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TECHNICAL-ANALYTICAL PROCEDURES FOR THE VERIFICATION OF THE QUALITY OF WASTE MANAGEMENT SERVICES IN A METROPOLITAN CITY: THE EXPERIENCE OF ROMA CAPITALE.

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DEFINITION OF THE VISION

- The work carried out on the entire territory of Roma capitale allowed us to acquire significant data on the production and quality of the waste produced by the citizens in the 15 municipalities of the city.
- The data are necessary to evaluate the current state of operational management, allowing for a more rational adaptation of the system that compose the waste collection and the waste transport.
- The data collected is the result of measurements that lasted more than a year and made possible to evaluate the efficiency of separate waste collection as well as the behavior of Users.
- In each of the 15 Municipalities, the waste collected was analyzed according to the UNI and ISPRA procedures to determine the product composition and a series of physical parameters necessary to the design of the operating systems.
- All the experimentally data acquired have allowed, to know in a precise way the global situation and Municipality by Municipality on the phenomenon of waste production in consideration of the quantities, characteristics, composition, criticality on the conferment and collection, possible lack of structures and/or equipment etc.
- The survey also highlighted a comparison of the effectiveness of the services between the different Municipalities.

PURPOSE AND OBJECTIVE

1. *Verification of the current yield of separate waste collection,*
2. *Identification of necessary interventions to increase waste sorting,*
3. *Planning of interventions to increase the recycling index,*
4. *Verification of the sizing with particular regard to the volume, the collection routes, the loading of the vehicles,*
5. *Improvement of the delivery and collection phases to avoid the out-of-bins phenomenon and rationalize the management of vehicles,*
6. *Obtain data for the correct application of contracts between waste disposal / transfer plant (like Paper and organic waste)*
7. *Use of the results for the application of the 15 deliberation ARERA (TQRIF),*

CURRENT SITUATION

- *Probable lack of equipment with particular regard on the number of dumpsters.*
- *Positioning of dumpsters in some cases to be reviewed.*
- *Inappropriate choice of some vehicles.*
- *Some paths difficult to operate.*
- *Better coordination between the different operational offices and the delivery plants.*
- *It requires a strong improvement of the plant network.*
- *Same vehicles used for the collection of various types of waste.*
- *Collection frequencies in some cases insufficient.*
- *Communications and responses with users in some areas scarce.*

THE EXPERIMENTAL INVESTIGATION

- The activity was done by highly qualified professions and with suitable equipment, following this operating scheme:

1. *Planning of the choice of waste samples*
2. *Information to the operational services for the choice of vehicles to be sent to the plants*
3. *Planning the analysis locations.*
4. *Organization of the itinerant analysts team for the analytical phase in the indicated places.*
5. *Waste analysis through manual separation certifying the different types of waste*
6. *Determination of the density of the different types of waste in kg/m^3.*
7. *Determination of waste production in Rome and in the various Municipalities for the entire year 2021.*
8. *Analysis of the demographic data.*
9. *Statistical interpolations of data.*
10. *Processing the data detected to obtain a series of indicators on the waste production phenomenon in the individual Municipalities.*
11. *Data transfer for management checks.*

PARAMETERS AND DATA DETECTED

The use of these parameters has therefore allowed a series of elaborations to verify critical elements of management for the consequent resolution.

Total quantities collected.
Tourist presences for day.
Resident population.
Surface.
Population density.
Area type.
Urbanization.
U.W. collection methodology.
Actual attendance with average annual tourism.
Practicability.
n. Families.
n. Medium family members.
Total Quantity waste for inhabitant equivalent.
Total Quantity waste for equivalent nucleus.
Total quantity waste for inhabitant with attendance.

Domestic utilities served.
Non-domestic utilities served.
Quantity delivered R.U.W.
Quantity of paper/cardboard delivered.
Quantity of glass delivered.
Quantity delivered of canteen waste and Organic.
Multi-material quantity delivered.
Other material conferred.
Total TRIBUTE area.
Area TRIBUTE UD.
Area TRIBUTE UND.
Average U.W. production on total area.
Average U.W. production on total area UD.
Average U.W. production on total area UND.

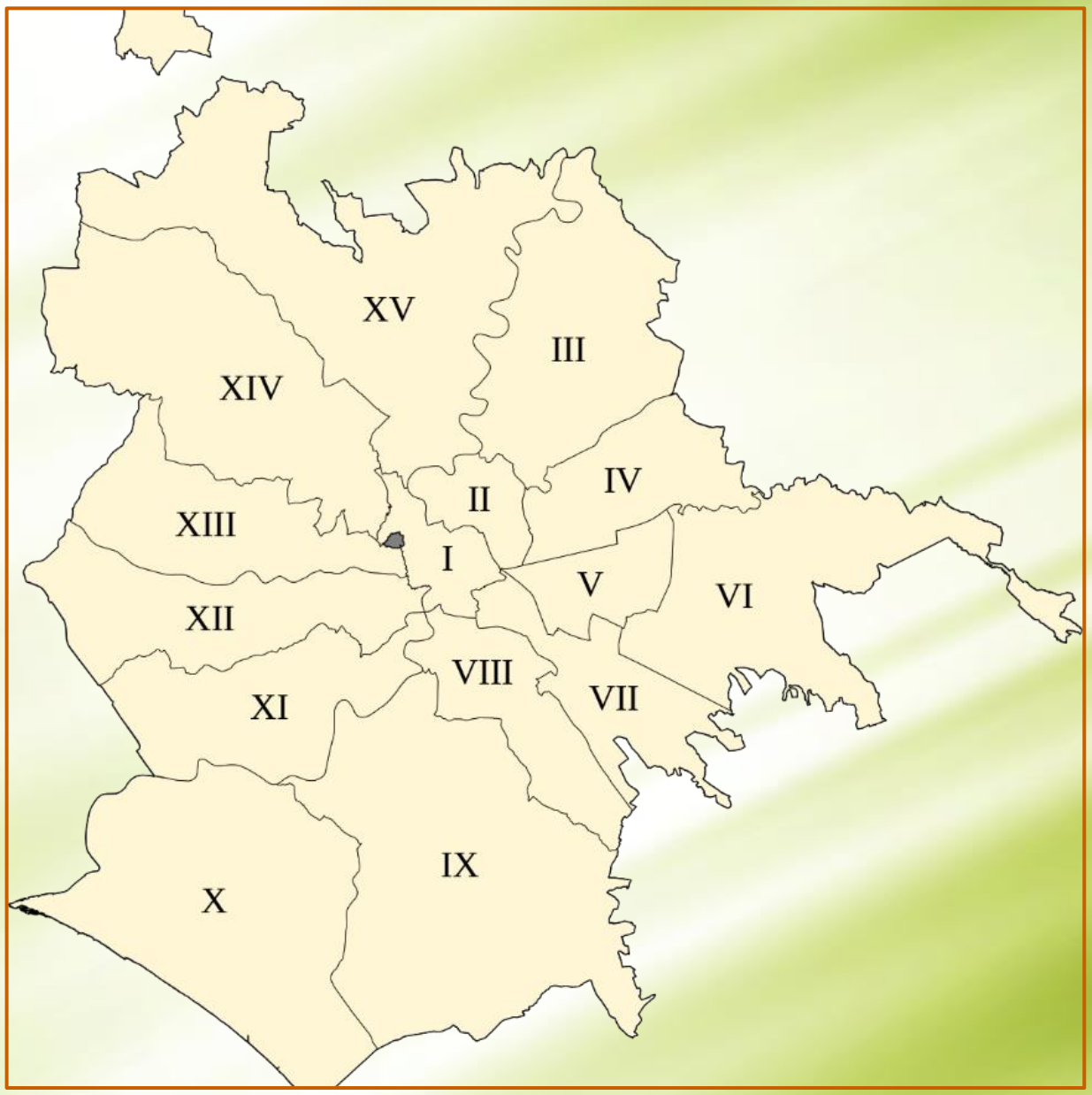
EXPERIMENTAL PHASE:
THE ANALYSES

The work, which began in 2020 and still go on, start with a careful planning to identifying the different areas of the individual municipalities, their disposal/transfer plant and their management mechanism.

The first operational phase was the characterization of the waste necessary to obtain the composition of the different categories of waste produced in a year in the capital.

For this work, about 1,200 analyses have been made

On the right the figure illustrates the division of the territory of Rome into individual municipalities.

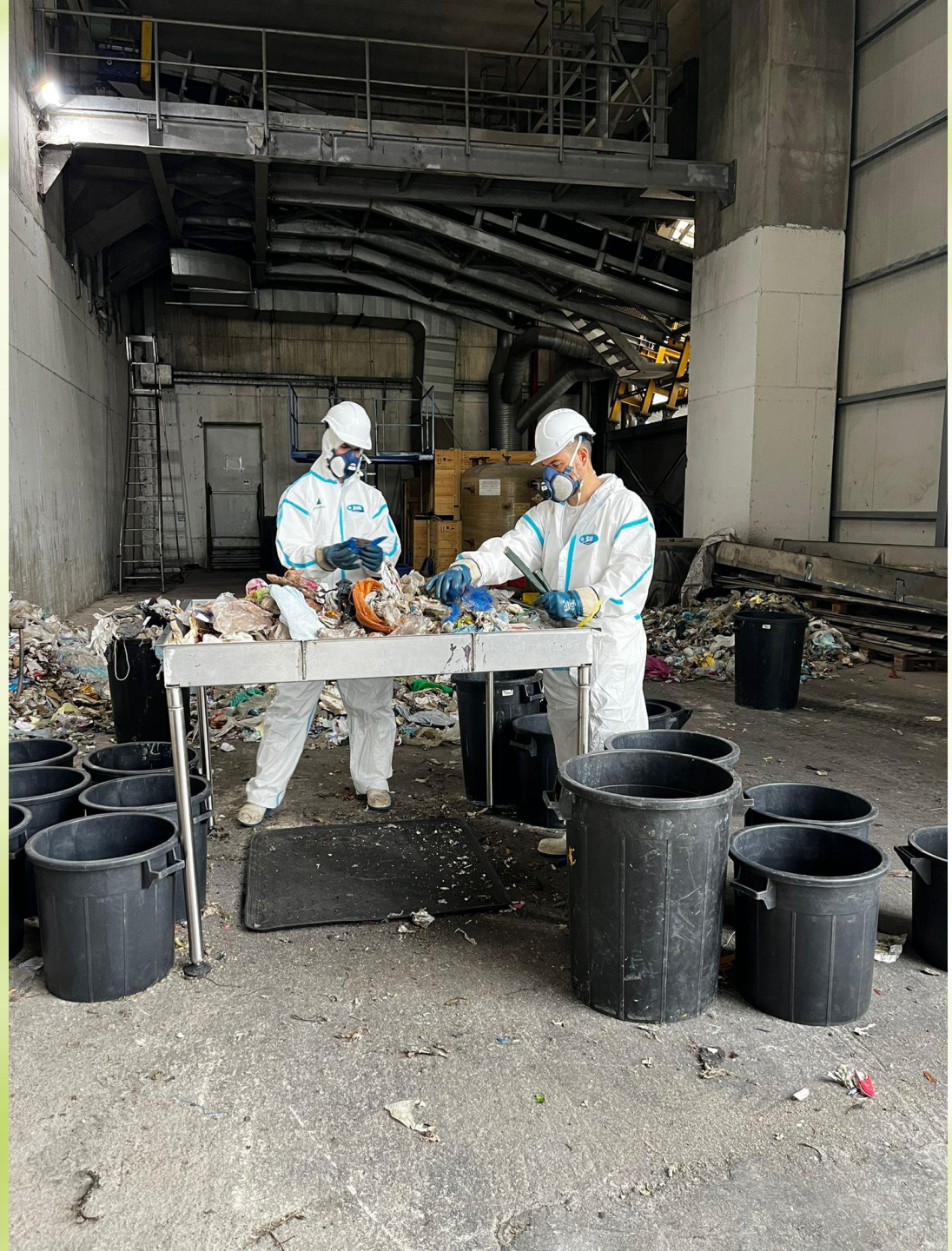


EXPERIMENTAL PHASE RESULTS

Undifferentiated Fractions	Multi-material Fractions	Organic waste Fractions	Paper and Cardboard Fractions	Iron and other metals Fractions	Glass Fractions
Under mm.20	Under mm.20	Under mm.20	Graphic Paper	mm. 20	mm. 10
Canteen waste - organic	Canteen waste - organic	Canteen waste - organic	Cardboard packaging	Canteen waste - organic	Metal packaging
Compostabile Green	Paper/Cardboard	Non typographicPaper/Cardboard	Lightweight cardboard packaging	Compostabile Green	Plastic fraction
Paper/Cardboard	Wood	Compostabile Green	Paper packaging	Paper/Cardboard	Ceramic - stone
Wood	Polystyrene	Wooden packaging	Beverage carton	Wood	Other impurities
Plastic packaging	Flexible plastic packaging	Biodegradable plastic	Various	Plastic packaging	Laminated glass, etc.
Non-packaging plastic	Bottles (PET)	Printed paper		Non-packaging plastic	
Rubber	Packaging (HDPE, PVC)	Diapers		Rubber	
Polylaminate packaging	Non-domestic plastic films	Lightweight plastic		Ferrous metals not packaging	
Ferrous	Black shopper	Heavy plastic		Steel packaging	
Non-ferrous metals	Other plastic packaging	Rags and fabrics		Non-ferrous metals	
Glass	Leather and rubbers	Leather and rubbers		Glass	
Building material	Other non-packaging plastic	Polylaminate packaging		Building material	
Textile	Polylaminates plastic	Ferrous		Textile	
Sanitary textiles	Steel packaging	Non-ferrous metals		Sanitary textiles	
Dangerous	Other ferrous metals	Glass		Dangerous	
Batteries	Aluminium packaging	Building material		Batteries	
RAEE	Unpackaged aluminium	Bulky		RAEE	
Various	Other non-ferrous metals	Various		Various	
	Glass packaging				
	Non-packaging glass				
	Rags and fabrics				
	Bulky				
	Various				

Fractions detected in the different classes of waste collected

EXPERIMENTAL PHASE



EXPERIMENTAL PHASE RESULTS

Undifferentiated	NUMBER MUNICIPALITY															
Municipality	I	II	III	IV	V	VI	VII	IIX	IX	X	XI	XII	XIII	XIV	XV	**TOTAL**
Fraction																
Under mm.20	5,538%	3,871%	3,684%	5,992%	3,655%	2,251%	3,363%	4,442%	1,916%	4,423%	2,632%	3,068%	2,770%	5,250%	5,590%	**3,898%**
Canteen waste - organic	21,766%	32,519%	21,643%	13,990%	22,917%	15,077%	26,405%	27,304%	13,778%	15,619%	21,789%	17,513%	22,109%	14,327%	19,818%	**20,512%**
Compostabile Green	4,925%	1,995%	3,917%	6,679%	1,543%	8,992%	3,821%	2,450%	3,103%	3,893%	4,259%	4,018%	9,144%	7,057%	0,453%	**4,520%**
Paper/Cardboard	20,561%	19,157%	18,596%	20,619%	20,110%	19,329%	16,320%	10,334%	28,712%	20,899%	14,569%	21,194%	19,778%	19,101%	25,549%	**19,327%**
Wood	2,362%	0,932%	1,789%	3,836%	1,822%	0,524%	0,069%	0,987%	1,029%	2,395%	2,417%	0,218%	2,475%	0,804%	0,128%	**1,536%**
Plastic packaging	20,432%	13,916%	15,109%	17,744%	19,213%	22,263%	16,414%	19,520%	22,983%	14,148%	18,807%	21,320%	20,034%	14,720%	23,789%	**18,480%**
Non-packaging plastic	2,182%	3,203%	2,403%	2,146%	1,646%	2,386%	1,935%	3,622%	7,407%	6,332%	1,531%	0,489%	1,575%	1,299%	5,210%	**2,718%**
Rubber	1,063%	0,210%	0,913%	2,785%	2,682%	0,800%	2,973%	1,946%	1,609%	1,302%	1,472%	1,186%	2,360%	1,385%	1,388%	**1,750%**
Polylaminate packaging	0,749%	0,674%	0,352%	0,722%	0,465%	0,569%	1,132%	1,559%	0,336%	1,010%	1,088%	1,109%	0,398%	1,466%	0,325%	**0,813%**
Ferrous	4,055%	1,241%	1,801%	1,945%	3,052%	7,123%	1,941%	1,388%	2,896%	4,265%	2,934%	3,328%	1,197%	2,767%	1,302%	**2,922%**
Non-ferrous metals	0,866%	0,663%	1,176%	1,016%	0,600%	1,373%	1,371%	1,734%	2,247%	0,687%	1,008%	0,886%	1,038%	1,078%	0,376%	**1,080%**
Glass	4,436%	11,660%	7,268%	3,957%	5,409%	5,958%	5,462%	4,814%	4,383%	4,780%	7,431%	5,354%	2,449%	5,733%	2,618%	**5,394%**
Building material	0,467%	0,436%	6,038%	2,110%	0,244%	0,000%	1,819%	2,994%	0,447%	1,535%	0,000%	0,758%	0,085%	7,314%	0,423%	**1,587%**
Textile	4,992%	2,869%	8,917%	5,318%	8,163%	7,649%	7,172%	10,857%	2,738%	4,379%	8,295%	9,055%	6,150%	9,751%	3,497%	**6,809%**
Sanitary textiles	2,984%	3,808%	4,642%	5,736%	5,462%	2,718%	4,835%	2,007%	4,424%	9,294%	6,286%	6,079%	6,067%	3,419%	5,231%	**4,891%**
Dangerous	0,012%	0,020%	0,000%	0,138%	0,003%	0,000%	0,198%	0,066%	0,010%	0,129%	0,004%	0,121%	0,063%	0,012%	0,000%	**0,060%**
Batteries	0,000%	0,152%	0,090%	0,041%	0,020%	0,064%	0,366%	0,026%	0,000%	0,080%	0,000%	0,000%	0,000%	0,046%	0,060%	**0,074%**
RAEE	0,031%	0,203%	0,000%	1,430%	0,099%	0,000%	1,581%	0,459%	0,000%	1,039%	0,000%	0,776%	0,042%	0,913%	2,058%	**0,563%**
Various	2,580%	2,471%	1,663%	3,795%	2,894%	2,924%	2,821%	3,490%	1,982%	3,792%	5,479%	3,525%	2,267%	3,559%	2,186%	**3,065%**
TOTAL	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**	**100,000%**

Values in % by weight for the undifferentiated waste

EXPERIMENTAL PHASE RESULTS

Multi-Material	NUMBER MUNICIPALITY															
Municipality	I	II	III	IV	V	VI	VII	IIX	IX	X	XI	XII	XIII	XIV	XV	**TOTAL**
Fraction																
Under mm.20	0,736%	1,919%	2,198%	0,641%	1,820%	0,778%	1,055%	0,797%	0,972%	1,128%	0,468%	1,602%	0,543%	0,487%	3,281%	**0,991%**
Canteen waste - organic	1,814%	2,012%	0,453%	0,623%	2,968%	3,925%	0,550%	0,370%	2,033%	0,025%	0,842%	0,627%	0,133%	2,421%	4,001%	**1,376%**
Paper/Cardboard	3,370%	5,833%	2,340%	3,734%	3,156%	2,972%	2,675%	2,836%	3,136%	1,375%	3,159%	4,848%	2,269%	2,216%	4,100%	**3,125%**
Wood	0,801%	0,048%	0,000%	0,000%	0,066%	0,000%	0,000%	0,015%	0,000%	0,000%	0,324%	0,000%	1,796%	0,016%	0,000%	**0,274%**
Polystyrene	1,310%	7,278%	0,737%	1,288%	2,329%	3,459%	1,712%	1,932%	1,779%	2,029%	2,702%	2,696%	2,171%	2,169%	0,989%	**2,184%**
Flexible plastic packaging	23,604%	25,607%	20,054%	30,810%	19,427%	23,538%	20,747%	24,114%	27,494%	23,368%	26,060%	20,503%	27,670%	21,979%	14,888%	**24,186%**
Bottles (PET)	28,688%	24,116%	40,742%	29,336%	20,851%	30,158%	34,905%	36,267%	30,783%	31,896%	29,979%	18,523%	29,730%	30,854%	43,477%	**30,383%**
Packaging (HDPE, PVC)	6,609%	4,025%	7,680%	9,033%	7,256%	6,195%	7,755%	3,777%	7,722%	9,147%	8,468%	7,799%	5,086%	5,261%	4,190%	**6,758%**
Non-domestic plastic films	2,768%	0,512%	0,284%	1,027%	1,650%	2,528%	0,422%	1,667%	0,700%	0,592%	2,076%	3,516%	2,224%	2,752%	0,000%	**1,646%**
Black shopper	1,925%	0,943%	0,052%	2,255%	1,514%	0,383%	1,279%	2,271%	1,038%	1,958%	2,725%	2,645%	1,530%	2,230%	4,432%	**1,722%**
Other plastic packaging	11,754%	7,804%	10,124%	8,557%	8,679%	9,511%	8,523%	9,312%	10,057%	12,590%	6,986%	11,274%	9,536%	10,877%	5,988%	**9,908%**
Leather and rubbers	0,432%	0,984%	0,349%	0,505%	1,670%	0,130%	0,820%	1,099%	1,307%	0,689%	0,107%	0,321%	1,752%	0,397%	0,000%	**0,740%**
Other non-packaging plastic	0,677%	1,770%	6,788%	1,261%	3,710%	0,890%	1,458%	0,377%	1,712%	1,374%	2,596%	2,223%	0,957%	2,174%	0,773%	**1,518%**
Polylaminates plastic	0,956%	0,996%	0,595%	0,824%	1,406%	1,819%	1,660%	0,714%	0,333%	0,181%	0,879%	1,691%	0,900%	1,379%	1,528%	**0,975%**
Steel packaging	5,909%	6,205%	2,612%	3,643%	7,068%	6,030%	6,212%	7,424%	5,340%	8,532%	4,631%	8,774%	7,699%	5,047%	4,091%	**6,098%**
Other ferrous metals	0,000%	0,246%	0,000%	0,686%	0,427%	0,000%	0,577%	0,443%	0,000%	0,000%	0,336%	2,170%	0,166%	1,661%	0,000%	**0,373%**
Aluminium packaging	2,917%	1,987%	1,513%	1,905%	2,023%	2,409%	4,996%	1,947%	2,970%	2,754%	3,881%	4,860%	2,449%	3,719%	4,136%	**2,950%**
Unpackaged aluminium	0,005%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	**0,001%**
Other non-ferrous metals	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	**0,000%**
Glass packaging	2,984%	3,107%	1,461%	2,013%	8,242%	2,634%	1,777%	2,084%	0,960%	1,346%	2,403%	3,264%	0,299%	1,362%	0,854%	**2,214%**
Non-packaging glass	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,236%	0,000%	0,000%	**0,014%**
Rags and fabrics	0,369%	1,647%	0,957%	0,420%	1,122%	1,185%	1,109%	1,568%	0,720%	0,409%	0,513%	0,357%	1,143%	1,105%	2,463%	**0,863%**
Bulky	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,000%	0,499%	0,000%	0,000%	0,000%	**0,021%**
Various	2,372%	2,960%	1,060%	1,439%	4,614%	1,456%	1,767%	0,986%	0,947%	0,607%	0,865%	1,807%	1,711%	1,894%	0,809%	**1,679%**
TOTAL	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	**100,000%**

Values in % by weight for the multi-material (plastic-tin)

EXPERIMENTAL PHASE RESULTS

FORSU	NUMBER MUNICIPALITY															
Municipality	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	**TOTAL**
FRACTION																
Under mm.20	**3,92%**	**3,64%**	**3,00%**	**11,83%**	**3,93%**	**3,00%**	**2,00%**	**3,87%**	**3,55%**	**3,37%**	**1,28%**	**2,87%**	**3,33%**	**2,55%**	**0,37%**	**3,28%**
Canteen waste - organic	**71,11%**	**66,78%**	**70,23%**	**56,42%**	**70,99%**	**68,67%**	**65,90%**	**67,79%**	**73,24%**	**63,38%**	**85,33%**	**60,13%**	**66,97%**	**71,42%**	**34,24%**	**66,94%**
Non typographicPaper/Cardb	**6,56%**	**5,11%**	**6,88%**	**4,18%**	**6,55%**	**8,70%**	**5,37%**	**5,88%**	**7,76%**	**10,73%**	**6,17%**	**6,94%**	**5,61%**	**4,67%**	**5,33%**	**7,13%**
Compostabile Green	**2,80%**	**8,81%**	**1,35%**	**0,08%**	**2,81%**	**2,59%**	**4,93%**	**7,62%**	**4,25%**	**8,62%**	**0,00%**	**10,58%**	**4,21%**	**6,68%**	**0,28%**	**6,11%**
Wooden packaging	**2,84%**	**1,30%**	**2,89%**	**0,03%**	**2,85%**	**2,54%**	**3,87%**	**4,27%**	**0,79%**	**4,21%**	**1,73%**	**0,00%**	**1,10%**	**0,80%**	**0,00%**	**2,32%**
Biodegradable plastic	**3,01%**	**2,53%**	**2,37%**	**4,04%**	**3,02%**	**3,00%**	**3,72%**	**1,73%**	**2,81%**	**1,65%**	**0,04%**	**2,90%**	**3,12%**	**2,28%**	**4,92%**	**2,47%**
Printed paper	1,78%	1,77%	2,21%	7,07%	1,79%	1,70%	2,28%	1,66%	1,25%	1,63%	0,29%	2,38%	2,71%	1,94%	11,96%	2,02%
Diapers	0,70%	0,69%	0,50%	1,96%	0,71%	1,28%	0,24%	0,23%	0,57%	0,11%	0,00%	1,66%	0,48%	0,50%	0,00%	0,59%
Lightweight plastic	2,94%	3,51%	5,29%	4,58%	2,95%	4,08%	5,53%	3,47%	3,32%	3,45%	4,35%	4,46%	4,18%	3,26%	13,43%	3,98%
Heavy plastic	1,13%	1,16%	1,36%	2,29%	1,14%	1,26%	1,27%	1,49%	0,61%	0,78%	0,29%	1,96%	2,93%	1,49%	6,09%	1,36%
Rags and fabrics	0,72%	1,67%	1,57%	1,53%	0,73%	1,00%	2,62%	0,62%	0,32%	0,40%	0,00%	2,35%	1,12%	0,77%	4,30%	1,12%
Leather and rubbers	0,16%	0,21%	0,12%	0,00%	0,17%	0,05%	0,04%	0,10%	0,23%	0,10%	0,00%	0,38%	0,35%	0,08%	0,00%	0,15%
Polylaminate packaging	0,09%	0,07%	0,05%	0,00%	0,10%	0,09%	0,09%	0,08%	0,07%	0,06%	0,24%	0,15%	0,09%	0,21%	0,35%	0,09%
Ferrous	0,31%	0,27%	0,26%	0,31%	0,32%	0,43%	0,33%	0,30%	0,32%	0,29%	0,27%	0,30%	0,41%	0,31%	1,25%	0,32%
Non-ferrous metals	0,17%	0,44%	0,24%	0,40%	0,18%	0,31%	0,53%	0,18%	0,14%	0,24%	0,00%	0,28%	0,38%	0,32%	0,34%	0,29%
Glass	0,94%	1,03%	0,45%	2,82%	0,95%	0,73%	0,28%	0,45%	0,26%	0,56%	0,00%	1,35%	1,92%	1,88%	9,89%	0,97%
Building material	0,13%	0,01%	0,03%	1,05%	0,14%	0,00%	0,00%	0,14%	0,00%	0,03%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%
Bulky	0,12%	0,00%	0,00%	0,00%	0,13%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Various	0,55%	1,02%	1,20%	1,41%	0,56%	0,58%	1,02%	0,14%	0,53%	0,39%	0,00%	1,31%	1,09%	0,83%	7,25%	0,80%
TOTAL	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
TOTAL BIODEGRADABLE	**90,25%**	**88,16%**	**86,72%**	**76,58%**	**90,14%**	**88,50%**	**85,79%**	**91,15%**	**92,39%**	**91,97%**	**94,56%**	**83,41%**	**84,33%**	**88,41%**	**45,14%**	**88,26%**

Values in % by weight for the Biodegradable organic

EXPERIMENTAL PHASE RESULTS

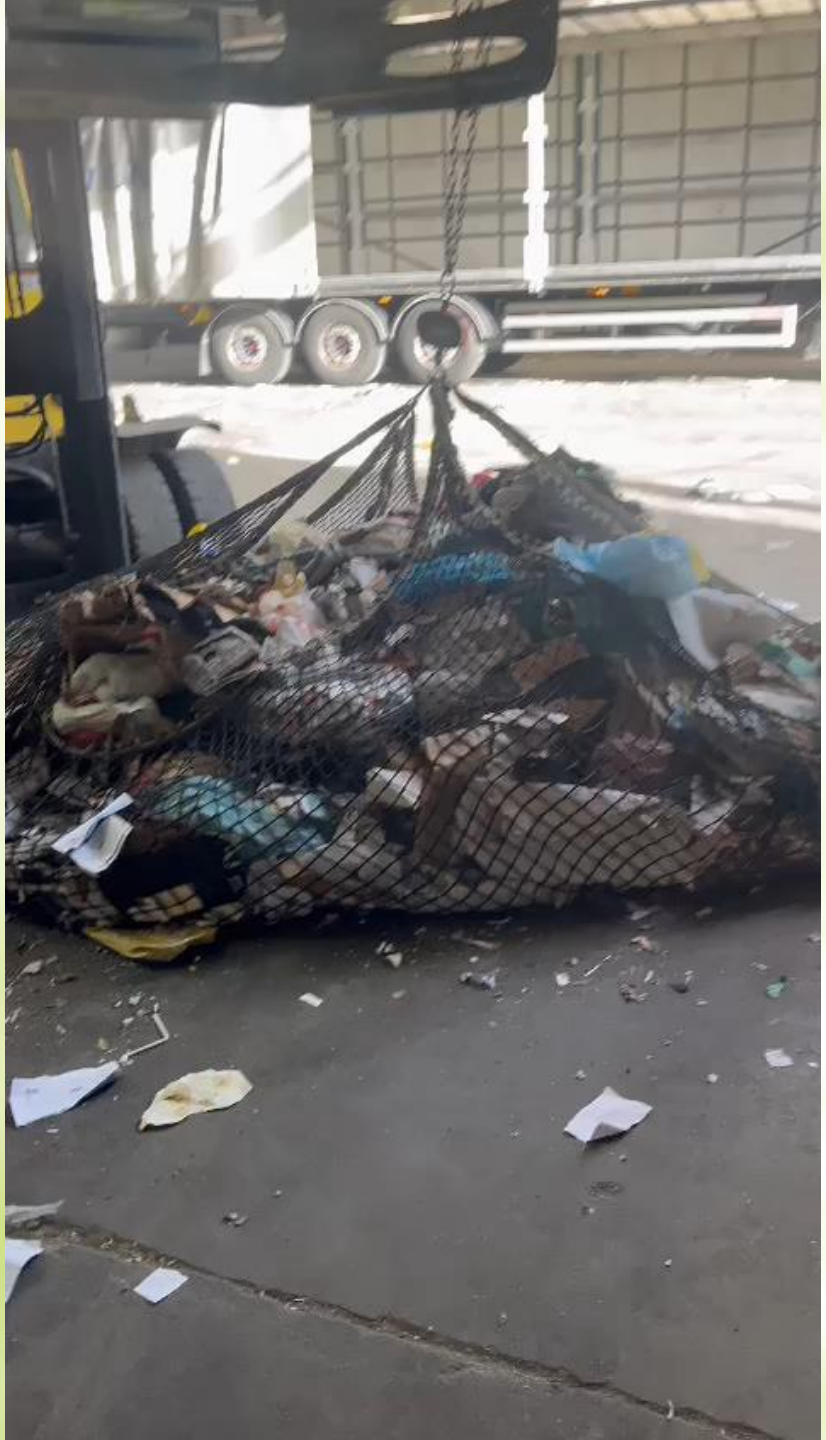
Paper and Cardboard	NUMBER MUNICIPALITY															
Municipality	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	**TOTAL**
Fraction																
1 - Graphic Paper	52,068%	49,778%	48,748%	60,484%	46,889%	52,670%	50,204%	56,246%	43,390%	51,132%	50,258%	54,340%	51,321%	54,839%	56,316%	**51,379%**
2 - Cardboard packaging	29,746%	33,022%	31,643%	22,374%	28,624%	32,500%	33,696%	27,902%	42,470%	29,070%	26,964%	29,770%	27,411%	28,464%	25,874%	**30,517%**
3 - Lightweight cardboard pac	1,378%	2,252%	2,717%	3,120%	2,543%	1,940%	2,471%	2,969%	1,392%	4,054%	1,252%	1,302%	2,891%	2,110%	2,379%	**2,403%**
4 - Paper packaging	0,621%	1,148%	1,120%	1,111%	0,988%	1,128%	0,734%	0,558%	0,839%	0,800%	0,768%	0,565%	0,811%	0,723%	1,137%	**0,880%**
5 - Beverage carton	0,558%	0,361%	0,447%	0,754%	0,361%	0,711%	0,609%	0,591%	0,708%	0,830%	0,505%	0,487%	0,645%	0,455%	0,460%	**0,577%**
6 - Various	32,303%	36,782%	35,927%	27,360%	32,515%	36,279%	37,510%	32,019%	45,409%	34,755%	29,489%	32,124%	31,759%	31,752%	29,850%	**34,377%**
7 - Total cellulosic material	**84,371%**	**86,560%**	**84,675%**	**87,844%**	**79,404%**	**88,948%**	**87,714%**	**88,265%**	**88,798%**	**85,887%**	**79,746%**	**86,464%**	**83,080%**	**86,591%**	**86,166%**	**85,756%**
8 - Other weighted waste	**15,629%**	**13,440%**	**15,325%**	**12,156%**	**20,596%**	**11,052%**	**12,286%**	**11,735%**	**11,202%**	**14,113%**	**20,254%**	**13,536%**	**16,920%**	**13,409%**	**13,834%**	**14,244%**
9 - Total (7+8)	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	100,000%	**100,000%**

Values in % by weight for the Paper and Cardboard

Glass	NUMBER MUNICIPALITY	
Municipality	I	**TOTAL**
Fraction		
mm. 10	1,63%	**1,63%**
Glass	95,58%	**95,58%**
Steel packaging	0,70%	**0,70%**
Plastic	1,44%	**1,44%**
Infusibles - ceramic porcelair	0,36%	**0,36%**
Other impurities	0,29%	**0,29%**
Laminated glass, screened, c	0,00%	**0,00%**
Total glass material	**95,58%**	**95,58%**
Other waste	**4,42%**	**4,42%**
Total	100,00%	**100,00%**

Values in % by weight for the Glass

PAPER AND CARDBOARD ANALYSIS



EXPERIMENTAL PHASE RESULTS

		TOTAL QUANTITY COLLECTED FOR 2021															
		6.177.000,00	4.901.000,00	13.338.000,00	6.614.000,00	9.846.000,00	3.571.000,00	10.484.000,00	5.798.000,00	7.728.000,00	13.852.000,00	9.336.000,00	2.122.000,00	2.052.000,00	7.961.000,00	2.661.000,00	106.441.000,00
OTHER		NUMBER MUNICIPALITY															TOTAL
FRACTION	U.M.	I	II	III	IV	V	VI	VII	IIX	IX	X	XI	XII	XIII	XIV	XV	%
Under mm. 10	%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%	3,67%
Canteen waste	%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%	24,62%
Compostabile green	%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%	3,18%
Paper/cardboard	%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%	27,21%
Wood	%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%	1,25%
Lightweight plastic packaging	%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%	14,06%
Film plastic	%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%	2,51%
Polystyrene	%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%	0,11%
Other plastic	%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%	0,26%
Leather and rubbers	%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%	1,03%
Polylaminate packaging	%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%	0,46%
Ferrous	%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%	2,03%
Non-ferrous metals	%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%
Glass	%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%	8,34%
Building material	%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%	0,87%
Sanitary textiles	%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%	2,96%
Textile	%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%	3,99%
Bulky	%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%	0,01%
Various	%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%	2,18%
Dangerous	%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%	0,10%
RAEE	%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%	0,37%
TOTAL	%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Values in % by weight per fraction of waste on average waste collected by municipality

EXPERIMENTAL PHASE RESULTS

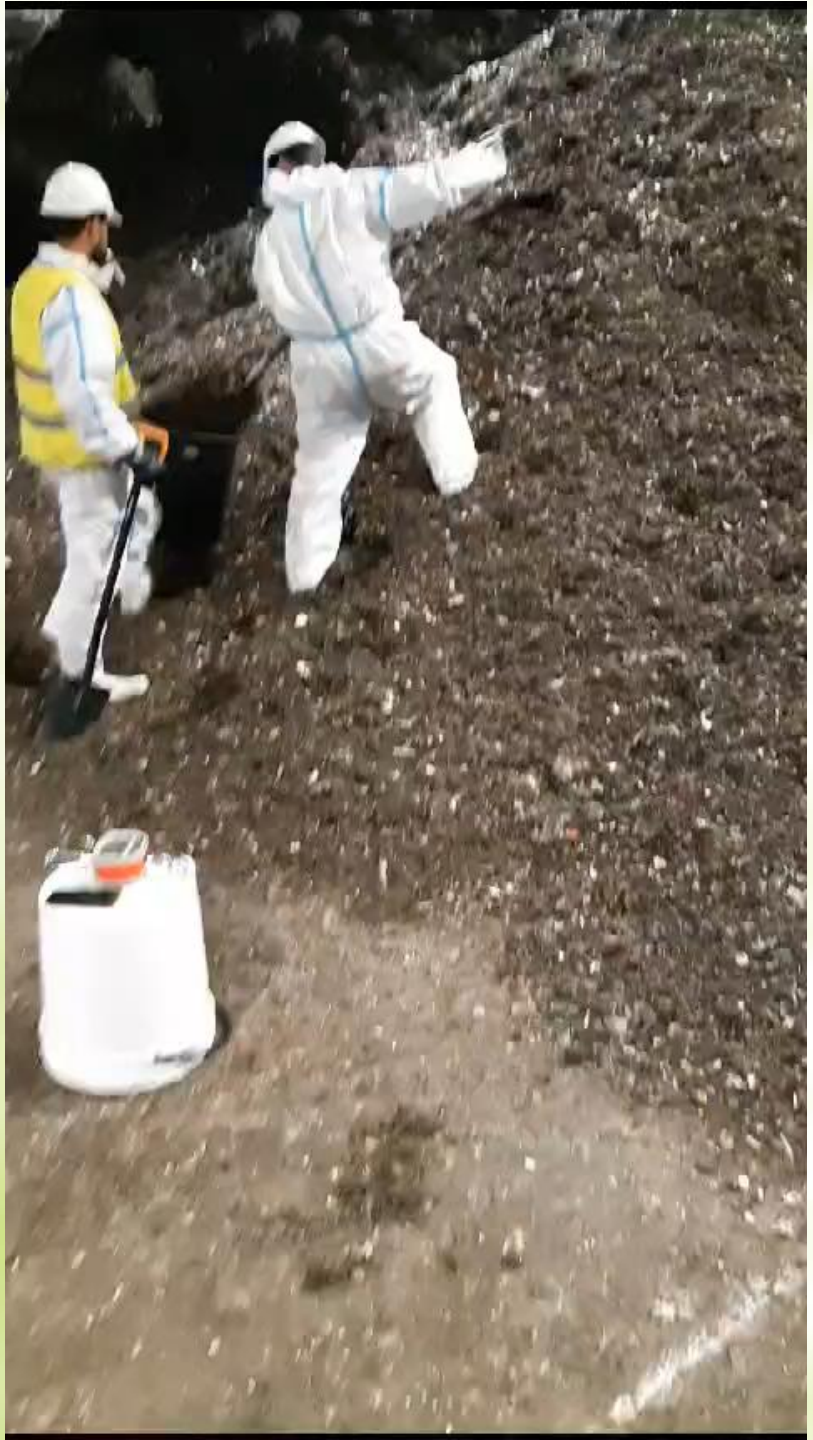
MUNICIPALITY	n	I	II	III	IV	V	VI	VII	IIX	IX	X	XI	XII	XIII	XIV	XV	Media
Container capacity	l	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	**100**
Undifferentiated	kg	19,60	18,60	22,40	25,20	21,50	21,20	23,20	23,60	22,20	20,80	23,80	16,00	19,80	23,80	22,20	**21,59**
Multimaterial	kg	9,00	9,60	10,40	9,80	9,60	8,40	8,00	9,80	7,80	10,40	8,40	7,60	10,20	10,00	9,20	**9,21**
Canteen Waste	kg	70,40	69,60	67,60	69,60	63,80	61,00	65,00	61,60	63,80	65,00	67,60	70,40	68,40	65,00	68,20	**66,47**
Paper/Cardboard	kg	15,70	18,00	16,50	12,80	21,60	19,80	18,40	16,90	12,80	15,90	18,50	14,50	19,80	21,40	16,80	**17,29**
Iron	kg	97,00	77,80	73,80	73,40	71,80	71,00	65,60	79,00	78,80	77,00	77,80	71,20	76,80	75,60	78,40	**76,33**
Glass	kg	89,00	84,00	87,00	79,60	79,20	77,40	82,20	77,20	75,00	73,80	79,40	77,00	76,60	76,00	78,40	**79,45**

Bulk Density

MUNICIPALITY	n	I	II	III	IV	V	VI	VII	IIX	IX	X	XI	XII	XIII	XIV	XV	Media
Undifferentiated	kg/m^3	196,00	186,00	224,00	252,00	215,00	212,00	232,00	236,00	222,00	208,00	238,00	160,00	198,00	238,00	222,00	**215,93**
Multimaterial	kg/m^3	90,00	96,00	104,00	98,00	96,00	84,00	80,00	98,00	78,00	104,00	84,00	76,00	102,00	100,00	92,00	**92,13**
Canteen waste	kg/m^3	704,00	696,00	676,00	696,00	638,00	610,00	650,00	616,00	638,00	650,00	676,00	704,00	684,00	650,00	682,00	**664,67**
Paper/Cardboard	kg/m^3	157,00	180,00	165,00	128,00	216,00	198,00	184,00	169,00	128,00	159,00	185,00	145,00	198,00	214,00	168,00	**172,93**
Iron	kg/m^3	970,00	778,00	738,00	734,00	718,00	710,00	656,00	790,00	788,00	770,00	778,00	712,00	768,00	756,00	784,00	**763,33**
Glass	kg/m^3	890,00	840,00	870,00	796,00	792,00	774,00	822,00	772,00	750,00	738,00	794,00	770,00	766,00	760,00	784,00	**794,53**

Processing for volumetric determinations
Density values of the collected waste categories

BULK DENSITY



DATA PROCESSING AND INDICATORS

AMA ROMA S.p.A.		CHARACTERISTIC INDICATORS FOR THE MUNICIPALITY OF ROMA CITTA' CAPITALE
PARAMETER DESCRIPTION	U.M.	NUMBER MUNICIPALITY
MUNICIPALITY	n.	I	II	III	IV	V	VI	VII	IIX
TOTAL QUANTITY COLLECTED 2021	kg/year	142.764.000	125.364.000	102.869.000	100.054.000	139.640.000	121.224.000	169.348.000	68.363.000
Tourist presences per day	n.	7.798,00	690,60	156,30	142,10	211,70	78,70	740,00	242,00
Resident population	n.	167.330	167.649	205.759	174.638	243.607	256.878	305.003	130.089
Surface	km2	8.478,25	8.566,12	2.099,68	3.594,63	9.103,75	2.261,64	6.701,22	2.773,79
Population density	ab/km2	19,74	19,57	98,00	48,58	26,76	113,58	45,51	46,90
Area type	i	City centre	Mixed Res. Comm	Mixed housing	Social housing	Social housing	Commer. Housing	Mixed housing	Mixed housing
Urbanization	i	High	Average	High	High	High	High	Average	Average
U.W. collection methodology	i	PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP
Actual attendance with average annual tourism	**n.**	**360.163**	**184.726**	**209.624**	**178.152**	**248.842**	**258.824**	**323.302**	**136.073**
Viability	i	Critical mileage	Critical mileage	Norm. distances	Good mileage	Good mileage	Good mileage	Percorrenza norm.	Percorrenza norm.
Households	n.	101.964	87.766	98.702	81.827	118.268	110.270	148.729	66.158
Average family members	n.	1,64	1,91	2,08	2,13	2,06	2,33	2,05	1,97
Quantity of waste tot. for eq. Inhabitant	kg/year	853,19	747,78	499,95	572,92	573,22	471,91	555,23	525,51
Quantity of waste tot. for eq. Nucleus	kg/year	1.400,14	1.428,39	1.042,22	1.222,75	1.180,71	1.099,34	1.138,63	1.033,33
Quantity of waste per inhabitant with attendance	kg/year	396,39	678,65	490,73	561,62	561,16	468,36	523,81	502,40
Domestic utilities served	n.	84.354	82.359	94.204	77.853	103.112	92.285	141.293	60.843
Non-domestic utilities served	n.	43.468	18.965	11.300	10.315	17.030	10.121	23.331	8.786
Quantity of R.U.R. delivered	kg/year	88.394.000	75.907.000	52.241.000	55.933.000	91.706.000	67.617.000	104.489.000	33.376.000
Quantity of paper/cardboard delivered	kg/year	19.438.000	17.789.000	16.677.000	14.482.000	18.986.000	19.079.000	26.033.000	11.682.000
Quantity of glass delivered	kg/year	7.001.000	4.509.000	4.708.000	3.741.000	3.325.000	5.313.000	7.434.000	3.415.000
Quantity of FORSU	kg/year	15.943.000	16.968.000	11.669.000	15.294.000	10.649.000	20.525.000	13.632.000	10.525.000
Quantity of multi-material delivered	kg/year	5.811.000	5.290.000	4.236.000	3.990.000	5.129.000	5.119.000	7.275.000	3.568.000
OTHER Material	kg/year	6.177.000	4.901.000	13.338.000	6.614.000	9.846.000	3.571.000	10.484.000	5.798.000
TOTAL TRIBUTE area	m2	10.544.928,14	9.076.597,26	10.207.578,14	8.462.396,87	12.231.057,64	11.403.919,28	15.381.277,88	6.841.937,90
Superficies TRIBUTE UD	m2	4.844.605,48	5.948.754,68	8.012.880,05	6.496.883,50	8.881.604,46	9.120.069,64	11.169.795,59	5.145.361,22
Superficies TRIBUTE UND	m2	5.700.322,66	3.127.842,58	2.194.698,09	1.965.513,38	3.349.453,18	2.283.849,64	4.211.482,28	1.696.576,68
Average R.U. production on Tot Surface	kg/m2anno	**13,54**	**13,81**	**10,08**	**11,82**	**11,42**	**10,63**	**11,01**	**9,99**
Average production U.W. on Surface Tot UD	kg/m2anno	**4,10**	**7,36**	**7,06**	**8,02**	**7,12**	**7,66**	**6,86**	**6,57**
Average production U.W. on Surface Tot UND	kg/m2anno	**9,43**	**6,45**	**3,01**	**3,81**	**4,30**	**2,97**	**4,15**	**3,43**

DATA PROCESSING AND INDICATORS

AMA ROMA S.p.A.		CHARACTERISTIC INDICATORS FOR THE MUNICIPALITY OF ROMA CITTA' CAPITALE							
PARAMETER DESCRIPTION	U.M.	NUMBER MUNICIPALITY							TOTAL
MUNICIPALITY	n.	IX	X	XI	XII	XIII	XIV	XV	
TOTAL QUANTITY COLLECTED 2021	kg/anno	99.257.000	139.804.000	78.231.000	71.948.000	59.909.000	74.553.000	77.688.000	1.571.016.000
Tourist presences per day	n.	108,90	274,20	153,20	436,50	978,90	213,70	109,90	Metropoli
Resident population	n.	183.476	231.220	154.974	140.719	133.388	191.851	160.502	2.847.083
Surface	km2	1.000,18	1.537,09	2.177,56	1.931,59	1.992,63	1.437,66	858,44	54.514,23
Population density	ab/km2	183,44	150,43	71,17	72,85	66,94	133,45	186,97	52,23
Area type	i	Living	Living	Social housing	Living	Mixed housing	Mixed housing	Living	Mix
Urbanization	i	Average	Average High	High	Average	Medium high	Medium high	Average	Medium high
U.W. collection methodology	i	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	Skip / PP	0,00
Actual attendance with average annual tourism	**n.**	**186.169**	**238.001**	**158.762**	**151.513**	**157.595**	**197.135**	**163.220**	**3.152.102**
Viability	i	Good mileage	Good mileage	Good mileage	Good mileage	Good mileage	Critical mileage	Critical mileage	0,00
Households	n.	82.920	102.917	72.156	68.221	61.948	90.163	75.910	1.367.919
Average family members	n.	2,21	2,25	2,15	2,06	2,15	2,13	2,11	2,08
Quantity of waste tot. for eq. Inhabitant	kg/anno	540,98	604,64	504,80	511,29	449,13	388,60	484,03	551,80
Quantity of waste tot. for eq. Nucleus	kg/anno	1.197,02	1.358,42	1.084,19	1.054,63	967,09	826,87	1.023,42	1.148,47
Quantity of waste per inhabitant with attendance	kg/anno	533,16	587,41	492,76	474,86	380,15	378,18	475,97	498,40
Domestic utilities served	n.	79.109	94.745	63.841	64.569	57.572	78.713	62.238	1.237.090
Non-domestic utilities served	n.	9.707	12.039	9.334	9.617	9.420	8.420	7.081	208.934
Quantity of R.U.R. delivered	kg/anno	39.067.000	50.198.000	37.910.000	38.768.000	34.574.000	38.900.000	49.750.000	858.830.000
Quantity of paper/cardboard delivered	kg/anno	17.570.000	18.503.000	14.925.000	11.748.000	10.663.000	12.104.000	11.165.000	240.844.000
Quantity of glass delivered	kg/anno	5.978.000	7.027.000	3.552.000	3.653.000	3.109.000	3.898.000	3.105.000	69.768.000
Quantity of FORSU	kg/anno	22.788.000	42.725.000	9.751.000	12.667.000	6.507.000	7.600.000	7.514.000	224.757.000
Quantity of multi-material delivered	kg/anno	6.125.000	7.499.000	2.758.000	2.989.000	3.004.000	4.090.000	3.493.000	70.376.000
OTHER Material	kg/anno	7.728.000	13.852.000	9.336.000	2.122.000	2.052.000	7.961.000	2.661.000	106.441.000
TOTAL TRIBUTE area	m2	8.575.432,91	10.643.485,64	7.462.239,96	7.055.289,54	6.406.547,49	9.324.490,56	7.850.471,69	141.467.650,90
Superficies TRIBUTE UD	m2	6.698.618,18	8.249.853,55	5.594.532,15	5.264.791,72	4.664.027,60	7.494.037,72	6.231.590,67	103.817.406,21
Superficies TRIBUTE UND	m2	1.876.814,73	2.393.632,09	1.867.707,81	1.790.497,82	1.742.519,89	1.830.452,85	1.618.881,01	37.650.244,68
Average R.U. production on Tot Surface	kg/m2anno	**11,57**	**13,14**	**10,48**	**10,20**	**9,35**	**8,00**	**9,90**	**11,11**
Average production U.W. on Surface Tot UD	kg/m2anno	**8,05**	**9,03**	**6,86**	**6,62**	**5,85**	**5,80**	**7,05**	**6,97**
Average production U.W. on Surface Tot UND	kg/m2anno	**3,52**	**4,10**	**3,63**	**3,57**	**3,50**	**2,19**	**2,84**	**4,13**

DESIGN ELABORATIONS

Container analysis

	kg/m^3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection	
	215,93	6/7		92,13	3/7		664,67	3/7		172,93	2/7		794,53	1/7	
	Volume	R.U.R. and other		Volume	Multi-material		Volume	CANTEEN WASTE - ORGANIC		Volume	Paper/cardboard		Volume	Glass	
n. collection days		315			165			165			110			52	
containers litres		2700	3200		2700	3200		2700	3200		2700	3200		2000	2500
Filling coefficient	l/anno	0,80	0,80	l/anno	0,70	0,70	l/anno	0,85	0,85		0,70	0,70		0,80	0,80
Municipality	Total	n. Skip 2700	n. Skip 3200	Total	n. Skip 2700	n. Skip 3200	Total	n. Skip 2700	n. Skip 3200	Total	n. Skip 2700	n. Skip 3200	Total	Skip	Skip
1	1.390.361,52	644	543	382.252	202	171	145.372,48	63	53	1.021.833,60	541	456	169.451,19	106	85
2	1.188.020,99	550	464	347.981	184	155	154.718,70	67	57	935.147,54	495	417	109.135,18	68	55
3	964.127,67	446	377	278.648	147	124	114.001,09	50	42	876.690,97	464	391	113.951,75	71	57
4	919.551,89	426	359	262.465	139	117	139.454,73	61	51	761.302,31	403	340	90.546,62	57	45
5	1.492.994,60	691	583	337.390	179	151	97.100,39	42	36	998.072,47	528	446	80.477,82	50	40
6	1.046.589,92	485	409	336.732	178	150	187.152,37	82	69	1.002.961,38	531	448	128.595,08	80	64
7	1.690.307,12	783	660	478.555	253	214	124.300,17	54	46	1.368.525,27	724	611	179.931,45	112	90
8	575.927,31	267	225	234.706	124	105	95.969,73	42	35	614.109,48	325	274	82.656,16	52	41
9	687.969,54	319	269	402.908	213	180	207.787,00	91	76	923.634,96	489	412	144.690,64	90	72
10	941.648,66	436	368	493.290	261	220	389.577,82	170	143	972.681,71	515	434	170.080,49	106	85
11	694.600,04	322	271	181.423	96	81	88.912,19	39	33	784.590,31	415	350	85.972,09	54	43
12	601.155,56	278	235	196.619	104	88	115.501,05	50	42	617.579,03	327	276	88.416,68	55	44
13	538.467,19	249	210	197.606	105	88	59.332,54	26	22	560.541,81	297	250	75.249,78	47	38
14	688.939,86	319	269	269.044	142	120	69.298,81	30	25	636.293,54	337	284	94.346,63	59	47
15	770.534,70	357	301	229.772	122	103	68.514,63	30	25	586.931,38	311	262	75.152,97	47	38
TOTAL	14.191.197	6.570	5.543	4.629.391	2.449	2.067	2.056.994	896	756	12.660.896	6.699	5.652	1.688.655	1.055	844

DESIGN ELABORATIONS

Vehicle analysis

	kg/m^3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection		kg/m3	Frequency of collection	
	215,93	6/7		92,13	3/7		664,67	3/7		172,93	2/7		794,53	1/7	
	Max flow rate	R.U.R. and other		Max flow rate	Multi-material		Max flow rate	CANTEEN WASTE - ORGANIC		Max flow rate	Paper/cardboard		Max flow rate	Glass	
n. collection days		315			165			165			110			52	
Type of vehicle		Mono Oper.													
Max flow rate		10,00	6,00	20,00	5,00	3,00	20,00	10,00	6,00	20,00	10,00	6,00	20,00	12,00	7,00
Mod. compactor															
n. containers served															
Municipality															
1	300.225,40	30	50	35.218	7	12	96.624	10	16	176.709,09	18	29	134.634,62	11	19
2	256.533,33	26	43	32.061	6	11	102.836	10	17	161.718,18	16	27	86.711,54	7	12
3	208.187,30	21	35	25.673	5	9	70.721	7	12	151.609,09	15	25	90.538,46	8	13
4	198.561,90	20	33	24.182	5	8	92.691	9	15	131.654,55	13	22	71.942,31	6	10
5	322.387,30	32	54	31.085	6	10	64.539	6	11	172.600,00	17	29	63.942,31	5	9
6	225.993,65	23	38	31.024	6	10	124.394	12	21	173.445,45	17	29	102.173,08	9	15
7	364.993,65	36	61	44.091	9	15	82.618	8	14	236.663,64	24	39	142.961,54	12	20
8	124.361,90	12	21	21.624	4	7	63.788	6	11	106.200,00	11	18	65.673,08	5	9
9	148.555,56	15	25	37.121	7	12	138.109	14	23	159.727,27	16	27	114.961,54	10	16
10	203.333,33	20	34	45.448	9	15	258.939	26	43	168.209,09	17	28	135.134,62	11	19
11	149.987,30	15	25	16.715	3	6	59.097	6	10	135.681,82	14	23	68.307,69	6	10
12	129.809,52	13	22	18.115	4	6	76.770	8	13	106.800,00	11	18	70.250,00	6	10
13	116.273,02	12	19	18.206	4	6	39.436	4	7	96.936,36	10	16	59.788,46	5	9
14	148.765,08	15	25	24.788	5	8	46.061	5	8	110.036,36	11	18	74.961,54	6	11
15	166.384,13	17	28	21.170	4	7	45.539	5	8	101.500,00	10	17	59.711,54	5	9
TOTAL	3.064.352,38	306,44	510,73	426.521,21	85,30	142,17	1.362.163,64	136,22	227,03	2.189.490,91	218,95	364,92	1.341.692,31	111,81	191,67

CONCLUSION

- In this first phase of the investigation, the results help us to define some important considerations:

- *The analyzes on residual urban waste (RUW) indicate the city need to increase the waste sorting (%) especially for the collection of organic and paper materials. One of our suggestion is to distinguish paper from cardboard.*
- *Even the plastic fraction find in the residual waste, referring above all to primary packaging, requires greater attention with regard to sort wasting (%).*
- *The analyzes on the multi-material are satisfactory, good recovery of plastic and ferrous materials. From a quantitative point of view, the interception could be increased by recovering further fractions from the unsorted waste.*
- *The results on the canteen-organic waste still indicate the need to improve the quality of sortig. In fact we found about 10% of foreign waste. In this case, it should be checked whether the phenomenon is due to the time of delivery (user) or at the time of collection (exchange of dumpsters).*
- *With regard to paper and cardboard, since there is still a quantity of extraneous fraction greater than 15%, it is necessary to improve collection (also considering the costs of the current contract). Furthermore, in order to increase the waste sorting, interception will have to be improved in the undifferentiated.*
- *On the right the table shows the composition of the total waste collected throughout the city of Rome*

ROME CAPITAL		
	Totale RU kg/anno	% in peso
FRAZIONE		
Under mm.20	**62.746.255,13**	**3,99%**
organic waste	**404.440.632,04**	**25,74%**
compostabile green	**34.077.234,77**	**2,17%**
paper/cardboard	**427.029.445,42**	**27,18%**
wood	**34.368.746,57**	**2,19%**
Plastic	**185.182.934,46**	**11,79%**
Plastic in film	**42.223.721,21**	**2,69%**
Polystyrene	**1.811.196,57**	**0,12%**
Plastic non packaging	**4.224.113,60**	**0,27%**
Rubber	**17.851.201,21**	**1,14%**
Polylaminate packaging	**5.953.284,18**	**0,38%**
Iron	**32.054.773,11**	**2,04%**
Steel	**11.268.355,95**	**0,72%**
Glass	**125.708.702,40**	**8,00%**
Building material	**13.704.918,47**	**0,87%**
Sanitary	**62.481.162,40**	**3,98%**
Textile	**57.966.048,06**	**3,69%**
Bulky	**463.934,74**	**0,03%**
Various	**32.588.092,97**	**2,07%**
Dangerous	**5.369.491,45**	**0,34%**
Electric waste	**9.501.755,29**	**0,60%**
TOTAL	**1.571.016.000,00**	**100,00%**

CONCLUSION

- The work also made it possible to obtain a series of data useful for any checks on the sizing of the service and a redefinition of the industrial plan.

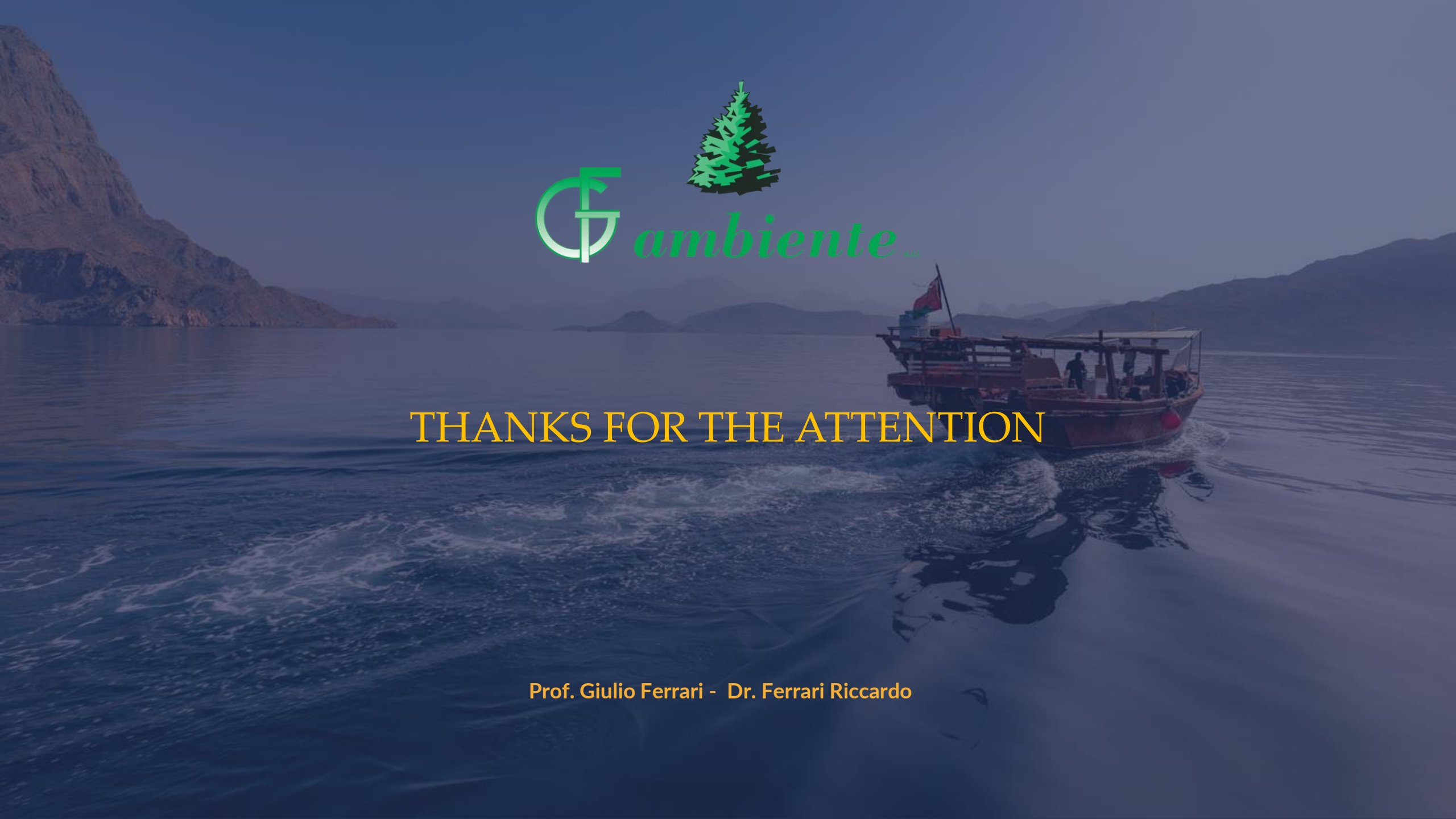
- The calculation of the density of the individual material classes was obtained by trying to simulate the physical characteristics of the same at the time of collection. This made the possibility to define the potential volume required for correct containment. (Suitable capacity of dumpsters to avoid waste out of it).

- The values obtained, in terms of quantity, referring to the individual municipalities made it possible to calculate the potential number of bins necessary for a correct service. For this work, the collection frequencies and the use of 2700 liters or 3200 liters bins were considered. By changing the volume of the containers, the system updates the data in any case.

- Based on a hypothesis on the individual quantities collected by two types of vehicles, considering the frequency of collection, the potential number of compactors for each municipality was determined.

- Further processing was done in order to determinate a series of indicators relating to the phenomena of waste production for each municipality, indicators which are also useful for rebalancing the tribute waste tax over the entire territory of the municipality of Rome.

- Regarding the waste tax, some contradictions emerge between the statistical data collected by the Municipality (ref. documentation available on the web) and the number of users. This suggest the need of a revision in according to the waste tax user database.


GF ambiente s.r.l.
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