

## Sustainable Urban Requalification: Circularity of Processes for a New Metabolism<sup>1</sup>

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### Abstract

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Through this paper we present the first results of a research combining the management problem of Municipal Solid Waste to the requalification of built environment. The goal of this research is to mitigate the vulnerability of territory and urban heritage and to transform a problem into opportunities. Above all, we have paid attention to several exemplifying cases of Italian territory: suburbs of large towns, historical centres, small centres (and, in particular, those with a strong historical connotation). Their features are, at the same time, restrictions and challenges for designing new compatible systems that can contribute to the requalification of urban landscape recovering spaces with demolition products and residual materials and comparing with managerial needs.

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**Keywords:** sustainable requalification, urban landscape, urban metabolism, waste management, services

### 1. Introduction

Taking into consideration the problems concerning the growing production of Municipal Solid Waste and its disposal, it is evident the last European directives have strengthened *Self-sufficiency and Proximity Principle* (according to this principle, disposal must take place within the territory of a community to guarantee the maximal safeguard of environment and health and to transform waste into a resource through contextualised solutions).

Thanks to separate collection and on-site pre-treatment, it is possible to attribute the characteristics of secondary raw material deposit to towns and agglomerates being these materials comparable to natural ones from some points of view.

The innovative aspect of this research is represented, above all, by some strategic and methodological aspects outlining a trend reversal and transforming technological innovations into compatible and efficient actions and solutions for the preservation and recovery of urban and environmental heritage and, wherever possible, contribution of new qualities.

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<sup>1</sup> This paper must be considered as an outcome produced by a teamwork search experience. As a consequence, please note paragraphs n°. 1, 2 and 4 are edited by Antonella Mami, while paragraphs n°. 3 and 5 are edited by Lidia Mormino

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Starting from the discretization of the problem related to logistics and recovery and technological retrofitting cases of urban services in open spaces and buildings, with the instrumental use of well-known innovative technologies, this search proposes real actions characterised by an administrative, technical and economic feasibility. Such actions can be realised as precise interventions of sustainable and innovative requalification of services and residency as well as occasions of social participation and development in network with public administrations, enterprises, service sector, users.

It is still possible to acquire financial flows for the resolution of this problem in the current period characterized by a strong crisis of resources and environmental awareness, in which the waste issue represents a pressing problem faced often in emergency terms. Through the achievement of economic and financial capitals, new opportunities for the town physical recovery and social and occupational development – with all the consequent advantages – could take place.

All these efforts must be driven: to make communities independent from the point of view of waste disposal; to increase the value of waste through the production of secondary raw materials and energy; to create intervention models and strategies that could be consistent and/or modulated; to contribute to the achievement of Kyoto and Horizon 2020 objectives; to underline the interdependence between sustainable development, safeguard of resources and employment.

## 2. Sustainable Requalification of Suburban Districts

An urban suburb can become a laboratory for innovative projects that cannot find the right space at highly defined spaces.

Thanks to its 'not defined' feature – with abandoned spaces without any identity - the new technologies for urban waste transformation into energy could appear adequate in this context making them play a very significant role within towns from a social point of view. The suburb scale allows the breakdown of a complex metropolitan reality engaging the local communities in waste management. Thanks to its intrinsic features, a suburb can become a metabolizer of its own waste transforming it into resources.

The organic waste cycle management within a suburb can become an opportunity for its requalification engaging its inhabitants actively. Separate collection system and plants management would engage inhabitants activating good practises, encouraging job opportunities in a place where unemployment rate is usually very high, improving social aggregation and renewing interest in suburban districts.

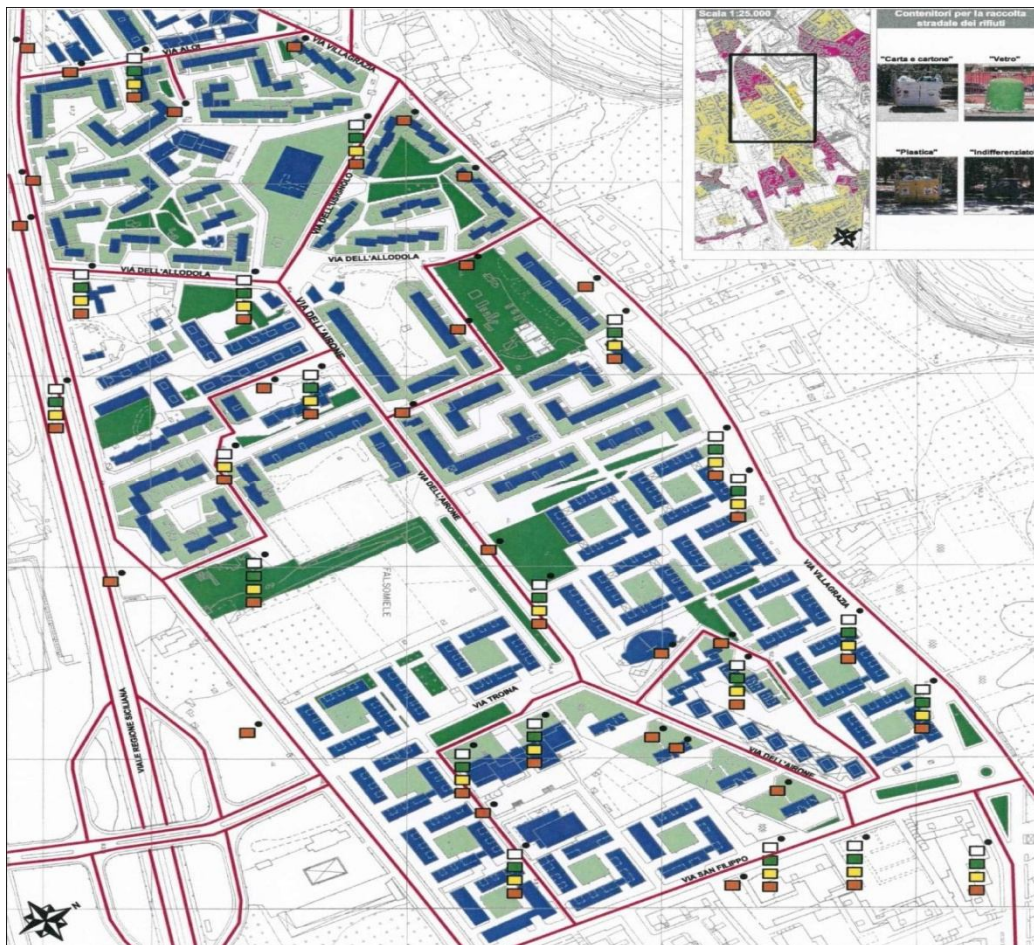
Through this research we have collected relevant data and elaborated already existing information in order to verify time, quantity and quality availability of suitable raw material (Municipal Solid Waste – organic fraction) deriving from separate waste collection for the production of biogas, thermal energy and compost in very technological and innovative plants.

In the light of the foregoing concepts, we have assessed the possibility to insert innovative appliances for organic waste treatment within a suburb with a reproducible and scalable system of actions destined to satisfy suburban exigencies. In order to evaluate the efficiency of the proposal we have examined direct data concerning a suburban district (population, buildings analysis, quantity of produced waste, etc.) and elaborated indirect data (energy consumption, costs for waste management, environmental damages produced by collection systems, etc.) in order to outline the qualitative and quantitative reference frame with the assessment of different alternative plausible contexts. We have assessed the costs for managing collection and disposal system and benefits to be obtained compared to the current context; we have found that it is also possible to obtain substantial cost savings. An emblematic case-study consists of the implementation of a public residential suburb in Palermo called *Borgo Ulivia*, with the intention of meeting waste emergency and, at the same time, activating actions for a correct urban recovery<sup>4</sup> (Fig.1).

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<sup>4</sup> To deepen this topic, it is possible to refer to the thesis *Rifiuti ed energia nella riqualificazione sostenibile della periferia urbana* (Waste and energy in sustainable requalification of suburbs) by Ms. F. Grisanti, PhD. and engineer – tutors: Ms. A. Mami, Ms. G.

The typology of the examined suburb, in a predominantly residential use, is very frequent in our national territory and our proposal seems to be replicable. In all the Italian territory it is possible to find several examples of suburbs similar to *Borgo Ulivia* since they were spread during the Fifties and Sixties characterising a relevant part of suburbs; they all are joined by permeable housing types, low population density, the presence of green spaces and open/closed & public/private transition cases. The compost produced by waste could be used both to revitalise green spaces among buildings and to fertilize fields in near rural areas and urban orchards (Fig. 1). As far as technological solutions to be used are concerned, we suppose a single-stage wet anaerobic digestion with a simple and variable technology. The system consists of a simple and modular plant allowing the transformation of organic waste into clean energy inside metal containers with restricted dimensions. Comparing to traditional plants that consider the construction of building works (generally speaking, reinforced concrete tanks), this solution considers the installation of transportable and assembled modules working as similar machines that can be easily integrated in the urban areas of gardens. This system can determine positive effects for the reduction of waste management costs from the economic point of view and for the limited use of landfills and the reduction of emissions of greenhouse gases from the environmental point of view.



**Fig. 1: Analysis of the Current Collection System in Borgo Ulivia, a Suburb in Palermo. Drawing by Luca Paparcuri**

A suburb can transform itself: from a simple energy consumer to a real producer with the advantage to be able to manage organic waste – that is damaging when piled in landfills – independently (*proximity principle*) and to close waste cycle within the suburb it self (*circularity*).

### 3. Sustainable Requalification of Very Small Centres and Organisation of a Management Network

Even if the current digital society, devoted to continuous global movements, defines small centres as very limited communities, from the sustainable point of view, the restrained dimensions of these realities can be passed over and used as real remarkable potentialities. Their features - characterised by eco-sustainability and inclusiveness - can be developed in a very meaningful way.

Especially in the matter of waste issue, a strong dimensional control, the relationship with countryside and community's engagement and participation can contribute to the success of a strategy aiming strongly at the circular process and, as already mentioned, proximity economics<sup>5</sup>.

Like for other situations, the very limited dimensions can present urbanisation and dimensional and efficient characteristics only if organised through a network where several centres – also with different dimensions – find an efficient managerial aggregation in mutual terms.

Community consistency, distances among centres, presence and quality of infrastructures become fundamental factors to individuate minimal and optimal bases for the management and treatment of material flows and Municipal Solid Waste. We assist to a double situation: organic fraction can reach the cycle closure especially in a very limited dimensional reality (in a detached unit with few buildings it is possible to arrive at the compost production at least) but, at the same time, other fractions - in storage, selection and volumetric reduction – need minimal quantities (under which their management is at a loss) for efficiency and specialised plants whose cost would not otherwise be depreciable with reduced quantities.

It is evident the individuation of an optimal district depends on several factors<sup>6</sup>: from geographical factors (a mix of orographic and socio-economic elements) to infrastructural and qualitative and quantitative ones referring to the waste production and separate fractions selections. Physical and identity (customs) factors of residential areas and the existence of few buildings are not certainly the last ones to be considered since they are strictly connected to the typologies of waste collection (vehicles, flows, time indications, fractions, infrastructural district, mode of transfer, quality and quantity of Municipal Solid Waste conferred).

It is fundamental some centres could start working together like towns in a network – at least under certain aspects – in order to define and individuate districts and areas of competence sharing the same infrastructural management and logistics and aiming at some common goals – determined by this kind of process - concerning environment, landscape, socio-economic and occupational development. Community's satisfaction towards this synergy and the fair distribution of outcomes, costs and incomes is an essential element for aggregation.

This research is focused on a group of urban centres located near Palermo, on the hills surrounding the southern part of the town. Despite administrative vicissitudes, these urban centres can be considered belonging to the metropolitan area because of the reduced distance and the easy travel times.

<sup>5</sup> Aiming at the on-site treatment, it is possible to limit NIMBY (*Not In My Back Yard*) and NOPE (*Not On Place Earth*) syndromes in restrained groups.

<sup>6</sup> Recalling most of national rules, Sicilian law defines ATO (*Ambiti Territoriali Ottimali*, Optimal Territorial Areas), ARO (*Aree di Raccolta Ottimali*, Optimal Collection Areas), SRR (*Società per la Regolamentazione del servizio gestione Rifiuti*, Company for the Regulation of Waste Management Service).

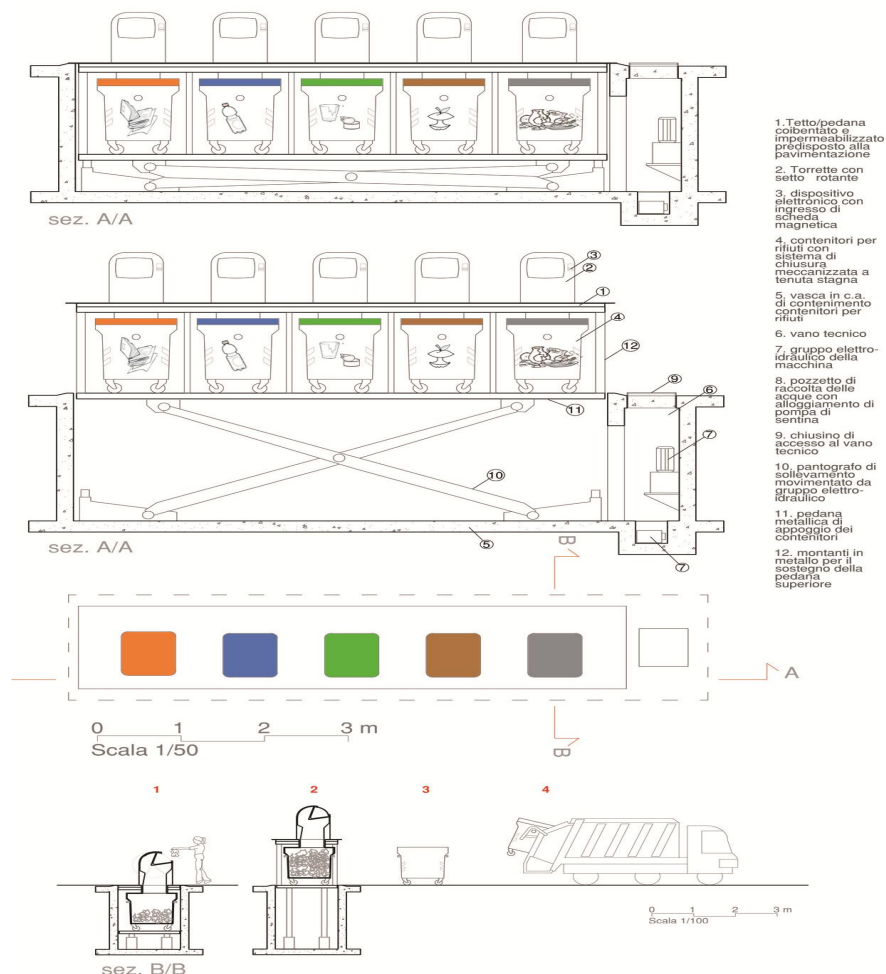
AROs play the role to supply the service of waste sweeping, collection and transport. They consist of municipalities working as individual bodies or in associated way through agreements; they can realise intervention plans and participate to tenders for services. The guide-lines for the realisation of area plans – the so-called *Piani d'ambito* - by ARO (19.09.2013) refer to the definition of characteristics and restrictions that are typical of all the disciplines concerning urban and built heritage such as settlement structures, typologies of existing buildings, viability, geomorphological, urban and infrastructural restrictions.

This element underlines that the discipline related to waste is not separable from urban and architectural disciplines.

This research has already produced some results concerning the urban centre of S. Cristina Gela where – in addition to the usual analyses – an urban project, a network of urban ecological islands – located inside the perimeter of the most ancient centre – (multiple underground bins) and the organisation of waste collection with electrical means have been defined<sup>7</sup> (Fig. 2).

Above all, a territorial management plan of Municipal Solid Waste has been realised aiming at the engagement of other urban centres and considering storage and area treatment stations. These stations can be seen like real factories where selection, treatment, shredding, reduction to bales, sterilization and so on can transform the fractions of Municipal Solid Waste into resources to re-insert as secondary raw materials, elements for reuse and raw materials.

The organisation of urban ecological stations destined to continuous separate collection (avoiding door-to-door options due to time restraints) and distribution on tap is an occasion of recovery of the urban areas on the margin (today they seem to be frayed and abandoned); these small centres can be organised and defined newly from a physical point of view.



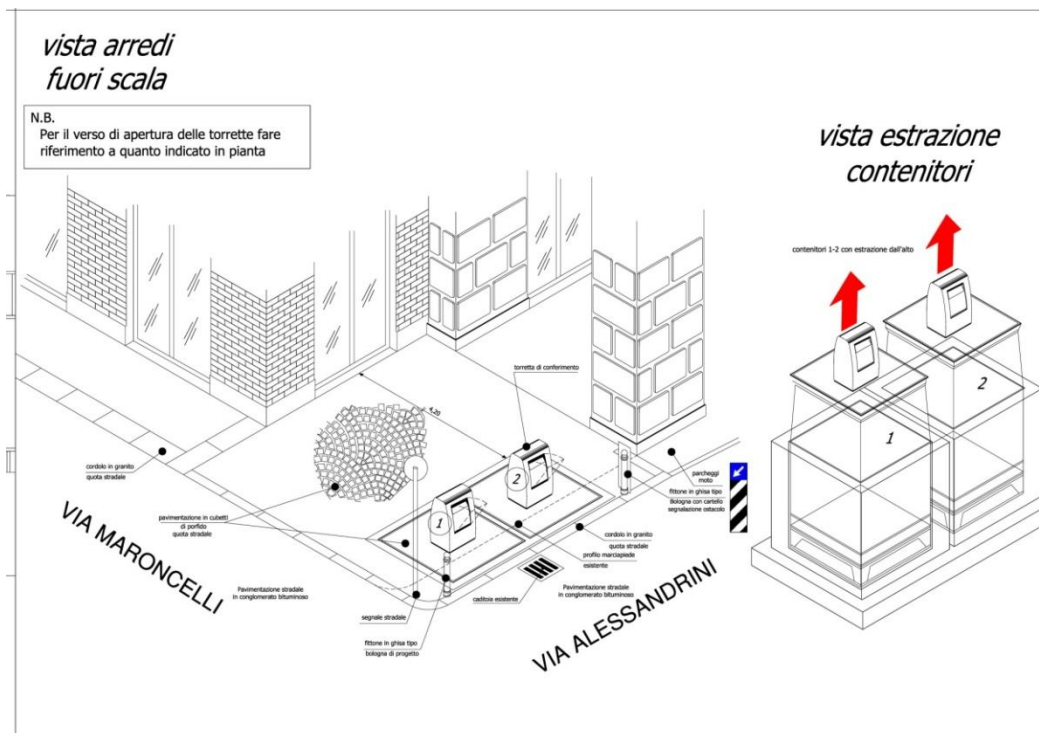
**Fig. 2: Section of Underground Bins Drawing by Guglielmo Di Chiara**

<sup>7</sup> The collaboration with Ms. G. Bonafede - professor, Mr. G. Di Cara - Architect jr., must be mentioned in this part of the search.

In addition to the obvious attention to – physical and not only – integrability of these areas, we have to reflect upon walkability/vehicularity, limit redefinition, the acquisition of centrality as a central aspect of system, physical arrangement of roadways, pavements, underground works, elements or street furniture, public lightning, reorganization of urban vehicle mobility (lines, hierarchies, haul roads, parking lots) and pedestrian mobility (exclusive venues, traveling rays and urban service basins)<sup>8</sup>.

#### 4. Requalification of the Historical Centre of a Large Town

It is necessary to deal with the waste issue in range of a consolidated historical and urban context also for the preservation of a 'town system' in response to phenomena such as gradual population growth and production of scraps of technological and industrial materials which are difficult to dispose of. Besides being the reason for environmental deterioration, such phenomena often cause some alterations of urban landscape not only in physical terms but also from a social, cultural and economic point of view. The will to preserve shared values by a community obliges a reflection aiming at individuating possible solutions that, firstly, could solve this problem and, then, could be integrated with the typical features of historical and urban landscape (Fig. 3).



**Fig. 3 – Project of a Mini Underground Island in via Alessandrini, Historical Centre of Bologna for Reference to its Drawing:**

[http://www.comune.bologna.it/media/files/16\\_via\\_alessandrini\\_angolo\\_maroncelli.pdf](http://www.comune.bologna.it/media/files/16_via_alessandrini_angolo_maroncelli.pdf)

It is possible to assess the possible solutions according to two issues: on the one hand, deepening the features of single urban spaces – characterised by a specified conformation and, above all, infrastructural, technological and organisational heritages; on the other hand – from a much more general point of view – taking into consideration the management strategy of waste and resource of the whole town.

<sup>8</sup> Today the research is focused on Piana degli Albanesi, a small town near Palermo. In this case our interests are concentrated on: waste collection and infrastructures in a historical urban tissue; innovative collection systems - such as the pneumatic aspiration - in recent urban expansion areas; allocation of treatment stations in an area destined to craftworks, at the edge of the centre, reusing industrial abandoned sheds.

The third issue to be assessed concerns the exposure of historical towns: in addition to the population pressure determined by migration processes, we find dynamical user flows expressing a strong inclination to disperse of resources and production of waste. The dynamism of flows derives from the typical attractive features of urban centre recalling a number of workers, students, migrants, consumers and tourists whose evaluation must consider several variables like hour specifications, seasonality, habits of life, touristic and commercial attractions.

The abovementioned considerations are the result of a bottom-up approach that – starting from a specified case study – drives to wider common observations, repeatable for other urban centres with a strong historical identity. Together with the classification and recognition of multiple and proposable urban strategies in progress, this part of the research has identified alternative technologies or integrative technologies in the waste circular process (prevention, recycling, collection, treatment and transformation)<sup>9</sup>.

Recycling strategies			Prevention strategies		
Processes / Actors		Actions	Processes / Actors		Actions
Communication processes	Awareness campaign	Media events	Communication processes	Awareness campaign	Media events
		Training in educational institutions			Training in educational institutions
		Development of shared goals			Development of shared goals
Participatory processes	Information	Information and online support	Participatory processes	Information	Information and online support
		Telephone support			Telephone support
		Digital forum of coordination			Digital forum of coordination
Entrepreneurs	Production	Design and sharing workshops	Commercial Processes	Bottom up	Design and sharing workshops
		Composting for urban gardens			Sale centers
		Production with eco-friendly materials and secondary raw materials			Automated distributors
Citizens / Users	Home composting	Production of goods and disaggregated packaging	Legislative processes	Barter	Shops
		Production with recyclable materials			Markets
		Transformation			Transformation of recycled materials in secondary raw materials
Administrations	Separate collection	Selection	Research	Reduction of packaging	Collection centers
		Inserting into bins or dumpsters			Returnable container
		Organization and management of separate collection			Systems and networks
Grants / incentives	Citizens	Selection	Grants / incentives	Local policies	Collection management
		Inserting into bins or dumpsters			Treatment and changes management
		Organization and management of streams after storage			Sale
Grants / incentives	Entrepreneurs	Agreement with consortia	Grants / incentives	National policies	Collection management
		Organization and management of transformations in site			Biogas
		Organization and management of separate collection			Systems and networks
Grants / incentives	Entrepreneurs	Composting	Grants / incentives	Public entities	Analysis of industrial processes
		Returnable containers			Analysis of management strategies
		Vouchers, bonuses, incentives and gifts			Analysis of industrial processes
Grants / incentives	Citizens	Tax remission	Grants / incentives	Private entities	Analysis of management strategies
		Collection points on magnetic cards			Reimbursement of containers at the return
		Pay As You Throw			Vouchers, bonuses, incentives and gifts
Grants / incentives	Entrepreneurs	Free distribution of composters	Grants / incentives	Citizens	Tax remission
		Subsidies for short supply chain			Collection points on magnetic cards
		Incentives for the recycling monitoring			Pay As You Throw
Grants / incentives	Entrepreneurs	Incentives for the recycled amount	Grants / incentives	Entrepreneurs	Subsidies for short supply chain
					Incentives for the recycling monitoring

**Tab. 1 – Recycling and Prevention Strategies Elaboration by Antonella Mami and Elvira Nicolini**

<sup>9</sup> There is a current research agreement with Envac Iberia S.A. for the study and experimental deepening of pneumatic aspiration techniques of Municipal Solid Waste and the implementation of correlated infrastructures.

Collection and transformation strategies 1/5				
Processes / Actors	Actions			
Organic	Establishments	Biochemical	Biomass and sludge from anaerobic digestion Biogas from dry digestion Biogas from wet digestion Mechanical biological cold treatment Methane, hydrogen and methanol from Energy from gasification air flow reversed Fuel from thermochemical gasification Liquid fuel from biomass biorefinery Biogas cogeneration	
		Thermochemical		
		Urban plant		Vehicular collection Pneumatic collection Stationary vacuum systems Diffuse collection centers
			Devices	Composters
	Mechanical			Separation and screening Flotation Sizing Shredding Washing Grinding Drying Granulation Pyrolysis Hydrogenation G asification Chemolysis Glycolysis or Methanolysis Waste to Energy plant
	Plastic	Establishments		
		Urban plant		Vehicular collection Pneumatic collection Stationary systems of aspiration Diffuse collection centers
			Devices	

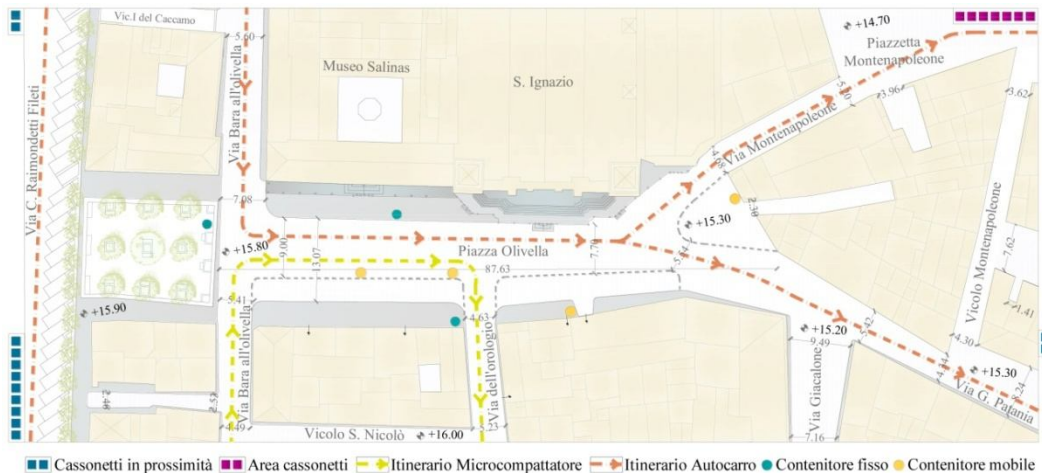
  

Collection and transformation strategies 2/5				
Processes / Actors	Actions			
Paper	Establishments	Mechanical	Separation and screening Elementarization Pulping Refinement Filtration Bleaching and washing Drying Pressing Chemical crushing in digester Sulfite process Kraft process (sulphate) Waste to Energy plant	
		Chemical		
		Urban plant		Vehicular collection Pneumatic collection Stationary systems of aspiration Diffuse collection centers
			Devices	
	Glass	Establishments	Mechanical	Manual sorting Screening Crushing Selection with electromagnets and Automatic selection Cleaning Grinding Melting of low-melting components Chemical reactions between the Refinement Moulding Cooling
			Thermochemical (hollow glass production)	
		Urban plant		Vehicular collection Diffuse collection centers
			Devices	

**Tab. 2: Strategies for Collection and Transformation. Elaboration by Antonella Mami and Elvira Nicolini**

The search is focused on the historical centre of Palermo (more precisely on Castellammare district) for a specified analysis on what concerns the management of Municipal Solid Waste (uses, services, users, typologies of separate fractions, quantitative rates) and morphological and infrastructural characteristics of spaces in the historical town from the whole points of view<sup>10</sup>. (Fig.4)

We have surveyed the whole public spaces through deepening forms and cartographic studies of physical, architectural, use, dating and preservation characteristics, typologies of spaces and net infrastructures also under the road ground.



**Fig. 4: Current System of Waste Management in Vehicular and Separate Modes in Olivella, Castellammare District in Palermo. Drawing by Elvira Nicolini**

<sup>10</sup> The collaboration with Ms. E. Nicolini - PhD student and engineer, must be mentioned in this part of the search. There is a current research agreement with Risorse Ambiente Palermo S.p.A., a company established in July 2013, involved in the management of Municipal Solid Waste in Palermo. In these months we have been handling a coordinate plan for the infrastructuring of the historical centre of Bologna, the only relevant case from a national point of view.



We have deepened the realisation of an integrate system with percentage of vehicular system and parts with a pneumatic net system. The latter owns good characteristics of feasibility and validity and a need of high initial investments but it is able to affect the preservation and safeguard of factors concerning the landscape and perception of buildings in a positive way (Fig.5).



**Fig. 5: Simulation of via Patania, Corner of Piazzetta Montenapoleone, Palermo. Elaboration by Elvira Nicolini**

Through this option, we could affect public spaces positively with occasions of physical recovery of urban spaces in addition to infrastructural recovery. The mode of continuous functioning could allow to forget the very sad images of emergency situations of Municipal Solid Waste issues affecting urban landscapes – especially in Southern Italy – in brutal terms.

Two leading theories: the pre-treatment of waste in order to anticipate its movement to resource starting from residential units; the reciprocity between the historical town and its perimeter edges whose features are residential-commercial or agricultural-productive within a synergy context among town parts.

## **5. Requalification of an Urban Centre with a Strong Historical Connotation**

Italian territory is rich in medium-small urban centres and villages where architectural and urban heritage – built through centuries – has a great value even if it needs extremely wise interventions of recovering, refunctionalisation and restoration. In this context lots of issues concerning urban infrastructures, implementation of services and their management need a special care and attention to be paid towards urban landscape, strongly connoted and in a delicate balance.

Even if the good management of services heralds urban quality, a strictly technical approach which pays attention only to thematic aspects can be considered harmful. We cannot adapt and force pre-established models. An integrable system made up of networks, appliances and connections and its physical and morphological contextualisation are essential. It is appropriate to imagine the development of methods of analysis and intervention that – starting from the peculiarity of tissues, spaces and buildings – try the implementation of technically possible, correct and efficient solutions guaranteeing their performance but also the safeguard and preservation of buildings. The waste issue in small historical centres of the Italian territory is linked to a specified and sustainable transport system to be intended not only in environmental terms but also from a physical point of view, that is to say, the possibility of waste storage and treatment.

The latter is destined, above all, to volumetric reduction of fraction that can affect flows and transports very positively with the reduction of costs, time and atmospheric emissions. These centres are often far from main infrastructures and located in inaccessible places.

These are the factors that have safeguarded their preservation and integration (even if often in partial abandon conditions). But, at the same time, they give us the opportunity to find new (or old) qualities and desirability today.

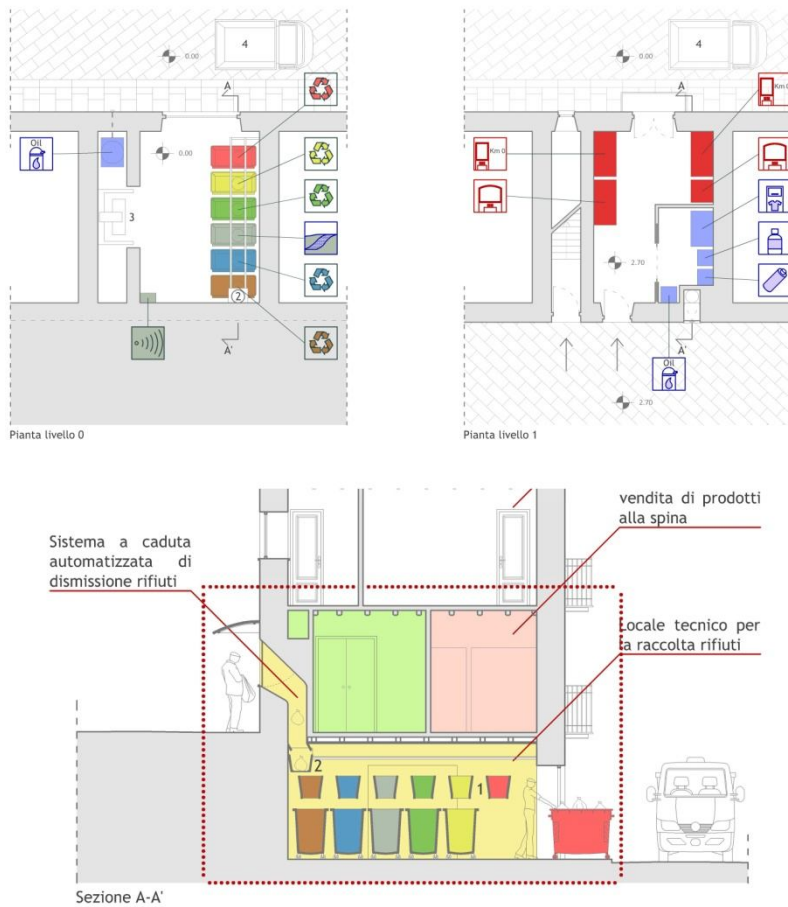
The limited dimension of contexts and communities guarantees endogenous rules for coexistence and respect towards the context from which we can restart to implement development in sustainable terms. So, it is realistic to imagine that waste management strategies could combine efficiently with prevention ones linked to ethical correctness of behaviors and habits and to the possibility to affect resources sale. For example, there is a reference to the distribution of products on tap – above all, those in short chain - since these centres are surrounded by agricultural and rural territories able to produce quality goods and resources destined to local consumption in addition to niche marketing.

San Mauro Castelverde is a small town near Palermo. It represents an emblematic case on which this research has been focused thanks to its old centre considered as its most consistent and characterizing part<sup>11</sup>. Like many other mountain towns, S. Mauro Castelverde has undergone a significant abandonment because of emigration and moving to coastal centres or the capital city. As a consequence, we can find abandoned buildings – some of them have a limited architectural and historical value – in the urban tissue.

This research has tried to potentiate the theory to implement the reuse of some units as 'eco-stations', that is to say, specified buildings that have been refunctionalised for the organisation of separate collection and pre-treatment. In some case, the possibility to reuse these places for the distribution of products on tap has been considered.(Fig. 6).

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<sup>11</sup> The collaboration with Ms. G. Bonafede – professor, and Mr. P. Di Bella, architect, must be mentioned in this part of the search.



**Fig. 6: Plan and Section of an Eco-Station with Separate Collection and Distribution of Products on Tap. Drawing by Pietro Di Bella**

The recognition of buildings takes into consideration typological characteristics, use and property conditions contributing to the identification of a systematized network with vehicular mobility and qualitative and quantitative issues concerning Municipal Solid Waste fractions and compared to the consistency and inhabitants and services mix. (Fig. 7)



**Fig. 7: Network of the Foreseen Eco-Stations. Drawing by Pietro Di Bella**

Even if the need of consistent retrofitting works in the recovery of properties has been outlined, this theory would produce results of compatibility and physical and morphological integration of appliances and infrastructures without renouncing the achievement of efficiency parameters of service. The urban network designed for the historical centre is inserted in a wider system including an outside-the-walls ecological transfer station where it is possible to select, store and pre-treat waste.

As quoted in the abovementioned paragraphs, this management system finds concreteness and feasibility also positioning the centre inside a wider network (consisting of small urban realities) destined to synergy and sharing of services in a larger territory where we can put the circular process (Waste-Resources-Waste) in practice as much as possible: this should be the real key to success.

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