necessary, confirming the complementarity of the two treatment forms. It is precisely in this context that the Italian system continues to register a strong plant shortage, with an evident deficiency in treatment capacity and consequent recourse to export. A situation that makes territorial areas fragile. Even northern ones, which although being more industrially structured, are not always able to respond to emergencies or conjunctural crises.

The effects of the difficult interpretation of regulations and the slow authorization procedures are not less heavy in management activities, to which a persistent social prejudice that arises whenever the need to locate the site of a new plant arises, should be added.

Analyzing on different scales the waste chains considered in this 2018 report, we can focus the attention on the following aspects:

**PAPER:** at European level, collection is at 71.5%. There is a surplus of around 8 million tons compared to current recycling capacities. In 2017 in fact, China, followed by Indonesia and Malesia, the main recipients of exports, have considerably reduced imports, citing mostly qualitative reasons, which were unilaterally established. The decision has generated a market value collapse of 300% and a situation that still remains complicated on a global scale, albeit with some improvements. Just think that in the US some areas have suspended the separate collection of paper and sent it for disposal. At this point, it is clear that the situation can only really stabilize when Europe is able to increase its treatment capacity and, above all, if objective and equal procedures to be applied in the qualitative assessments of the streams being exported are negotiated between the countries involved.
**GLASS:** at a national level, the collection has grown by 8.4%, the recycling recorded a +6.6% and the released for consumption a +1.7%. The increase of collections is mainly due to the progressive diffusion of differentiated management systems in the south, but unfortunately, faced with the increase in the material to be treated, there has been a simultaneous reduction in the treatment plants. Moreover, since these are not yet consolidated experiences, the quality of the waste placed on the market is rather low. On the other hand, the greater demand of the glassworks was accompanied by a more stringent qualitative request. This situation, in addition to generating suffering phenomena with accumulations of stocks and significant quantities of material awaiting destination (sometimes with forced exports), also led to a collapse in valuations, which have fallen by 80% from 2015. Some timid turnarounds were seen in November 2018, but only at the end of 2019 will it be clear if the trend was able to consolidate an effective improvement.

**PLASTIC:** the protagonist of the moment. Faced with its ubiquitous and persistent presence in ecosystems, which has arrived at the formation of imposing oceanic polymeric islands, the world seems oriented towards its elimination, with an evident underestimation of the technological and economic value of this material. It is not possible to discern the different importance of the different polymers and even less the congruity of the multiple uses, attributing to the plastic the fault of environmental pollution rather than pointing the finger at incorrect behaviors, inefficiency of waste management systems and aberrations of certain production lines. Let us take a look at a few figures worldwide to describe the unsustainability of the situation: only 22% of the plastic produced is recycled and large quantities of plastic waste are generated every year, with a forecast for a further increase in the coming years; in Europe, of the 30 million tons of waste collected, 41.6% underwent waste-to-energy treatments, 27.3% ended up in landfills (with very different values in the various European countries); only 31.1% was mechanically recycled and sent for material recovery. Furthermore, only 63% of this flow was managed in Europe, the remaining 37% was shipped outside the EU, with all the uncertainties of the case regarding its actual fate. Even for plastics, therefore, the limited treatment capacity heavily affects the prospects of recycling.

**METALS:** if from the collection point of view, metals are a consolidated reality with values close to 80% and recycling capacity greater than 90%, it cannot be overlooked that 2018 saw a discontinuous trend in prices with an overall drop of 7%. Here the international dynamics are very significant, and the closure of China’s imports, associated with the increase in Australian exports, has had serious effects. The repercussions of the “trade war” triggered by the US could be even more problematic. A series of regulatory implementations - in particular on the “End of Waste” - and the uncertainties about the major national steel companies which have complicated the already fragile stream management during the year must be added to the scenario described.

A picture that is far from reassuring and in constant transformation, within which **Veritas Group spa is developing innovative forms of adaptation designed to increase the resilience of its industrial and service system.** It is for this very reason that the Venetian companies belonging to the Group are committed to maintaining and consolidating the processes of waste chain traceability, management tools that puts them in the condition of measuring in real time the effectiveness in the management of separate collection streams and continuously monitor industrial performance in order to achieve the maximum environmental benefit in an economic sustainability framework.
In 2018, the production of waste in the Veritas basin increased, as did separate collection, which reached 69.16% (a figure that should be reduced on average by 3.67% if the average amount of improper confrments is taken into account, streams which reached peaks of 18% in waste fractions such as mixed packaging, testifying to the importance of the need for continuous information and training for the citizen). More than 13% of recyclable materials still end up in the undifferentiated waste, however, and only thanks to the important local plant equipment it can be sent to partial recovery. Obviously, all this has a cost.

The results we are achieving are however important, especially if they are related to the complexity of the basin served, characterized by the enormous tourist impact, by a highly articulated socio-economic composition, by a massive presence of commuting and by a highly varied territorial articulation, also in the management service methods. What is emerging is a phase of profound transformation:

• collection systems are undergoing a progressive standardization and optimization of the processes, significant technological and organizational investments associated with the remodeling of services are underway, often achieved following laborious preparation and start-up activities. It is still a work in progress, but significant containments of fuel consumption for traction and an improvement in the ratio between the km traveled and the tons transported are already emerging;

• treatment activities required more work in the different selection phases, as evidenced by the increase in energy consumption; this made it possible, however, to guarantee important performances in terms of the material sent for recovery, with significant improvements in the quality yield, also in the face of a strong heterogeneity of the incoming streams. The synergy between the collection and treatment phases remains to be improved;

• local and international contingent situations go towards the restriction of the qualitative parameters of the material streams leaving the plants, a choice that will affect the management of the refuse generated by the recovery operations. In a logic of cycle optimization, this refuse can feed other recovery paths, but adequate nearby plants are needed both in terms of technology and size.

It is within this framework that the vision for the plant development projects of Veritas Group spa is being consolidated: a strategy that aims at industrial symbiosis, that is, at the integration of INDUSTRIAL SYMBIOSIS for the recovery of material and energy right in the amphibious lagoon edge where Porto Marghera is located. Here it is possible to outline new scenarios for the development of a productive area undergoing transformation which is finally at the service of the needs of the territory and at the same time capable of generating lasting work.

Without adequate plant engineering, the municipal waste management system cannot guarantee the sustainability of services and the certainty of recycling, fundamental elements of the circular economy. However, both the respect for legality and the certainty of certified, traced and sustainable streams have not been taken for granted, they are rather conquered values, which can be defended only if one is able to continuously develop innovation and adaptability.
01 INTRODUCTION

As a result of Veritas Group’s commitment, begun more than six years ago, the traceability of municipal waste chains allows to answer with objective and certified data to one of the citizens’ most-frequently-asked questions: “where does the waste we throw out end up?”.

Also in 2018, Veritas Group traced and monitored the recovery chains of the major municipal solid waste fractions of separate collections in the served areas, in pursuit of the transparent communication of results to stakeholders and citizens. This was done in accordance with European orientations on waste recycling and the European Directives in the context of Circular Economy, particularly Directive 2018/851 on waste and Directive 2018/852 on packaging and packaging waste.

Following the collected waste during all the steps of the recovery chain and monitoring the data given directly by the treatment plants involved, this traceability work allows to evaluate how the territory fares with the recycling objectives imposed by the recent European Directive on Circular Economy.

The materials traced in the following waste chains (paper, glass, plastic and metals) were mostly made up by packaging waste and thus disciplined by the European Parliament and Council Directive 2018/852 of May 30 2018, which defines the following objectives:

<table>
<thead>
<tr>
<th>Individual Waste Chains</th>
<th>Objective by 2025</th>
<th>Objective by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and Cardboard</td>
<td>75,0%</td>
<td>85,0%</td>
</tr>
<tr>
<td>Glass</td>
<td>70,0%</td>
<td>75,0%</td>
</tr>
<tr>
<td>Plastic</td>
<td>50,0%</td>
<td>55,0%</td>
</tr>
<tr>
<td>Aluminum</td>
<td>50,0%</td>
<td>60,0%</td>
</tr>
<tr>
<td>Ferrous Metals</td>
<td>70,0%</td>
<td>80,0%</td>
</tr>
<tr>
<td>Wood</td>
<td>25,0%</td>
<td>30,0%</td>
</tr>
</tbody>
</table>
Through the analysis of the waste streams treated in selection and refining plants and of the quantities of secondary raw materials produced, it is possible to evaluate not only the amounts of collected and recovered waste but also the effective recovery of the conferred materials.

The results, obtained through the monitoring of glass, plastic, metals and paper waste chains and certified by a third-party and independent Body, show that:

The reported results refer to all the municipal and assimilated waste streams collected in 2018 by Veritas Group in the 44 municipalities of the Metropolitan City of Venice and in Mogliano Veneto (in the province of Treviso). The collected waste was traced from its conferment by citizens and businesses, during the roadside and curbside collection phase, inside collection centers, through the selection plant and, where possible, during the subsequent refining phase before being sent to recycling plants.

All the players involved operated according to internal rules defined by the companies and declared in specific technical specifications, codes of conduct necessary to obtain the certificate of conformity from the Certification Body. During all the activities, the necessary monitoring data of each waste chain material and energy streams have been collected, thus allowing for the punctual calculation of the most representative indicators. Through the experience gained in the past three years, more accurate collection and data analysis methodologies, taking into consideration the numerous variables that characterize the served territory, were implemented: types of collection vehicle (on land and on water), introduction of new treatment plants, variations in plant internal work cycles, changes in collection patterns.
within the served municipalities, etc. All the occurred changes were introduced in the technical specifications, evaluating the possible impact on the summary indicators.

Thus, the present work allows the manager of the environmental sanitation service to monitor and report back the recoverable waste streams entering and exiting treatment plants, as well as the necessary energy consumption in every phase of the analyzed processes. The yearly monitoring also allows to evaluate trend of streams and recovery percentages over time, allowing companies to put in place the necessary actions to enhance the waste management system.

This is also part of the project of technological update of existing plants and ongoing implementation of new interventions at the Marghera Ecodistrict, a hub for the treatment of municipal and special waste where Veritas Group wants to create a real model of industrial symbiosis that allows the treatment of the majority of the collected municipal waste types, reducing the distances between phases of the same waste chains, optimizing stream management and reducing energy consumption and related atmospheric emissions, bettering the overall recovery performances.

This activity of research and analysis is the result of the daily commitment of all the people that work in Veritas Group companies and affiliated treatment plants and highlights in which part of society, economy and politics our community has decided to place itself, namely in the one that continues to guide the world towards more responsible and aware cultural horizons for the environment. In this context, our lifestyle gains meaning, revealing itself as a set of really effective actions on a local scale but also as the open glance of a community that takes charge of global issues.

The results of this work demonstrate the importance of the application of the CIRCULAR ECONOMY model by Veritas Group. In this context, waste becomes an essential resource for the production of goods made of regenerated raw materials and companies that keep renewing and developing are at the base of production cycles in which waste separately conferred by citizens at the end of their life cycle become the key resource of a continuous material stream that closes in on itself.

In this reality, separated waste, packaging and organic substances necessary for human diet, are none other than transitory phases of continuously evolving matter like in biological ecosystems.

The material that is put back into the cycle will no longer impact on the environment and take away land that could be otherwise used for farming, but is used to feed vital or technological cycles. Materials like glass, plastic, metals and the paper and cardboard of which packaging is made, go back to fulfilling their original function, thus saving energy and raw materials of which the planet is ever so scarce. Producing packaging from recycled materials requires less resources than using raw material.

Traceability results tell us we are already at a good point and that we are improving, but it’s not enough; not everything that reaches recovery plants can be regenerated, especially since there is a lot of improperly conferred material together with the recoverable material.

The goal, then, remains to increase the quantity of the collected material from separate collection and avoid landfilling them, but also to improve the quality of the collected material to extract as much renewable material as possible, reducing to zero the presence
of unexploitable waste. This would represent a leap forward for our sustainability that would allow us to **fully exploit raw materials**, closing their life cycle **without turning them to waste** and further benefiting from their **reuse**.

This can only bring enormous benefits to present and future generations, of economical nature too: waste management costs are still too high both for communities and for companies involved.

This happens for various reasons, but mostly because not everyone is aware of the fact that the cost of collecting and sorting waste is inversely proportionate to the care and sensibility that we put into choosing the products to buy and in the way we transform our goods into waste.

The punctual analysis on the quality of the separated fractions conducted by Veritas on the base of **985 waste characterizations** throughout the whole basin, highlights that 5.92% of paper and 18.17% of the mixed packaging (glass-plastic-cans) is comprised of extraneous fractions. Furthermore 44.77% of the undifferentiated municipal waste is comprised of wrongly conferred recyclable fractions which amounts to 70.013 tons that could have been recycled.

The transparency of the collected data offers every municipal administration the tools to inform their own citizens: from now on it shall be explained that not-knowing is a personal choice that has a high cost for the community, both economically and environmentally. This cost has been estimated by Veritas to be over €8 million that can only be eliminated by a combination of good civic practices, optimized collection systems and flexible recovery processes.
Chapter 2

RECYCLABLE WASTE PRODUCTION AND SEPARATE COLLECTIONS PROGRESS
2.1. **THE SERVED TERRITORY AND THE INFLUENCE OF TOURISM**

The reference area for the traceability of paper, glass, plastic and metal waste chains corresponds to **the whole territory served by Veritas Group**, which manages the environmental sanitation service in all the municipalities within the **Metropolitan City of Venice and in Mogliano Veneto (in the province of Treviso)** for a grand total of 45 municipalities, each with its own urban and territorial peculiarities and a high level of tourism, especially along the coastline.

Jesolo, Eraclea, Chioggia, San Michele al Tagliamento, Caorle and Cavallino-Treporti alone recorded more than 23,250,000 tourists in 2018, mostly concentrated during the summer months; on top of them, over 12 million tourists in Venice municipality are to be added, with a somewhat homogeneous distribution throughout the year. Overall, including the rest of the served municipalities, **over 36 million tourists were recorded**.

**FIGURE 1.** Tourist trend for the municipalities of the Venice metropolitan coastline in 2018. *(Data elaboration Veneto Region statistical office)*.

The effects of tourism manifest themselves particularly in the **production of waste**, which grows sensibly during summertime in the municipalities along the coast: as an example, in the
municipalities of Caorle and Bibione, summertime production is approximately 6 times greater than during wintertime. Less fluctuations are recorded in the Municipality of Venice, which as we have seen is characterized by a constant tourist phenomenon throughout the year.

The tourist vocation of the Venetian area has a substantial impact on the companies of the Group, which have to implement specific services in order to guarantee the collection and recycling of waste in every moment of the year, by increasing the collection frequency or instituting special services. At the same time, plants have to ensure the treatment of the collected waste and the recovery of the different selected material, to guarantee the continuity of the recycle chain.

The data on the environmental sanitation service elaborated by Veritas Spa highlights an increase in municipal waste production: in 2018, 529,774.75 t of municipal waste were produced, of which 350,597.51 t from separate collection. Despite a slight decrease in population, the amount of municipal waste has increased by 3,224 t since 2017. On average, per-capita production went from 535 kg/inh*year in 2017 to approximately 540 kg/inh*year in 2018.

It should be observed that this increase was due to the higher production of separated fractions: the amount of collected paper and cardboard increased by 2,145 t compared to 2017, while glass, plastic and metal waste increased by almost 5,000 t. Organic waste increased by almost 3,000 t while green waste by approximately 850 t. Instead, the undifferentiated municipal waste decreased by approximately 3,100 t compared to the previous year, recording

![Waste Production by Municipality along the Venice Metropolitan Coastline (Year 2018)](image)

**FIGURE 2.** Waste production trend in the municipalities along the Venice metropolitan coastline in 2018. (Data elaboration Veritas).

### 2.2. Municipal Waste Production in the Metropolitan City of Venice

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a progressively decreasing trend over the course of the previous three years. This reflects
on the values of separate collection which have increased over the past three years, going
from 64.52% in 2016, to 65.14% in 2017, to 69.16% in 2018, highlighting an ever-increasing
waste separation. In 2018, 34 municipalities surpassed the 76% regional goal, 5 municipalities
reached a percentage between 70% and 76%, 2 municipalities between 60% and 70% while
only 4 municipalities reached a value lower than 60%.


2.3. QUALITY OF COLLECTED WASTE

The data shown on the side highlight how the quantity of separate waste has progressively increased over the past years, with a value of separate collection getting closer and closer to the 76% regional objective for 2020. It is necessary to also improve the quality of collected waste by reducing the presence of non-recyclable fractions, to be able to recover more renewable material from waste.

In 2018, Veritas and the other Group companies conducted 985 waste characterizations on the main differentiated fractions, municipality by municipality and at a preset frequency, to monitor the presence of extraneous fractions and evaluate the quality of household source separation. This allowed to quantify the extraneous fractions in the waste streams of each municipality and evaluate the economic impacts these erroneous conferments lead to in terms of missed valorization of recyclable materials and increased costs of screened waste disposal.

On a metropolitan scale, erroneous conferments amounted on average to 5,92% of paper and cardboard waste, down from 2017, with values over 10% for roadside collection and lower than 1,5% for curbside collection. Overall, of the 48.549 t of collected paper and cardboard, an estimated 2.877 t of materials were improperly conferred.

Regarding glass, plastic and metal waste, the highest percentage of extraneous fractions is found in the mixed packaging VPL (glass-plastic-cans) with an average value of 18,17%, that reaches almost 25% for roadside collection. Mixed packaging PL (plastic-cans) registers a 7,77% of extraneous fractions whilst VL (glass-cans) is at 6,13%. Single-material plastic collection also has quite high values of erroneous conferments, with an average percentage of 13,74%. All the considered fractions are gradually decreasing, a sign of improving household separation. Nonetheless, an estimated 16.220 t of improperly conferred material is still too high an amount that Eco-Ricicli Veritas’ plant has to separate to obtain a material with a quality suitable for recycling.

Lastly, waste characterizations carried out on undifferentiated waste show that 44,77% of the conferred waste is made up of still recoverable material, particularly plastic (over 18% of the undifferentiated waste), paper (more than 10%), organic (almost 6%) and glass (about 5%). Overall, 70.000 t of recyclable and exploitable materials have been conferred in the undifferentiated waste: with correct conferments an estimated 9.518 t of paper and cardboard, 17.203 t of plastic, 7.178 t of glass and 2.979 t of metals could have been recovered with an economic savings of over 4,7 million euros for these materials alone.

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1For 2016 and 2017 the values of separate collection were calculated with the method provided by the DGRV (Resolution of the Veneto Region Council) 3918/02, while for 2018 the DM (Ministerial Decree) May 26, 2016 was used. The DM 26.05.2016 includes within the separate collection also the amounts of bulky waste, street-cleaning residues and inert waste sent for recovery (which weren’t considered in the separate collection with the previous method). The organic waste recovered via household composting is considered a neutral stream (it was previously considered in the separate collection). The separate collection, thus, increases with the new method due to the introduction of new fractions. The calculation using the DGRV 3918/02 yields, for 2018, a value of 66.36%, still higher than the previous years.
**EXTRANEOUS FRACTIONS IN SEPARATE COLLECTIONS (2015-2018)**

**PAPER AND CARDBOARD**
- 2015: 6.28%
- 2016: 5.92%
- 2017: 6.59%
- 2018: 5.92%

**GLASS, PLASTIC AND CANS (VPL)**
- 2015: 19.14%
- 2016: 20.78%
- 2017: 18.20%
- 2018: 18.17%

**PLASTIC (P)**
- 2015: 14.30%
- 2016: 15.04%
- 2017: 13.74%

**PLASTIC AND CANS (PL)**
- 2015: 9.03%
- 2016: 9.42%
- 2017: 10.35%
- 2018: 7.77%

**GLASS AND CANS (VL)**
- 2015: 9.87%
- 2016: 7.67%
- 2017: 5.84%
- 2018: 6.13%

**LEGEND**
- 2015
- 2016
- 2017
- 2018

**FIGURE 5.** Trend of extraneous fractions in the main differentiated fractions – years 2015-2018.

**EXPLOITABLE FRACTIONS IN THE UNDIFFERENTIATED WASTE (2015-2018)**

<table>
<thead>
<tr>
<th>Material</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic stream A &amp; B</td>
<td>15.54%</td>
<td>18.89%</td>
<td>19.02%</td>
<td>16.01%</td>
</tr>
<tr>
<td>Paper, cardboard and tetrapak</td>
<td>17.75%</td>
<td>14.57%</td>
<td>8.98%</td>
<td>10.14%</td>
</tr>
<tr>
<td>Organic waste</td>
<td>12.01%</td>
<td>7.56%</td>
<td>12.08%</td>
<td>5.63%</td>
</tr>
<tr>
<td>Glass</td>
<td>6.50%</td>
<td>4.21%</td>
<td>3.80%</td>
<td>4.59%</td>
</tr>
<tr>
<td>Green waste</td>
<td>-</td>
<td>10.95%</td>
<td>6.38%</td>
<td>2.85%</td>
</tr>
<tr>
<td>Non-COREPLA plastic</td>
<td>2.67%</td>
<td>2.68%</td>
<td>2.38%</td>
<td>2.32%</td>
</tr>
<tr>
<td>Iron products and packaging</td>
<td>0.76%</td>
<td>0.98%</td>
<td>0.73%</td>
<td>1.35%</td>
</tr>
<tr>
<td>WEEE</td>
<td>0.74%</td>
<td>1.18%</td>
<td>1.50%</td>
<td>0.76%</td>
</tr>
<tr>
<td>Aluminium products and</td>
<td>0.55%</td>
<td>0.47%</td>
<td>0.75%</td>
<td>0.55%</td>
</tr>
<tr>
<td>packaging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood</td>
<td>9.25%</td>
<td>2.20%</td>
<td>1.13%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Medicines</td>
<td>0.15%</td>
<td>0.15%</td>
<td>0.20%</td>
<td>0.05%</td>
</tr>
<tr>
<td>Batteries</td>
<td>0.01%</td>
<td>&lt;0,01%</td>
<td>0.04%</td>
<td>0.01%</td>
</tr>
</tbody>
</table>

**FIGURE 6.** Trend of exploitable fractions in the undifferentiated waste – years 2015-2018.
PAPER, GLASS, PLASTIC AND METAL WASTE CHAIN TRACEABILITY

Chapter 3
3.1. WASTE CHAIN ANALYSIS AND MONITORING METHODOLOGY

In accordance with what was defined in the validated technical specifications, all glass, plastic, metal and paper streams collected in Veritas Group’s catchment basin were traced and certified for 2018 as well. The application of management and operational procedures by all the involved parties (both the companies that manage the environmental sanitation services and the plants that receive and select the collected material for recovery) allowed to monitor every step of the waste chain, from household and commercial conferments to collection, until plant processing.

Differently from previous years, the focus was set on municipal and assimilated waste by only monitoring conferred waste from households and businesses, which contribute to the separate collection calculation and make up almost the entirety of the managed waste; special waste conferred by other utilities on the basis of specific contracts were thus left out, even though they are managed similarly to municipal waste and equally traced.

The territory object of this study has been subdivided into 8 collection areas, similarly to previous years; this subdivision allows for greater detail in the analysis of collected waste streams, by considering specific modalities with which the service is conducted in different zones, monitoring streams in and out of various transfer stations and their storage and monitoring energy consumptions of the various vehicles used, both on land and on water.

The distinctive features of the catchment basin need to be remarked. It comprises both medium-small municipalities, mostly characterized by residential and artisanal users with constant waste production throughout the year, and others with high concentrations of tourist streams where waste production greatly increases during the summer season. This makes homogenizing the service difficult, as it needs to be adapted to local needs through the implementation of different collection systems and collected fractions even within the same municipality. Think of the unique case of Venice old town, whose specific territorial characteristics require specific implementations of the service: waste is collected by hand, door to door, or conferred by citizens to fixed collection points; it is later transported through the canals by boat and dropped at the operational headquarters from where they are subsequently taken to the transfer station by barge.
The collection activities carried out by the companies in charge of the service are thus proceduralized and monitored, in a different and specific way for each collection modality (curbside with terrestrial vehicles, door to door with boats, roadside with direct transport to the transfer station or treatment plant, roadside with water transport to the transfer station); waste storage and merging activities in the 5 transfer stations (Chioggia, Mirano, Jesolo, Portogruaro and Fusina) are also verified.

The waste stream analysis is carried out referring to the CER codes (EWC codes from European Waste Catalogue) assigned to each waste and the type of collected fraction: in the case of CER 150106 mixed packaging, the glass-plastic-cans joint collection is considered separately from glass-cans and plastic-cans streams, to monitor the production trend of each individual fraction and, consequently, possible variations in the collection modalities in the served municipalities.

As required by the technical specifications, every company collects data pertaining to their activities necessary for the monitoring of streams across the whole waste chain and for the calculation of energy and material indicators, on a yearly basis.
The reference period chosen for the reporting is the calendar year: this allows to consider seasonal stream variations and allows an effective comparison with the indicators from previous periods. Furthermore, it is possible to align the information with elaborations usually done by companies for the communications of data to supervisory Authorities (the MUD statement as an example), the preparation of annual production statements and the monitoring of the indicators defined within the corporate management systems (e.g. the ISO 14001-compliant environmental management system). The validated indicators in this document refer to the most recent data available, relative to the period from January 1 to December 31, 2018.

In the month of May 2019, the certification body Bureau Veritas conducted a compliance audit for the glass waste chain and recertification audits for the paper, plastic and metal waste chains. The audits had the goal of evaluating the conformity of the activities with the procedures defined within the technical specifications, verifying on the field all the different collection systems in each of the 8 collection areas.

The waste was followed from the curbside and roadside waste containers, during the collection phase and the storage activities carried out at the transfer stations until the processing at the selection and refining plants. All the documentation attesting the route taken by the material was verified, both the ones usually required by the current legislation and those specifically defined within the technical specifications. Lastly, all the data inserted in the waste chains monitoring tables were checked, verifying the sources and the calculation procedures of the indicators.

3.2. PAPER, GLASS, PLASTIC AND METAL WASTE COLLECTED IN 2018

It is useful to analyze the Venice metropolitan catchment area as a whole to evaluate the weight of these four waste chains on the collection system.

In 2018, 529,774.75 t of municipal waste (the sum of all types of waste, including domestic composting) were produced in the 45 municipalities served by Veritas Group. On average, per capita production is almost equal to 540 kg/inh\(^*\)year, in an approximately 2.015 km\(^2\) wide territory of 881,106 inhabitants with over 36,380,000 tourists.

Of the total collected waste, approximately 12% consists of paper and cardboard waste (paper and cardboard packaging CER 150101 and paper and cardboard CER 200101), equal to 64,039.71 t. The majority of paper and cardboard waste was conferred in the Metropolitan city of Venice mainland (29% of the total) and in the Riviera del Brenta and Miranese (almost 25% of the total); to follow, Metropolitan city of Venice east area (over 15%), Asvo’s managed area (almost 12%) and Venice old town (over 10%). All the values were in line with the ones recorded in 2017.
Per capita production of paper and cardboard waste in 2018 was equal to 65,3 kg/inh*year, slightly increasing from the previous year and higher than the last available average regional figure (58,5 kg/inh*year in 2017) due to the high number of tourists on the Venice metropolitan coastline. Such figures are both higher than those of Northern Italy (62,4 kg/inh/year) and the Italian average (54,2 kg/inh*year), due to the higher degree of household separation as highlighted by the higher separate collection value within the Venice metropolitan area compared to the national average (55,5% in 2017 is the last available figure).

Total glass, plastic and metal waste production in 2018 was equal to 86.793,61 t, recording a 6% increment from 2017. This amount comprises all fractions containing these materials: mixed packaging CER 150106 (VPL glass-plastic-cans, VL glass-cans and PL plastic-cans), single-material glass (glass packaging CER 150107 and glass CER 200102), single-material plastic (plastic packaging CER 150102 and plastic CER 200139) and metals (metallic packaging CER 150104 and metals CER 200140). These fraction amount to 16% of the total produced waste.

The majority of glass, plastic and metal waste was conferred in the Riviera del Brenta and Miranese area (almost 26% of the total) and in the Metropolitan city of Venice mainland area (25% of the total). To follow, Metropolitan city of Venice east area (17%) and Asvo (12%). Regarding the type of collected fractions, almost 78% of the waste is comprised of mixed packaging VPL, almost 4% of PL (mainly collected in Asvo’s territory and in minor part in the Riviera del Brenta and Miranese area) and 5% of VL (mostly collected in the Riviera del Brenta and Miranese area and in minor part in Metropolitan city of Venice mainland area). Separately collected materials are made up by almost 5% of plastic packaging CER 150102, by over 4% of glass CER 200102 and by almost 3% of metal CER 200140.

Per capita glass, plastic and metal waste production in 2018 was equal to 88,5 kg/inh*year. In this case also, the Venice metropolitan territory surpassed the national average (59,5 kg/inh*year), the Northern Italy average (74,3 kg/inh*year) and the regional average (79,6 kg/inh*year) recorded in 2017.

Lastly, 86.274,66 t of organic waste CER 200108, 64.958,46 t of green waste and 156.397,01 t of undifferentiated municipal waste were conferred.

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3 The latest available data refer to 2017. Source: Ibid.
WASTE CONFERRED IN 2018
BY COLLECTION AREAS

COLLECTION
AREA A1.1
East Venice
(former Alisea)

COLLECTION
AREA A1.8
Venice old town

GLASS, PLASTIC
AND CANS

<table>
<thead>
<tr>
<th>Code</th>
<th>CER 150106</th>
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<th>CER 150106</th>
<th>CER 150102</th>
<th>CER 200139</th>
<th>CER 150107</th>
<th>CER 200102</th>
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<th>CER 200140</th>
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<tr>
<td></td>
<td>VPL 14,210,36 t</td>
<td>PL 2,60 t</td>
<td>VL 81,27 t</td>
<td>P 6,74 t</td>
<td>V 82,87 t</td>
<td>V 49,40 t</td>
<td>P 53,53 t</td>
<td>V 6,74 t</td>
<td>M 503,27 t</td>
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<tr>
<td></td>
<td>VPL 3,909,79 t</td>
<td>PL 3,057,19 t</td>
<td>VL -</td>
<td>P -</td>
<td>V -</td>
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<td>P -</td>
<td>M -</td>
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PAPER AND CARDBOARD

<table>
<thead>
<tr>
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<tr>
<td></td>
<td>4,005,74 t</td>
<td>5,861,93 t</td>
</tr>
<tr>
<td></td>
<td>1,693,17 t</td>
<td>5,774,81 t</td>
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</table>
### 86.793,61 t
**OF GLASS, PLASTIC AND CANS CONFERRED**

<table>
<thead>
<tr>
<th>Cargo</th>
<th>Area</th>
<th>.transfer stations</th>
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<tbody>
<tr>
<td>GLASS</td>
<td>86.793,61 t</td>
<td>A 2.1 Jesolo, A 2.2 Portogruaro, A 2.4 Chioggia, A 2.5 Mirano, A 2.6 Fusina</td>
</tr>
<tr>
<td>PLASTIC</td>
<td>64.039,71 t</td>
<td>A 2.1 Jesolo, A 2.2 Portogruaro, A 2.4 Chioggia, A 2.5 Mirano, A 2.6 Fusina</td>
</tr>
<tr>
<td>CANS</td>
<td></td>
<td>A 2.1 Jesolo, A 2.2 Portogruaro, A 2.4 Chioggia, A 2.5 Mirano, A 2.6 Fusina</td>
</tr>
</tbody>
</table>

### COLLECTION AREA A1.2
**Cavanere and Cona**

### COLLECTION AREA A1.3
**Cavazzese and Cona**

### COLLECTION AREA A1.4
**Chioggia**

### COLLECTION AREA A1.5
**Riviera del Brenta and Miranese**

### COLLECTION AREA A1.6
**Venice old town**

### COLLECTION AREA A1.7
**Venice southern islands**

### COLLECTION AREA A1.8
**Venice Mainland**

<table>
<thead>
<tr>
<th>Cargo</th>
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<th>tote</th>
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<td>898,92 t</td>
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<tr>
<td>CANS</td>
<td>A1.4</td>
<td>15.795,12 t</td>
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<tr>
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<tr>
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<td>1.751,52 t</td>
</tr>
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<td>CANS</td>
<td>A1.7</td>
<td>18.293,23 t</td>
</tr>
<tr>
<td>GLASS</td>
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<td>PLASTIC</td>
<td>A1.9</td>
<td>18.293,23 t</td>
</tr>
<tr>
<td>CANS</td>
<td>A1.10</td>
<td>18.293,23 t</td>
</tr>
</tbody>
</table>
3.3. COMPANIES INVOLVED IN THE WASTE CHAIN TRACEABILITY

In the context of this study, and particularly in regards to the separation and refining phases, the following plants play a key role:

- Eco-Ricicli Veritas srl, for the selection of glass, plastic and cans;
- Trevisan Spa, for the selection of paper;
- Ecopatè Srl, for the refining of glass;
- Metalrecycling Venice Srl, for the refining of metals;
- Myreplast Industries Srl for the refining of non-COREPLA plastic

Whose industrial realities are briefly described in the following chapters.

3.3.1. ECO-RICICLI VERITAS SRL

Eco-Ricicli Veritas Srl is a company specialized in the management and treatment of dry recyclable fractions coming from the separate collection, particularly glass, plastic, metals, paper and wood.

The company has a mixed mechanical-manual selection plant, built between 2007 and 2008 on an area owned by the municipality of Venice that was previously used as an industrial waste landfill for the companies of the Marghera petrochemical district. This area has thus passed from being a place of waste abandoning to becoming a reference for the whole Northern Italy for the recovery of municipal waste.

Eco-Ricicli Veritas srl collects through his vehicle fleet and receives at its plant waste coming from the separate collections of six Veneto provinces as well as from territories in Friuli-Venezia Giulia and Trentino-Alto Adige. Through the plant lines, 40% of the multi-material waste collected in the Veneto Region is selected obtaining semi-finished glass matrix waste destined to refining plants for the production of oven-ready glass, as well as semi-finished plastic and metal waste destined to their respective recovery plants. The use of advanced and diverse technologies, like electromagnetic and eddy current separations, screening and extractors, allows even material coming from low quality separate collections to be destined for recovery, minimizing landfill usage, optimizing recovery cycles and guaranteeing treatment during seasonal peaks due to the specific served area (high number of tourists, like the historical city centre of Venice and the Venice metropolitan coastline).

On the path towards continuous improvement, the optimization of recycling processes and progressively diminishing environmental impacts, the Company is planning adjustment interventions of the existing plant lines and the realization of new lines for the selection of other waste fractions, such as bulky waste, light and heavy multi-material, single-material plastics, which will be part of the development plan of the Marghera Ecodistrict; a center dedicated to waste recovery, energy saving and renewable energy production initiatives, of which Metalrecycling Venice srl (metal refining) and Ecoprogetto Venezia srl (production of SRF from undifferentiated municipal waste) are also part of.
This environmental sustainability model put in place by the company is coherent with the objectives of the whole Veritas Group and translates into the application of an educational, organizational, project and technological path where environmental protection, reduction of raw material usage, energy saving and efficiency and renewable energy exploitation, together with economic and financial sustainability, are always front and center.

The certifications Eco-Ricicli Veritas srl has obtained for its quality and environmental management systems (ISO 9001 and ISO 14001) for the glass cullet and metal scrap End of Waste (UE n. 1179/2012 and n. 333/2011) and for the paper, glass, plastic and metal waste chain traceability, are a testament to this commitment.

3.3.2. TREVISAN SPA

Since 1974, Trevisan Spa has been dealing with the collection and selection of recyclable materials, in particular of paper and cardboard; it operates in its Noale (VE) plant and possesses a safety, health, environmental and quality integrated management system certified ISO 9001, ISO 14001 and OHSAS 18001.

At its authorized plant, the company has several lines dedicated to the selection, shredding and packaging of processed materials, working with state-of-the-art technologies. The paper and cardboard waste received by Trevisan Spa is selected to eliminate improper materials, thus obtaining secondary raw materials that is UNI EN-643 compliant and subsequently sent to papermills for recycling.

Trevisan Spa has several means of collection and transport like containers, press containers, mesh containers as well as mobile pressing systems to be installed at suppliers to facilitate the recovery, by increasing separate collection and abating treatment costs, use of space and working times, and to optimize the transport system. It also carries out the so called “confidential waste disposal” of sensitive paper material that needs to be destroyed for the safeguard of personal data (like the one produced by Law firms, credit institutions, public administration, etc.).

The commitment towards the environment is visible in the use of modern technological equipment when providing collection services and in the design of an information and education campaign aimed at highlighting the importance of proper separate collection and recycling.

3.3.3 ECOPATÈ SRL

Ecopatè’s plant is managed by an international partnership between Eco-Ricicli Veritas Srl and the French Patè sas and receives raw glass from a significant catchment basin, mostly located in the Triveneto but with waste coming from all over Italy. The plant processes both glass streams coming from single-material separate collection and glass scrap coming from multi-material selection plants (particularly from Eco-Ricicli Veritas Srl).
These streams undergo further selection and treatment aimed at eliminating every material that could impede glass recycling or reduce the process efficiency (organic residues, metallic parts, non-recoverable refuse, small-size glass and inert like ceramic and stones). The oven-ready glass thus obtained has very high qualitative characteristics and purity, in compliance with current regulations and particularly with the strict glassworks' protocols. The materials treated at Ecopatè's plant are in fact classified as glass cullet End of Waste in compliance with the EU Regulation n. 1179/2012. The ready-oven glass produced by the plant is sent to glassworks for the subsequent fusion and production of new bottles suitable for food use.

Since 2012, the company has been active in the glass recovery chain traceability project, participating at the first experimentation related to the glass coming from the municipality of Venice and selected by Eco-Ricicli Veritas Srl and then extending the traceability to every stream coming from the Veritas Group basin. The company has always been oriented towards sustainability, environmental protection and the safeguard of the health of its employees and thus has a safety, health, environmental and quality management system certified ISO 9001, ISO 14001 and OHSAS 18001.

3.3.4. METALRECYCLING VENICE SRL

Metalrecycling Venice Srl is the company founded in 2014 as the sale of the branch of Demont Srl and controlled by Eco-Ricicli Veritas Srl, that performs the refinement and marketing of metal scrap, itself involved in the implementation of the Marghera Ecodistrict and equipped with an environmental and quality management system certified ISO 9001, ISO 14001.

The company, as an operator of RICREA (the National Consortium for Recycling and Recovery of Metal Packaging) for the recovery of the ferrous metallic fraction present in the municipal waste separate collection, acquires the material from breakers, municipal companies and collectors on a national scale and thanks to highly specialized labor, selects and prepares it in different combinations to provide smelters with high grade scrap for the fusion of different alloys (nickel, titanium, copper, tungsten, vanadium, chrome). Metalrecycling Venice srl, like its parent company Eco-Ricicli Veritas srl, promotes the continuous improvement of its services for its clients (steelworks, smelters, refineries and other dealers) and continuously monitors its activities to protect the environment through the evaluation of its own qualitative and environmental performances and to put in place improvements to optimize its production cycles.
3.3.5. MYREPLAST INDUSTRIES SRL

MyReplast Industries Srl is controlled by NextChem, a member company of Maire Tecnimont Group managing 24 technological initiatives to speed up the green chemistry industrialization. The new plant, managed by MyReplast Industries Srl, is the most advanced and efficient in Europe for the **recycling of plastics** and is part of the Group’s Green Acceleration project.

The plant, located in Bedizzole, in the province of Brescia, is based on a business model that is economically sustainable and is unique in Europe for its production capacity, treatment flexibility and quality of the finished product. The plant is able to produce **40,000 t** of recycled polymers per year, treating differing incoming plastic waste, both coming from industrial post-consumption (automobile components, production waste of food and industrial packaging) and municipal post-consumption (coming from the selection of municipal separate collections). The technological treatment process ensures an end product – the recycled polymer – of the highest grade with a recycling efficiency around 95%. Through its innovative approach based on product development, MyReplast Industries’ plant enhances the properties of the incoming plastic material (up-cycling) allowing it to be used for products destined to high-end markets with increased added value.

Maire Tecnimont’s approach aims at implementing the “from the product to the waste management” logic: starting from the market needs downstream, the goal is to produce secondary raw materials with chemical-physical and mechanical characteristics able to fill the gap with virgin plastic (coming from hydrocarbons of fossil origin).
PAPER AND CARDBOARD WASTE CHAIN

The paper waste chain traceability follows all the paper and cardboard waste collected in the 45 municipalities served by Veritas Group, both the packaging separately collected at commercial utilities (CER 150101) and household paper and cardboard collected together (CER 200101).

The analyzed phases of the waste chains and the respective companies involved are:

- **CONFERMENT** of the waste by citizens and businesses;
- **COLLECTION** by Veritas Spa, Asvo Spa, Eco-Ricicli Veritas Srl;
- **SELECTION** at Trevisan Spa.

The material from Trevisan’s plant selection is compliant with the standards set by UNI EN 643:2002, is no longer categorized as waste and is sent to papermills for recycling.

4.1. CONFERMENT

The paper and cardboard waste CER 200101 is a mixed material, mainly consisting of newspapers, magazines, flyers, paper sheets, cardboard packages and boxes, tetrapak containers for food and beverages. In 2018, **48,551,73 t of paper and cardboard CER 200101** and **15,487,98 t of paper and cardboard CER 150101** coming from businesses (separate collections in shopping centers, supermarkets, shops, etc.) were conferred inside the Veritas Group catchment basin.

As previously illustrated, the total production, equal to 64,039,71 t, represents 12% of the total waste produced with a 3.5% increase compared to 2017 (almost 2,145 t more); **per capita production equals to 65.3 kg/inh*year**, considering both residents and tourists.

358 waste characterizations were conducted on paper and cardboard CER 200101 in 2018. They revealed an **average percentage of 5.92% of extraneous fractions**, mostly fabric and plastics, improperly conferred in bins and dustbins dedicated to the collection of paper. On the contrary, analyzing the undifferentiated municipal waste composition, 89 waste characterizations showed that 10.14% of the conferred undifferentiated waste consisted of paper, cardboard and tetrapak that could have been recycled into paper but instead became SRF in Ecoprogetto Venezia’s plant.

The interception index of paper was equal to **77.29%**, slightly decreasing from the previous year (78.51% in 2017); the amount not intercepted mostly ended up in the undifferentiated municipal waste and in the glass-plastic-cans multi-material collection.
4.2. COLLECTION

The paper and cardboard waste was separately traced and monitored in each of the eight collection areas: for each one, the total amount of collected waste was evaluated (both CER 150101 and CER 200101) and the energy consumption of the collection service was calculated based on the type of service (curbside, roadside) and the different vehicles utilized (land, water). For the five transfer stations, streams coming in and out and the energy of internal handling were monitored. Lastly, the consumption of vehicles leaving the transfer stations to transport the waste to Trevisan’s treatment plant or other plants was monitored. In total, in the whole catchment basin, **64,037.39 t of paper and cardboard** were collected in 2018, **2,100 t** more than in 2017.

For the collection, handling and transport of the waste, **955,836 litres of diesel fuel, 2,012 litres of petrol and 4,062 Nm³ of methane** were consumed. These consumption figures were given by the companies managing the service and depended on the specific type of collection of each municipality (curbside, roadside) and the type of vehicles used. An increase in methane consumption could be observed due to the introduction of new vehicles fueled with said combustible. The energy consumption for the handling of the waste at the transfer stations and the washing of the vehicles at the operational headquarters was **172,47 MWh**, decreasing from the previous year. The average consumption of primary energy for the collection, internal handling and transport of the waste was **170 kWh per ton of collected waste**, approximately **8 kWh** more than the previous year. CO₂ emissions of the collection phase, calculated considering the consumption of both the means of collection/transport and the transfer stations, were, on average, equal to **0,04 t of CO₂ per ton of collected waste.**
4.3. SELECTION

The paper, cardboard and tetrapak waste collected in the 45 municipalities and transported to Trevisan’s plant amounted to **62,161.62 t** in 2018. Of these, 14,545.69 t were separately collected packaging (CER 150101) and 47,615.93 t were jointly collected paper and cardboard (CER 200101). The amount entering Trevisan’s plant was slightly lower than the collected amount due to some specific streams being destined to other treatment plants and minor quantities being stored at transfer stations, that were sent for recovery at the beginning of 2019.

In the acceptance phase, Trevisan Spa conducted 76 waste characterizations on the paper and cardboard CER 200101 to evaluate the quality of the waste to sort: the results showed that **93.65% of the waste was comprised of paper material**, while 6.35% was comprised of extraneous fractions, that is material wrongly conferred by the citizen. This figure is in line with the waste characterizations conducted by Veritas Group during the collection phase.

It should be noted that in 2018, the COMIECO convention ceased, therefore the plant did not proceed with the usual selection of CER 200101 to obtain the packaging fraction to be sent to COMIECO-affiliated papermills. The paper and cardboard waste were selected to remove extraneous fractions and then sent to papermills. All of the received waste passed through the selection lines to eliminate extraneous fractions. From the selection, **14,327.51 t of packaging and 44,592.32 t of selected paper and cardboard were obtained**.

23.04% of the processed waste was sent for recycling as packaging, while 71.74% was selected and sent for recycling as selected mixed material (packaging and graphic paper). **94.78% of the incoming paper and cardboard waste was selected and sent for recovery** in specialized papermills.

The remaining 5.22%, equal to 3,242 t, was instead separated as extraneous fraction: in particular, 6,87 t were separated as glass scraps (CER 191205), 3,64 t were discarded (CER 160213* and CER 160214). Furthermore, 0.92 t consisted of mixed construction and demolition waste (CER 170904). The main separated fraction was made of non-recyclable scraps CER 191212, amounting to 3,230.37 t.

These figures are in line with what recorded in 2017: the amount of processed waste increased by 2,175 t, while the percentage of paper and cardboard sent for recovery at papermills marginally increased, from 94.44% to 94.78%. This was tied to a lower presence of extraneous fractions in the waste, particularly of non-recyclable scraps.

For the waste selection, 66,963 litres of diesel fuel and 559 MWh of electric energy were used. For each ton of selected waste, including both the operations in the selection lines and the handling activities of the different materials on site, approximately 33.5 kWh of energy were necessary. Carbon dioxide emissions during the selection phase remained equal to approximately 0.01 t of CO$_2$ per ton of processed waste.
4.4. PAPER AND CARDBOARD RECOVERY TREND

Having arrived in 2019 at the first recertification of the paper and cardboard recovery chain, it is possible to analyze the progress of the main indicators for the 2015-2018 period. Focusing on the first phases of the waste chain, a progressive increase in the paper and cardboard collected in the catchment basin can be observed, going from 60.550 t in 2015 to 64.038 t in 2018; per capita production of paper and cardboard varied from 62.8 kg/inh in 2015 to 65.3 kg/inh in 2018. Similarly, both selectively collected packaging (CER 150101) and jointly collected paper and cardboard (CER 200101) increased.

Concerning the treatment of paper and cardboard waste, a slight reduction of the recovery percentage can be observed between 2015 and 2016, due to a stricter selection at Trevisan’s plant in order to satisfy the increasingly stringer quality limits on the produced secondary raw material imposed by papermills. The monitoring of the conferred waste quality and the awareness actions put in place by Veritas Group on proper municipal waste separation, as well as Trevisan’s constant attention to maximizing recovery, achieved a progressive increase in the recovery percentage, going from 94.3% in 2016 to 94.8% in 2018. A significant increase in
similarly characterized fractions and a contextual decrease of packaging from selection was recorded in 2018: as previously outlined, this is due to the fact that in 2018, because of the ceased convention with COMIECO, the plant did not perform the selection of CER 200101 with the separation of packaging from graphic paper, but has separated the extraneous fractions and sent the material directly to papermills.

The analysis of the waste chain consumption highlights an increased consumption during the collection phase due both to Cona municipality being included in the catchment area and a higher degree of precision in the collection of data that for 2018 no longer considers average consumptions per type of vehicle but specific consumption directly monitored by collection managers. Furthermore, the consumption of natural gas vehicles is considered (up from previous years), aside from accessory consumption. The specific consumption of energy necessary for the management of paper and cardboard waste in all the chain phases, from collection to selection at Trevisan’s plant, went from 196 kWh/t in 2015 to 204 kWh/t in 2018. CO₂ emissions per ton of paper and cardboard remained constant through time and equal to 0.05 tCO₂/t.
**FIGURE 7.** Paper and cardboard collection trend – years 2015-2018.

**FIGURE 8.** Trend of treated and produced quantities during the selection phase of the paper and cardboard waste – years 2015-2018.
TRACEABILITY AND CERTIFICATION OF THE RECOVERY OF MATERIAL FROM PAPER, GLASS, PLASTIC AND METAL SEPARATE COLLECTION
DATA FOR 2018

Chapter 5
GLASS WASTE CHAIN

The glass waste chain traceability allows to follow all the streams containing glass waste, from the conferment by citizens and businesses, during the collection, inside the selection plant, up to the refinement of the glass scrap to obtain oven-ready glass usable by glassworks for the production of new bottles.

Specifically, the analyzed phases and the respective companies are:

- **CONFERMENT** of the waste by citizens and businesses;
- **COLLECTION** by Veritas Spa, Asvo Spa, Eco-Ricicli Veritas Srl;
- **SELECTION** at Eco-Ricicli Veritas Srl.
- **REFINEMENT** at Ecopatè Srl.

Given the heterogeneity of the collection systems, the different fractions containing glass are monitored separately, in particular the multi-material VPL waste (glass-plastic-cans) and multi-material waste VL (glass-cans). Both the multi-material waste VPL and VL (CER 150106, mixed packaging) and single-material glass streams CER 150107 (glass packaging) and CER 200102 (glass) are traced.

16.4% of GLASS, PLASTIC AND CANS, equal to 88 kg per person

To collect and select 1 t of waste containing GLASS 229 kWh are needed

And to refine 1 t of GLASS waste 111 kWh are needed

24.7 kg of MIXED OVEN-READY GLASS per person

5.4 kg of WHITE OVEN-READY GLASS per person

In 2018 every one of us produced 540 kg of waste (including household composting)

FROM GLASS TO GLASS

recovering
The collected waste is transported to transfer stations or directly to Eco-Ricicli Veritas’ plant, where glass is separated from plastic and metals in the dedicated lines, with care of eliminating the extraneous fractions also present. The exiting selected glass is sent to Ecopatè’s plant, where it is further refined to produce mixed and white oven-ready glass to send for recycling at glassworks.

5.1. CONFERMENT

The first phase of the waste chain is represented by the citizens and businesses conferring their glass waste following the guidelines provided by their municipality. In 2018, the citizens and businesses of the 45 municipalities served by Veritas Group conferred 86,793,61 t of glass, plastic and can waste, with an average per capita production of 88 kg of glass-plastic-cans (considering all the waste fractions containing glass, plastic and metals).

The 89 waste characterizations conducted by Ecoprogetto Venezia on the undifferentiated municipal waste in 2018, revealed that 4,59% of the undifferentiated waste is comprised of glass, erroneously conferred by citizens in the undifferentiated fraction.

Regarding the multi-material waste, the extraneous fractions found in the VPL was on average equal to 18,17% and was mostly comprised of paper, rags, WEEE and other pollutants; in the VL, the extraneous fractions are 6,13%. The interception index of glass was equal to 85,14%, a slight reduction from 2017. The non-intercepted glass was mostly conferred in the undifferentiated waste (14,33%) and to a lesser extent in paper, in plastic and in multi-material PL.

5.2. COLLECTION

In the 45 municipalities served, 76,453,90 t of waste containing glass were collected. This figure is lower than the one reported in the conferment phase as it considers only the multi-material VPL and VL (150106) and single-material glass (CER 150107 and CER 200102) fractions, so as to only consider waste streams containing glass. The difference is made up by single-material plastic (CER 150102 and CER 200139), multi-material plastic-cans PL (CER 150106) and separately collected metal (CER 150104 and CER 200140), not considered in this waste chain but in the respective plastic and metal ones.

For the collection, handling and transport of the waste, 865,350 litres of diesel fuel, 1,990 litres of petrol and 3,185 Nm³ of methane were used. The electric energy consumption of transfer stations and operational headquarters during the reference year were equal to 186,23 MWh. The unitary consumption of primary energy was equal to 130 kWh, per ton of collected waste, decreasing from the previous year.

CO₂ emissions of the collection phase were on average equal to 0,03 tCO₂ per ton of collected waste containing glass, calculated considering the consumption of both the vehicles for the collection and transport and the transfer stations.
5.3. SELECTION

The waste containing glass collected by the different companies and transported to Eco-Ricicli Veritas’ plant amounted to a total of 69,570,64 t. This figure was lower than the collected amount since 31,587,77 t of single-material glass collected in the municipalities served by Asvo were directly sent to Ecopatè’s plant; likewise, 2,356,58 t of multi-material VL collected in the Riviera del Brenta and Miranese municipalities and in the Metropolitan city of Venice mainland were sent to Ecopatè. Lastly, 1,163,67 t of waste were sent for treatment at other plants, whilst minor quantities were stored in transfer stations and sent for recovery in 2019.

In the acceptance phase at Eco-Ricicli Veritas’ plant, 360 waste characterizations were conducted on the incoming multi-material waste: the analyses revealed the glass from packaging fraction (glass>10*10 mm and fine fraction<10*10 mm) to be 56,09%. The analyses also revealed the presence of 28,77% of plastics and metals and 16,58% of extraneous fractions in the VPL, with an increase from 2017.

All of the received waste was sent through the selection lines to obtain a clean glass waste to be sent to the subsequent refining plant: from the waste selection, 31,982,52 t of glass were obtained, 45,97% of the processed waste, a slight increase from the previous year. On the selected glass, 306 analyses were conducted before sending it to the refining plant.

For the multi-material selection at Eco-Ricicli Veritas’ plant, 163,193 litres of diesel fuel and 1,806 MWh of electric energy were used. The unitary consumption of primary energy for the waste selection is approximately 88 kWh per ton of processed waste, a figure higher than the previous year. Carbon dioxide emissions from the selection phase are approximately 0,02 tCO₂ per ton of processed waste.

All of the produced glass cullet was subsequently transported from Eco-Ricicli Veritas srl to Ecopatè srl.

5.4. REFINEMENT

The glass from selection exiting Eco-Ricicli Veritas’ plant was sent for treatment at Ecopatè’s plant, together with the single-material glass collected in the municipalities served by Asvo and the VL collected in the area served by Veritas, for a total amount of 37,497,87 t. In 2018 the plant treated 37,212,89 t, an amount slightly lower than the one entering the plant for stocking reasons.

From the refinement of said waste (over 99% of the incoming stream), 29,578,06 t of oven-ready glass were obtained, 79,48% of the total processed waste. Compared to the previous year, the amount of material refined by Ecopatè increased both for the increased glass cullet produced by Eco-Ricicli Veritas Srl, as a direct consequence of the increase of separate collection, for the increased single-material glass collected by Asvo, and for the multi-material VL directly sent to Ecopatè (a stream that didn’t exist the previous years). The percentage of oven-ready glass obtained by the processed glass slightly decreased (80,02% in 2018); the analyses on the glass selected by Eco-Ricicli Veritas srl highlight a slight increase in extraneous fractions present. The material exiting the refining lines was comprised of glass.
grains (2,552,06 t), ceramic and porcelain (2,240,87 t) and non-recyclable scraps (863,61 t). A fraction of iron, aluminum and plastic (1,978,28 t) was also present and was sent to a selection plant to be treated again, with an approximate 80% recovery rate. Minerals (CER 191209) and glass scraps (fine glass grains and glass sheets CER 191205) were discarded fractions in the production of oven-ready glass but were sent for subsequent treatments finalized for their recovery in dedicated chains (recycled aggregates for construction/products) with a recovery of 70%.

Of the oven-ready glass produced, 24,264,64 t are comprised of mixed oven ready glass sent to O.I. glassworks at San Polo di Piave, while 5,313,42 t are comprised of white oven-ready glass, sent to other glassworks.

For the recycling phase, 89,597 Nm³ of methane, 16,572 litres of diesel fuel and 776,9 MWh of electric energy were consumed. The primary energy consumption of the refining phase was equal to 80 kWh per ton of refined waste, approximately 6 kWh per ton less compared to the previous year. Carbon dioxide emissions produced during the refinement phase were approximately 0,02 tCO₂ per ton of refined glass from selection, in line with the previous year.

For the production of glass from raw materials, CO₂ emissions were equal to 1,754 t CO₂eq/t of collected glass. Of these, 0,31 tCO₂eq/t of produced glass concern the procurement of said raw materials, in other words the transport from the storage place to glassworks. This figure, although estimated, is partial as it does not consider the extraction phase.

<table>
<thead>
<tr>
<th>Recycled Glass Waste Chain</th>
<th>Energy consumption of the different operational phases</th>
<th>To manage 1 t of waste throughout the whole traced waste chain, are needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Collection, transfer and transport</strong></td>
<td></td>
<td>= 0,34 MWh_p/t</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>865,350,38 litres (= 9,444,43 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Petrol</td>
<td>1,989,68 litres (= 19,49 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Electric energy</td>
<td>186,230,56 kWh (= 450,68 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td>3,185,40 m³ (= 32,40 MWh_p)</td>
<td></td>
</tr>
<tr>
<td><strong>Selection process and transport</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>194,477,00 litres (= 2,122,52 MWh_p)</td>
<td>Primary energy total 6,493,90 MWh_p</td>
</tr>
<tr>
<td>Electric energy</td>
<td>1,806,356,00 kWh (= 4,371,38 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td>89,596,91 m³ (= 911,32 MWh_p)</td>
<td></td>
</tr>
<tr>
<td><strong>Refinement and transport</strong></td>
<td></td>
<td>Primary energy total 3,173,11 MWh_p</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>84,449,36 litres (= 921,68 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Electric energy</td>
<td>776,906,00 kWh (= 1,880,11 MWh_p)</td>
<td></td>
</tr>
<tr>
<td>Methane</td>
<td>89,596,91 m³ (= 911,32 MWh_p)</td>
<td></td>
</tr>
</tbody>
</table>
5.5. GLASS WASTE RECOVERY TREND

Analyzing the trend of the indicators of the glass recovery chains between 2015-2018, an increase in glass, plastic, metal waste produced could be observed, varying from 73.732 t in 2015 to 86.794 t in 2018, with an almost 18% increment. Similarly, per capita production of said waste varied from 76.6 kg/inh*year in 2015 to 88.5 kg/inh*year in 2018.

Therefore, the amount of waste containing glass treated at Eco-Ricicli Veritas’s plant progressively increased, going from 60.886 t in 2015 to 69.570 in 2018. On the contrary, the amount of selected glass obtained decreased over time, going from 33.096 t to 31.983 t due to both the increase in extraneous fractions in the multi-material VPL and to the stricter selection by Eco-Ricicli Veritas srl to obtain a cleaner scrap. Concerning the treatment made at Ecopatè’s plant, a progressive increase in the amount of treated glass can be observed, varying from 33.623 t in 2015 to 37.213 t in 2018, a 10% increment almost equal to 3.600 t. This is due to the substantial increase in single-material glass collected in the municipalities served by Asvo that is directly sent to the refining plant without being first selected at Eco-Ricicli Veritas srl because of its amount. It went from 25.584 t of oven-ready glass produced in 2015 to 29.578 t in 2018, over 15% more in weight. The yield of the refinement process varied from 76.09% to 79.48% in the same period.

The analysis on the chain consumption shows a progressive reduction in the consumption of the collection phase, which varies from 15.540 MWh$_p$ to 9.947 MWh$_p$, with a specific consumption that varies from 258 to 130 kWh/t of collected waste. This particularly depends on the progressive reduction of diesel fuel consumption of the vehicles for the waste collection. Selection consumption, instead, increased from 3.693 MWh$_p$ to 6.152 MWh$_p$, or rather from 61 to 88 kWh/t of selected waste; this is mostly due to the increase in diesel fuel used and to a lesser extent to the increase in electric energy consumption. Conversely, the consumption of the refinement phase diminished going from 3.096 MWh$_p$ to 2.972 MWh$_p$ (92 kWh/t in 2015 and 80 kWh/t in 2018).

The specific energy consumption necessary for the management of the glass waste in all of the chain phases, from collection to refinement at Ecopatè’s plant, goes from 446 kWh/t in 2015 to 340 kWh/t in 2018. CO$_2$ emissions per ton of glass remain constant over time and equal to 0.08 tCO$_2$/t.
GLASS-CONTAINING WASTE COLLECTION TREND (2015-2018)


GLASS WASTE RECOVERY TREND (2015-2018)

PLASTIC WASTE CHAIN

Chapter 6
PLASTIC WASTE CHAIN

The plastic recovery chain traces the route of the plastic waste coming from the separate collection, from the conferment by citizens and businesses, through the collection, the selection at Eco-Ricicli Veritas’ plant where plastic packaging is separated from glass and metal packaging, until the refinement of non-COREPLA plastic at MyReplast Industries’ plant to obtain plastic material to be sent for recovery at specialized plants. Two streams exit Eco-Ricicli Veritas’ plant: the first one consists of plastic packaging sent to COREPLA selection centers, where they are separated by polymer and by color before recycling; the second one consists of non-COREPLA plastic (e.g. CONIP crates and rigid polyethylene and polypropylene packaging), sent to MyReplast Industries’ plant to be processed and become new material that is UNIPLAST-UNI 10667 compliant.

The traced phases and the respective companies are:

- **CONFERMENT** of the waste by citizens and businesses;
- **COLLECTION** by Veritas Spa, Asvo Spa, Eco-Ricicli Veritas Srl;
- **SELECTION** at Eco-Ricicli Veritas Srl.
- **REFINEMENT** at MyReplast Industries Srl.

To consider all waste fractions containing plastic, both multi-material VPL and PL streams (CER 150106 mixed packaging) and single-material plastic streams, CER 150102 (plastic packaging) and CER 200139 (plastics), are traced.
6.1. CONFERMENT

The first phase of the waste chain is represented by the conferment of plastic waste by citizens and businesses. In 2018, 86,793,61 t of glass, plastic and can waste were produced in the 45 served municipalities, considering all the fractions containing these types of materials (mixed packaging CER 150106, single-material glass CER 150107 and CER 200102, single-material plastic CER 150102 and CER 200139, metals CER 150104 and CER 200140).

From waste characterizations conducted by Ecoprogetto Venezia srl in 2018 on the undifferentiated municipal waste, it emerged that 18,33% of the undifferentiated waste consists of plastics, for the most part packaging and packaging film (about 16,01%) and to a lesser extent of non-COREPLA plastics (2,32%). A high percentage of recyclable material was still wrongly conferred in the undifferentiated fraction of the municipal waste.

The analyses on the multi-material waste showed a percentage of 18,17% of extraneous fractions in VPL and 7,77% in PL. In single-material plastic CER 150102 the extraneous fraction was equal to 13,74%.

The interception index of plastic was much lower than other fraction, with a value of 45,60%. From the analyses conducted by Veritas on the composition of the extraneous fractions it emerges that over 53% of the produced plastic is conferred in the undifferentiated waste, whilst approximately 1% is wrongly disposed in the paper and cardboard bin.

6.2. COLLECTION

As for the other waste chains, the collection phase was analyzed for the eight collection areas. This has allowed to trace in detail all the waste streams collected in the various municipalities: for each collection area, the collection routes, the type of collected and transported material and the respective quantities, and the consumption of the vehicles involved were monitored. For the five transfer stations in the metropolitan area, incoming and outgoing streams and the amount of stored materials were analyzed and the energy consumption for handling and managing the waste therein was calculated.

In the reference period, in the 45 municipalities served by Veritas Group, a total of 75,565,16 t of waste containing plastic was collected, an increase of 4,030 t from 2017. Specifically, 67,510,74 t of mixed packaging VPL (glass-plastic-cans), 3,781,54 t of PL (plastic-cans), 4,123,04 t of plastic packaging CER 150102 and 149,84 t of plastic CER 200139.

Of the total collected, 71,073,21 t of waste containing plastic were transported to Eco-Ricicli Veritas’ plant for the subsequent processing; approximately 4,196 tons of waste containing plastic were sent for recovery to other plants.

For the collection, handling and transportation of the waste a total of 834,784 litres of diesel fuel and 1,343 litres of petrol were consumed. Moreover, 185,24 MWh of electric energy were consumed in the transfer stations. For each ton of collected waste, 126,68 kWh were consumed.
CO₂ emissions of the collection phases were on average equal to 0.03 tCO₂ per ton of waste containing plastic collected, calculated considering the consumption of both the vehicles for the collection and transport and the transfer stations.

6.3. SELECTION

On the waste containing plastic entering Eco-Riciclì Veritas’ plant, 394 waste characterizations were conducted. The results show the waste consists in weight of 39.81% of plastic, 44.28% of glass and metals and 15.83% of extraneous fractions.

In 2018, 71,073,21 t of multi-material waste containing plastic were selected by the plant, from which 24,136,64 t of COREPLA plastic were obtained, equal to 33.96% of the processed material, a 4% increase from 2017.

From the analyses conducted on the exiting material, it emerged that the stream consisted of approximately 76% of packaging and 5.7% of “tracers”, that is polyethylene packaging film, expanded polystyrene packaging, big bags etc.; over 17% consists of extraneous fractions, a slight increase from 2017.

From the selection, 347,01 t of non-COREPLA plastic were also obtained, equal to 0.49% of the total waste processed. The percentage of selected non-COREPLA plastic is slightly lower than the previous year (0.86% in 2017).

For the selection of waste containing plastic at the plant, 165,413,24 litres of diesel fuel and 1,831 MWh of electric energy were used. Thus, 88 kWh per ton of selected waste. Carbon dioxide emissions of the selection process are approximately 0.02 tCO₂ per ton of processed waste.

6.4. REFINEMENT

In 2018, 347,01 t of non-COREPLA plastic exiting Eco-Riciclì Veritas’ plant were sent to MyReplast Industries’ plant. All the conferred plastic was refined in the plant lines, with an electric energy consumption of 59.02 MWh. From the processing, 277,71 t of refined plastic were obtained, subsequently sent for recycling to specialized plants.

The effective recovery of non-COREPLA plastics in 2018 was 80%; from the selection processes it emerged that 20% consisted of extraneous fractions like dusts, non-recyclable plastics and under screening materials.

The average energy consumption was equal to 412 kWh_per ton of processed material, while 0.08 tCO₂/t of refined waste were emitted.
6.5. PLASTIC WASTE RECOVERY TRENDS

The trend of the main indicators of the plastic recovery chain shows a progressive **increase in the amount of waste containing plastic collected**, from 64,825 t in 2015 to 75,565 t in 2018, almost 17% more in four years. This was due to both the increase in separate collections and the variations applied in the collection systems, that saw an increase in the number of municipalities where plastic was conferred separately.

The amount of waste containing plastic treated at Eco-Ricicli Veritas’ plant therefore increased, going from 65,702 t in 2015 to 71,073 t in 2018. The **obtained amount of COREPLA plastic from selection increased by almost 30% in weight over four years**, from 18,579 t to 24,137 t; this was also reflected in the waste characterizations that showed an increase in plastic in the conferred waste, from 25% in 2015 to 40% in 2018. On the total waste processed at Eco-Ricicli Veritas’ plant, the **percentage of selected COREPLA plastic increased from 28% to 34%** in the last four years. Regarding **selected non-COREPLA plastic**, the amounts vary from 858 t in 2015 to 347 t in 2018. In 2015 for each ton of waste containing plastic, 1.310 kg of non-COREPLA plastic were obtained; last year 488 kg were obtained. Non-COREPLA
plastic exiting Eco-Ricicli Veritas’ plant was sent for refinement at Plastic-One srl until the beginning of 2018 and subsequently to MyReplast Industries srl. In 2015, 861 t of refined plastic were obtained, in 2018 they were 278 t. Although the amounts of refined plastic progressively decreased, the recovery yield of the refinement grew, going from 73% in 2015 to 80% in 2018.

From the consumption analysis, a progressive decrease of consumption specific to the collection phase could be observed in the previous three years, with values going from 171 kWh\(_p\)/t in 2016 to 127 kWh\(_p\)/t in 2018. Conversely, selection consumption increased going from 3.550 MWh\(_p\) in 2015 to 6.236 MWh\(_p\) in 2018, that is from 54 to 88 kWh\(_p\)/t of selected waste.

**FIGURE 11.** Trend of waste containing plastic collected - years 2015-2018.
FIGURE 12. Trend of treated and produced amounts during the selection and refinement of plastic waste – years 2015-2018

The metal waste chain traces the route of iron and aluminum waste coming from the separate collection, from its conferment by citizens and businesses, to the waste selection phase at Eco-Ricicli Veritas’ plant, where, firstly, metallic fractions are separated from other fractions and, secondly, iron is separated from aluminum. The iron and aluminum waste streams exiting Eco-Ricicli Veritas’ plant are further refined at Metalrecycling Venice’s plant to be then sent for recycling to smelters.

The traced phases and the respective companies are:

- **CONFERMENT** of the waste by citizens and businesses;
- **COLLECTION** by Veritas Spa, Asvo Spa, Eco-Ricicli Veritas Srl;
- **SELECTION** at Eco-Ricicli Veritas Srl.
- **REFINEMENT** at Metalrecycling Venice Srl.

Similarly to the methodology adopted for the other waste chains, all waste fractions containing metals are analyzed: metallic waste is conferred both together with plastic and glass packaging (mixed packaging glass-plastic-cans VPL), and together with plastic (mixed packaging plastic-cans PL) or glass (mixed packaging glass-cans VL); metal collection also occurs separately at collection centers.

This waste chain traces both multi-material VPL, PL and VL (CER 150106 mixed packaging) and metallic waste separately collected CER 200140 (metals) and CER 150104 (metallic packaging).
7.1. CONFERMENT

Of the 86,793,61 t of glass, plastic and can waste conferred in 2018, the major fraction was comprised of mixed packaging (75,841,49 t, 87% of the total conferred waste); 2,351,17 t (2.7% of the total conferred waste) consisted of metals separately collected at municipal collection centers (CER 200140), whilst 19,06 t consisted of separately collected metallic packaging (CER 150104). On average, yearly per capita production was equal to approximately 88 kg/inh of glass-plastic-cans.

The results of the waste characterizations conducted by Ecoprogetto Venezia srl in 2018 on the undifferentiated municipal waste, showed that 1,35% of the undifferentiated waste consisted of metallic packaging and objects and 0,55% by aluminum packaging and objects, waste that was erroneously conferred in the undifferentiated fraction by citizens and businesses.

The analyses conducted on the multi-material waste showed a percentage of extraneous fractions higher in VPL, equal to 18,17%. Lower figures are found for PL (7,77%) and VL (6,14%). Considering these results on the whole, an interception index of metals equal to 65,47% was found, decreasing from 2017: metals were erroneously conferred in the undifferentiated waste, 31,43%, and to a lesser extent in paper and cardboard and in plastic fractions.

7.2. COLLECTION

The second phase of the waste chain is the collection of the metallic waste conferred by citizens and businesses throughout Veritas Group’s catchment basin. The collection is managed by Veritas Spa, Asvo Spa and Eco-Ricicli Veritas Srl. From the analysis of every stream, it can be observed that, in 2018, 78,217,05 t of waste containing metal were collected, 4,100 t more than the previous year; the majority was collected in the municipalities of the Riviera del Brenta (24%), in the Metropolitan city of Venice mainland (26%) and in the municipalities of the East Venice area (19%).

Of the total collected waste, 68,704,96 t of waste containing metal were transported to Eco-Ricicli Veritas’ plant for the subsequent processing; 6,976,41 t were sent for recovery to other treatment plants while 1,989,88 t of metal CER 200140 were transported directly to Metalrecycling Venice srl for the subsequent refinement.

For the collection, handling and transport of the waste, 820,409 litres of diesel fuel, 1,995 litres of petrol and 3,185 m³ of methane were used. Furthermore, in the transfer stations, 184,19 MWh of electric energy were consumed. On average, 121 kWh of energy were consumed per ton of collected waste.

CO₂ emissions during the collection phase were on average equal to 0,03 tCO₂ per ton of collected glass-plastic-can waste, calculated considering the consumption of both the vehicles for the collection and transport and the transfer stations.
7.3. SELECTION

On the 68.704.96 t of multi-material waste containing metal entering Eco-Ricicli Veritas’ plant, 384 waste characterizations were conducted. The results show the waste consists in weight of 5,7% of iron and aluminum, 79,5% of glass and plastic and the remaining 18,2% of extraneous fractions.

In the reference period, all of the incoming waste was processed in the plant selection lines. From the treatment, 3.504,77 t of iron cans were obtained, equal to 5,1% of the treated material.

The analyses conducted on the iron waste selected, show that this stream mainly consists of iron (94,3%) and in minor percentages by glass (1,2%), plastic (2,3%) and aluminum (0,2%). Extraneous fractions still present have reduced to 2,0%.

From the selection, 175,76 t of aluminum cans were obtained, equal to 0,26% of the total processed. This stream consists of 92,9% of aluminum, 4,3% of plastic, 0,5% of iron, 0,4% of glass and 1,9% of extraneous fractions.

For the mixed packaging waste selection at the plant, 163.470 litres of diesel fuel and 1.809 MWh of electric energy were used. For each ton of selected waste, 90 kWh were consumed. The carbon dioxide emissions of the selection process are approximately 0,02 tCO₂ per ton of processed waste.

7.4. REFINEMENT

The selected iron, 3.504,77 t, and the selected aluminum, 175,75 t, coming from Eco-Ricicli Veritas srl were transported together with separately collected metallic waste, 1.989,88 t, at Metalrecycling Venice’s plant to be refined.

From the manual sorting of the selected iron and aluminum, 3.305,00 t of refined iron and 163,19 t of refined aluminum were obtained, while 212,34 t of extraneous fractions were separated. From the sorting of the separately collected metallic fraction CER 200140, 1.917,65 t of mixed metals were obtained, while 72,23 t of non-recyclable scraps were separated. Overall, metal recovery at Metalrecycling Venice’s plant was equal to 94,98% in 2018.

Overall, from Metalrecycling Venice’s plant, 2.955,98 t of iron, 147,74 t of aluminum and 2.106,31 t of metal CER 200140 were sent for recovery to specialized plants.

Refinement activities consumed in total 180 MWh of electric energy, with an average consumption of 31,67 kWh per processed ton; for each ton of processed waste, 0,01 t of CO₂ were emitted in the atmosphere.
7.5 METAL WASTE RECOVERY TRENDS

The yearly monitoring of the recovery chain of metals from separate collection shows a progressive increase in the waste containing metal collected, that goes from 65,040 t in 2015 to 78,217 t in 2018, over 20% more in four years.

The amount of waste containing metal treated at Eco-Ricicli Veritas’ plant increased, going from 65,049 t in 2015 to 68,705 t in 2018. The amount of iron produced from selection CER 191202 obtained, decreased in the past four years, with more than a 2,600 t variation (6,112 to 3,505 t). On the total waste containing metal processed at Eco-Ricicli Veritas’s plant, the percentage of the iron obtained from selection diminished from 9,50% to 5,10% in the previous four years. However, the waste characterizations conducted on the selected iron showed a higher degree of purity in the exiting fraction, now containing an amount of iron of 94,3% (against the 86,2% in 2015).

Regarding the aluminium obtained from selection, the amount varied from 269 t in 2015 to 176 t in 2018: in 2015 for each ton of waste containing metal, 420 kg of aluminum were obtained; in 2018, 260 kg were obtained. Similarly for aluminum, waste characterizations on the exiting...
material show an increased purity: in 2015, 82.0% of the material contained aluminum, in 2018, the percentage increased to 92.9%.

Both iron and aluminum selected by Eco-Ricicli Veritas srl were sent for refinement to Metalrecycling Venice's plant which also received the mixed metals conferred in the collection centers. Overall, the amount of metals sent for recovery to Metalrecycling diminished over time, going from 6.991 t in 2015 to 5.670 t in 2018.

It should be noted than in the previous years some interventions were conducted on Metalrecycling Venice's plant, making the comparison between processed and produced amounts difficult. Both in 2017 and 2018 there was no production of metallic End of Waste, as manual sorting of the incoming waste was conducted. The recovery percentage, decreasing from 2015 to 2017, increased in 2018.

From the consumption analysis a progressive decrease in the specific consumption of the collection phase can be observed during the previous three years, with values going from 164 kWh/t in 2016 to 121 kWh/t in 2018. Selection consumption, instead, increased, going from 3.583 MWh in 2015 to 6.163 MWh in 2018, that is from 58 to 90 kWh/t of selected waste.

**FIGURE 14.** Trend of waste containing metal collected - years 2015-2018.
TRACEABILITY AND CERTIFICATION OF THE RECOVERY OF MATERIAL FROM PAPER, GLASS, PLASTIC AND METAL SEPARATE COLLECTION

DATA FOR 2018

FIGURE 15. Trend of treated and produced amounts during the selection and refinement of metal waste - years 2015-2018

METAL WASTE SELECTION TREND (2015-2018)
**RECYCLED PAPER**

**Key figures**

In 2018

**64.039,71 t**

of PAPER AND CARDBOARD

were produced

65 kg per person

**94,78%** of selected paper and cardboard were sent to papermills for recovery.

**71,74%** as similarly characterized fractions

**23,04%** as selected packaging

To manage 1 t of paper and cardboard waste throughout the whole traced chain*

**204 kWh**

are necessary, of which:

**170 kWh** for the collection of paper and cardboard

**34 kWh** for the selection of paper and cardboard

For each ton of paper and cardboard managed the emission of

**0,6 tCO₂**

was avoided

**EU objective exceeded**

*) from collection to selection

---

**RECYCLED GLASS**

**Key figures**

In 2018

**76.453,90 t**

of MULTI-MATERIAL WASTE containing GLASS (VPL/VL/V)

were produced

78 kg per person

**79,48%** of refined glass were sent to glassworks for recovery.

**65,02%** as mixed oven-ready glass

**14,28%** as white oven-ready glass

To manage 1 t of waste containing glass throughout the whole traced chain*

**340 kWh**

are necessary, of which:

**130 kWh** for the collection of VPL/VL/V

**99 kWh** for the selection of VPL/VL/V and transport of VS

**111 kWh** for the refinement of VS and transport of VPF

For each ton of glass managed the emission of

**0,3 tCO₂**

was avoided

**EU objective exceeded**

*) from collection to dispatch to glassworks

---

**MATTER**

**ENERGY**

**EMISSION**
In 2018 **75.565,16 t** of MULTI-MATERIAL WASTE containing PLASTIC (VPL/PL/P) were produced. **77 kg per person**

**80,03%** Of refined non-COREPLA PLASTIC was sent for recovery to subsequent plants.

**92,00%** Of selected COREPLA PLASTIC was sent to recovery (of which **58%** for material recovery).

To manage **1 t** of waste containing plastic throughout the whole traced chain*—**684 kWh** are necessary, of which:

- **127 kWh** for the collection of VPL/PL/P
- **145 kWh** for the selection of VPL/PL/P and transport of PC and PNC
- **412 kWh** for the refinement of PNC

For each ton of plastic managed the emission of **1,5 tCO₂** was avoided.

In 2018 **78.217,05 t** of MULTI-MATERIAL WASTE containing METALS (VPL/VL/PL/M) were produced. **80 kg per person**

**94,98%** of refined metals were sent to recovery.

**33,82%** as refined mixed metals

**58,28%** as refined iron

**2,88%** as refined aluminum

To manage **1 t** of waste containing metal throughout the whole traced chain*—**247 kWh** are necessary, of which:

- **121 kWh** for the collection of VPL/VL/PL/M
- **94 kWh** for the selection of VPL/VL/PL/M and transport of FE-S/ALL-S/M
- **32 kWh** for the refinement of FE-S/ALL-S/M

For each ton of metal managed the emission of **1,5 tCO₂** was avoided.