# Rethinking the Spaces of Waste Management Infrastructure: towards integrated urban strategies to avoid urban solid waste in contemporary city

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## Abstract

This paper examines the issue of solid waste management in urban contexts, by an architectural perspective. In light of the emerging waste crisis, this paper proposes to redesign and gradually reintroduce waste management facilities in the urban tissue. The capacity to learn from trash can help to design a new generation of facilities, aiming to recover suburban areas and to re-establish a lost ecological balance.

The paper underlines the need to radically reconsider the spatial articulation and the organizational structure of the current waste management infrastructure, through an integrated approach aiming to define a decentralized and distributed urban model. Finally, the paper explores heuristic potentials for architectural design, identifying hybrid figures and finding key actions to intervene in the contemporary city, inspired by the notion of 'unblackboxing'.

## Keywords

Architecture, Waste Management, Urban Metabolism, Strategic Design, Unblackboxing

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**Introduction**

Today production and consumption of goods are the most extensive than any time in human history. Waste generation, both domestic and industrial, continues to increase worldwide in tandem with growth in consumption. Urbanization trends (in 2050 there will be about 9 billion inhabitants, of which 80% will live in cities) and the dynamics of the still widespread capitalist consumerism, threatens the environmental carrying capacity.

The issue of waste comes from the unsustainability of a development model that alters environmental and social balances. If current trends continue, the world may see a five-fold increase in waste generation by the year 2025. There is a need to develop an integrated approach in order to promote a sustainable solid waste management in the frame of a circular urban metabolism. Since the spread of notions of circular economy and urban metabolism, the need to consider waste as a resource it is today increasingly common in different fields and disciplines.

How to bring back the bulky presence of waste within the design of public space, city and territory? Looking at the urban agglomeration through the conceptual filter of urban metabolism, it appears as a body swollen and flooded by the many wastes that have become unmanageable (Marvin and Medd, 2010).

If matter that is in a temporary state of uselessness and loss of value (waste), brings back usage value (resource), is therefore necessary to develop an architectural and urban imagery that integrates their cycle with society, its rhythms and rituals, and with ecological cycles.

The aim of this reflection is to examine the issue of solid waste management by an architectural perspective. Historically, flows of resources have always had a spatial and aesthetic consideration, producing new urban imaginaries: aqueducts, mills, fountains, power plants, even railway stations constitute an architectural heritage of public interest, considered as integral part of urban and territorial morphology.

**An Operative Hypothesis**

History provides examples of how the relationship between waste and urban agglomeration has been rephrased over time, thanks to a continuous activity of repair and maintenance (Graham & Thrift, 2007). Often the topographies we observe and believe to be 'natural' have been determined by artificial processes (Alba Ramis, 2015), resulting from human activity. Most evident cases are former landfills, such as the historic trace of *Monte dei Cocci* in Rome or the more recent grass-covered Georgswerder Energy Hill in the Wilhelmsburg district of Hamburg.

The capacity to learn from trash can help to design a new generation of facilities and spaces, aiming to recover suburban areas and to re-establish a lost ecological balance.

Current environmental policy is generally founded on the principles of the 'waste management hierarchy', aimed to improve the selective collection and make it more efficient through the application of the proximity and self-sufficiency principles.

Prevention is the hierarchically superior goal in waste management strategy, according to the inverted pyramid scheme. It is followed by preparation for reuse, recycling, recovery of various kinds, and finally disposal. Each stage corresponds to physical spaces to be designed and integrated within the existing fabric, including different activities (selecting, compacting, vending, transporting, composting, disassembling, fixing, upcycling, disposing) and various additional equipment (vehicle parking spaces, temporary storage warehouses, spaces for the promotion of reuse and upcycling, repair centres and creative recycling laboratories, spaces to house compaction or composting units).

The combination of the activities previously mentioned delineates new locational geographies, which tend to be spatially organized according to fundamental principles:

- Convergence: defined as a strategy pointing to one side to catalyse existing flows, hybridizing them together with functions and spaces, and on the other to establish points of contact between the life of the building, the urban waste cycle and a more efficient use of existing infrastructures.
- Synergy: establishing a network of simultane-

**Fig. 2** – Top view of the Issean plant. Below, the unloading deck on the river Seine. Source: Syctom.

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**Fig. 1** –The top view of the former landfill close to the city centre. Credits: IBA Hamburg GmbH.

ous and reciprocal relations between systems;
- Intermodality: incorporating multiple modes of transportation in order to capitalize advantages and to determine impacts.
- Hybridization: primary functions are connected to a system of relations and complementary functions that will activate metabolic cycles.
- Adaptivity: each configuration founds its own balance dealing with the typology of urban tissue, public spaces networks, infrastructures.

It is clear how these needs and goals set up parameters for a new inter-scalar infrastructure, both physical and social, adaptive in relation to the contexts and to the specific functions required.
In light of the emerging waste issue, here is proposed to redesign and gradually reintroduce waste management facilities in the urban tissue, through an interscalar, incremental and adaptive approach, based on different phases that correspond to different times and scales of intervention.
The incremental model proposes a period of choices based on the constant search for a balance between the actors involved from time to time in decisions that will no longer be called upon to respect their actions with a rigid design ex ante, but they will also compete to its very definition. Each partial result accomplished in one phase becomes the starting point for the subsequent phase. Defining new spaces for waste management requires three phases of intervention, taking as a reference the Cityforming® Protocol (Carta & Lino, 2015), a planning protocol aimed to reactivate the metabolism of an area.
The first step involves micro-interventions and ur-

**Fig. 5** – View of the rooftop garden. Source: Maag Recycling.

opposite page
**Fig. 3** – Street view of the recycling and sorting centre at Porte de Pantin (Paris), DATA Architectes, 2016. (Image © DATA Architectes).
**Fig. 4** – Main front view of the Maag Recycling Centre (Winterthur, Switzerland), OOS Architects, 2004. Source: Maag Recycling.

ban ecology tactics supported by the use of various mobile devices for waste collection and citizen awareness. Services and processes triggered have a connection role, intervening on the public space and at a social level.

Subsequently, a second intermediate step is envisaged, characterized by a series of permanent interventions. These are architectural additions to the urban fabric for the grafting of multifunctional equipment as the first outposts of the chain to start reducing waste streams and disassembling and recovery phases. Collection and reuse centres are the spaces that at this scale play a key role. Within the second step also increases the accessibility of the area. The third step carries out the completion of the chain at the urban scale through the realization of buildings-hubs at the municipal scale or supra, in which a number of further uses and flows converge.

**Hardware and Software: a Proposal for a Strategic Framework**

An effective strategy for waste reduction resides in the adoption of integrated scenarios, in which a design capacity expressed in a plural and collective way (Manzini, 2015) determines the testing of models for localized urban ecologies at different scales. In order to achieve the ambitious goal of a circular society, as indicated by the European Union, it's required a strategic framework that stands for a dual design action, operating simultaneously on the 'urban hardware' (buildings, infrastructures, systems) and on the 'urban software' (tactics, protocols, processes).

The inherent link between waste production and human activities leads to consider the relevance of new forms of social performativity, active citizenship and prosumership (Timmeren, 2015). It is not for sure that increasing separate collection will guarantee lower levels of consumption and waste production. There is a real risk that efficiency could be understood as a factor that legitimates a further increase of consumption. Furthermore recycling make disposables new naturalized commodities instead of foregrounding waste redesign or reduction (MacBride 2011).

A broader degree of citizens must to be involved in waste management practices, as remarked in the latest report 'World Cities 2016' (UN-Habitat 2016). Among the five key principles to guide the urban development, citizens' empowerment is indicated. According to that, the second action foresees to intervene on the urban software.

In the so-called Anthropocene's era, the reduction of the waste stream cannot only depend from neither technological innovation nor industrial efficiency, but it has required a rethinking of the relations with things and waste, calling for a less pas-

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**Fig. 6** – Top view of Ecoparque (Granada, Spain), Gonzalo Arias Recalde architect, 2002. Source: Gonzalo Arias Recalde architect.



sive human agency (Bonneuil & Fressoz, 2016) to be involved through civic engagement.

**Program and Aesthetic: an On-Going Metamorphosis**

Waste facilities are increasingly facing a spatial and aesthetic metamorphosis, allowing to say that waste management spaces and facilities, starting to be simple technical rooms, are invested by a process of transformation. This transformation sees them taking on the role of real places for meeting, exchange, access to knowledge and finally, where new forms of experience are developed, good civic practices are involved, and finally new forms of economy can emerge.

In this perspective, these facilities should also to be characterized by functional hybridization and spatial quality, to be aesthetically recognizable and to be conceived not as mere storage spaces, but as productive and generative places, such as laboratories or factories, where a continuous transformation of matter and data can be driven by research and innovation.

Some case studies are presented below. The selection underlines strategic, locational, programmatic and aesthetic values.

*Isseane: a circular factory*

At Issy les Moulineaux, the Paris Metropolitan Waste Agency Syctom, decided in 2008 to replace the previous incineration plant with a new one, housing a sorting centre and a valorisation unit. It is also a productive hub for a widespread district heating network. Waste transport on barge and urban proximity allow reducing polluting emissions, vehicular traffic and transportation costs.

Aesthetically speaking, the dynamic wooden façade makes the plant looks like an office building or a shopping mall. The integration with the context is achieved thanks also to the invisible chimney encapsulated in the 2/3 grounded building. This allows reducing noise and airing pollution. Isseane activates synergies with the river, promotes a culture of environmental sustainability and energy efficiency by opening its spaces to educational initiatives.

*Infrastructural intersections: the network of dechetterie in Paris*

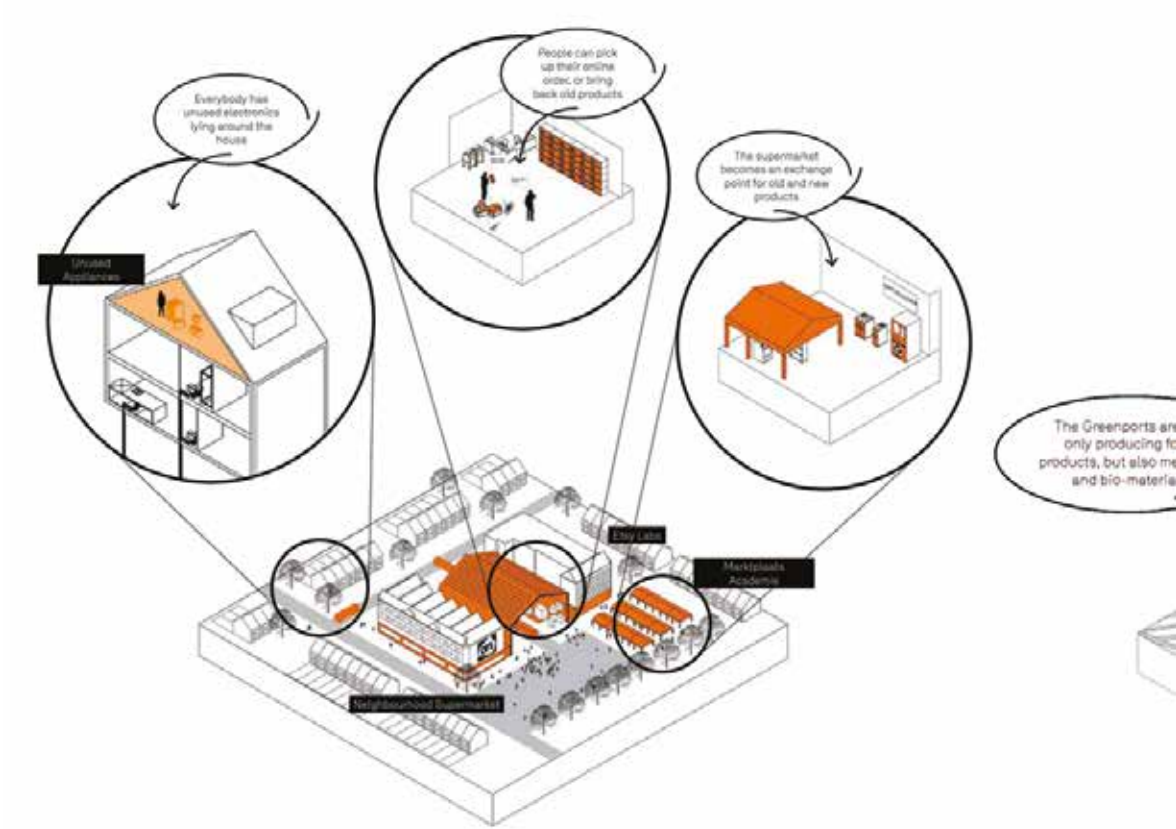
Paris is redefining its relationship with suburban areas beyond the Peripherique. A series of civic-amenity called CVAE (*Centre de valorisation et d'apport des encombrants*) are provided, where collect bulky waste, WEEE, green and garden waste, hazardous wastes as well as paper, cardboard, plastic, metal and glass.

Many sorting centres are located along the infrastructure, filling the voids under the overpass. Particularly relevant is the recycling and sorting centre at *Porte de Pantin*, built in a former traffic roundabout. An elegant white curtain made of staggered white brickwork, alternating with glass bricks, identifies the sorting centre. Aesthetic value accompanies locational advantages, given by the presence of the *Parc de la Villete*, the *Cité de la Musique* and, most recently, the *Philharmonie*.
It is noted how interstitial spaces transformed into a collection centre turns from forgotten space into a place of collective recognition: the overpass becomes the covering of a new metropolitan public space.

*A recycling garden in Winterthur*
The German word *hof* means court, courtyard. This inspired the Recy-hof project in Winterthur (Switzerland), a waste collection centre conceived by Mr. Werner Maag as a welcoming place for temporarily useless objects and materials. Designed by the OOS Open Operative System, in collaboration with landscape designers Stefan Rotzler and Matthias Krebs, the building fits in a strategic location, in a hinged area between the residential area and the industrial area of the city, with a high Degree of accessibility, and close to the railway line.
The building represents a convergence node that includes a collection centre, a lab, offices and services. Spaces and equipment for compacting and treating waste are placed on the other side of the parking lot. The green surface-rooftop put together a parking area and a community garden made by recyclables.

*A multitasking ramp*
In 2003, the architect Gonzalo Arias Recalde realized Ecoparque, a waste collection centre in Granada. The building is located at the edge of a production area and shares the access to the lot with a fuel station. For this reason, different flows are intercepted, ensuring proximity and synergies between different activities. Below the ramp there are three blocks hosting a seminar room and temporary deposits. Finally a third vertical block is located nearby the entrance, to host offices and services. Afterwards the functional program has also included an employment centre.
As an artificial landscape trail, Ecoparque is a porous and crossable border that separates vehicle trails and leaves open views of the surrounding landscape.

**Towards a Distributed and Decentralized Model**
Looking at fragility and inefficiency shown by current waste management infrastructures, the shift from a model based on few concentrated mac-



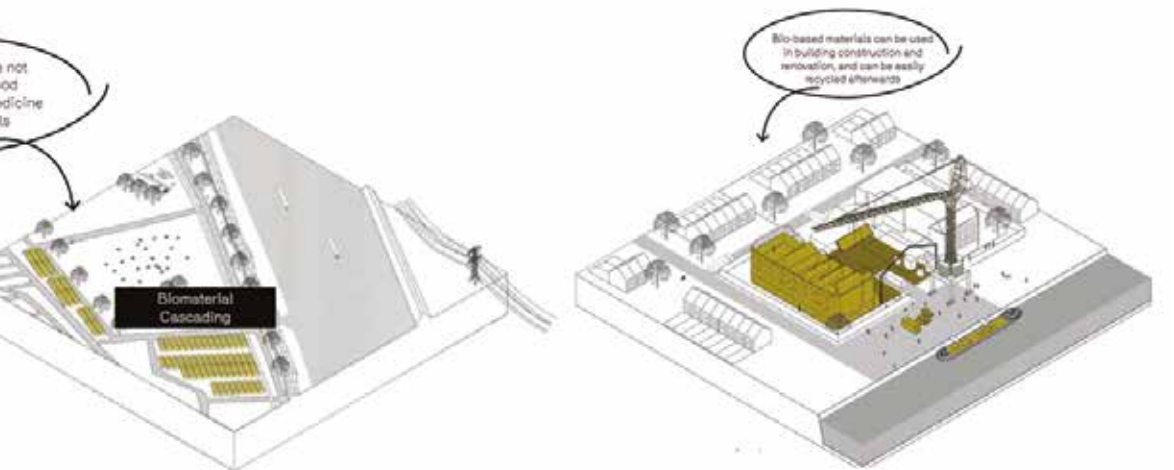

ro-plants, to a distributed and decentralized one, made by small-medium size facilities, represents a real trend reversal that will enable cities and territories to exit from an emergency condition, to finally get to an ordinary state (Mamì, 2014). From a linear model that meant opacity, distance between consumption and production, analytical separation and infinite circulation, we are approaching a new phase based on transparency, proximity, coexistence, systemic integration and circularity.

What kind of urban facilities do we imagine for this scenario? To this question tried to answer the vision *Urban Metabolism: sustainable development of Rotterdam* presented in 2014 at the Biennale of Architecture, *Urban by Nature,* in Rotterdam. The proposal, co-ordinated by Fabric together with a multidisciplinary team, presents a systematic approach and outlines different intervention strategies starting from the identification of nine streams (goods / goods, people, waste, animals and plants, energy, food, water, land and sand, air). The four design proposals converge on the common goal of optimizing metabolic flows. The strategy adopted on Rotterdam declines according to an adaptive logic, resulting into a multitude of medium/small-scale interventions on the medium small scale that are the points of activation or switching of the metabolic flows.

In a distributed and decentralized system, the role of these physical intermediate nodes related to waste management becomes meaningful in order to embed and to steer flows. These new glocal areas of 'friction' stimulate a civic attitude to change.

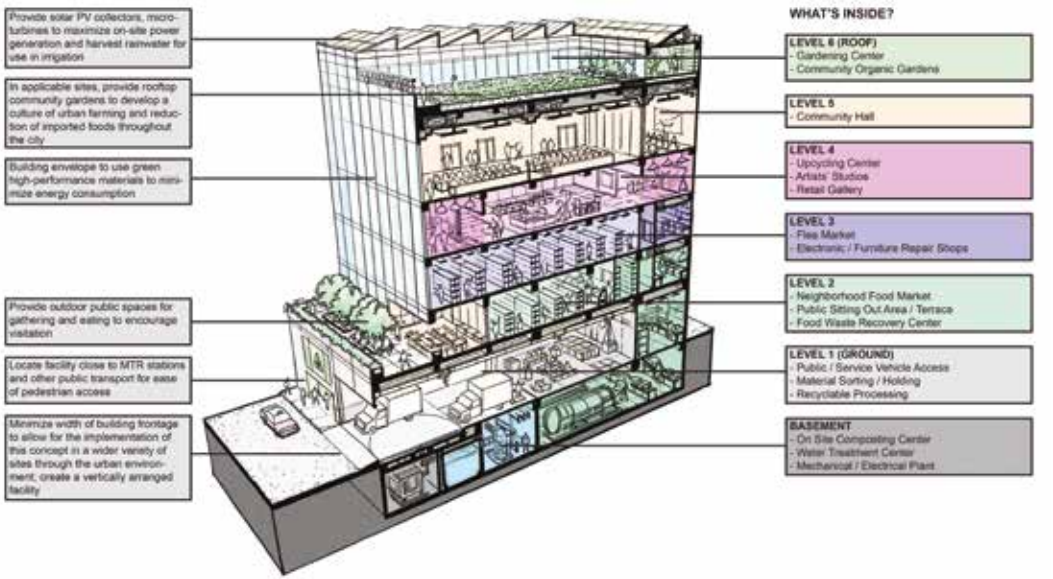
The challenge that contemporary design faces is to apply the principles of proximity, self-sufficiency

**Fig. 7** – Circular utility facilities for Rotterdam (2014). Proposal by FABRIC. Source: Urban metabolism: sustainable development of Rotterdam, IABR, Rotterdam, 2014, pp. 85, 90.




and environmental sustainability, combining them with improved living conditions and daily habits. The relations between these principles are well expressed by the prototype for a neighbourhood community hub proposed by Sepia Design for the city of Honk Kong. It is a multi-story building combining together recycling, community, leisure and educational activities. According to the scheme, an on-site composting centre and a waste treatment centre are located in the basement, in order to ensure odour and noise prevention. At the ground level, vehicles can access to a material sorting and processing area. Three upper floors host flea&food markets (with a food waste recovery centre) and repair & upcycling laboratories next to a retail gallery. A level providing multi-purpose function room for community meetings, educational events and exhibitions foregoes the rooftop. Depending on site conditions, on the roof can be produced food, within the community organic garden, and generated on-site energy with photovoltaic solar panels.

Mapping urban intersection points of flows (humans and non-human) helps to identify new spatial conditions and locational patterns to build a distributed infrastructure of small/medium sized waste facilities. Mid-size facilities are, in this design strategy, elements able to produce new urbanity, along with a wide range of functions. What are the conventional points of connection between various urban systems where a design strategy can promote a more circular metabolism? The strategy proposes to redefine the spatial organization of waste infrastructure through identifying three urban systems: infrastructures; knowledge networks; production and commerce.


Provide solar PV collectors, micro-turbines to maximize on-site power generation and harvest rainwater for use in irrigation
In applicable sites, provide rooftop community gardens to develop a culture of urban farming and reduction of imported foods throughout the city
Building envelope to use green high-performance materials to minimize energy consumption
Provide outdoor public spaces for gathering and eating to encourage visitation
Locate facility close to MTR stations and other public transport for ease of pedestrian access
Minimize width of building frontage to allow for the implementation of this concept in a wider variety of sites through the urban environment; create a vertically arranged facility
WHAT'S INSIDE?
LEVEL 6 (ROOF)
- Gardening Center
- Community Organic Gardens
LEVEL 5
- Community Hall
LEVEL 4
- Upcycling Center
- Artists' Studios
- Retail Gallery
LEVEL 3
- Flea Market
- Electronic / Furniture Repair Shops
LEVEL 2
- Neighborhood Food Market
- Public Sitting Out Area / Terrace
- Food Waste Recovery Center
LEVEL 1 (GROUND)
- Public / Service Vehicle Access
- Material Sorting / Holding
- Recyclable Processing
BASEMENT
- On Site Composting Center
- Water Treatment Center
- Mechanical / Electrical Plant

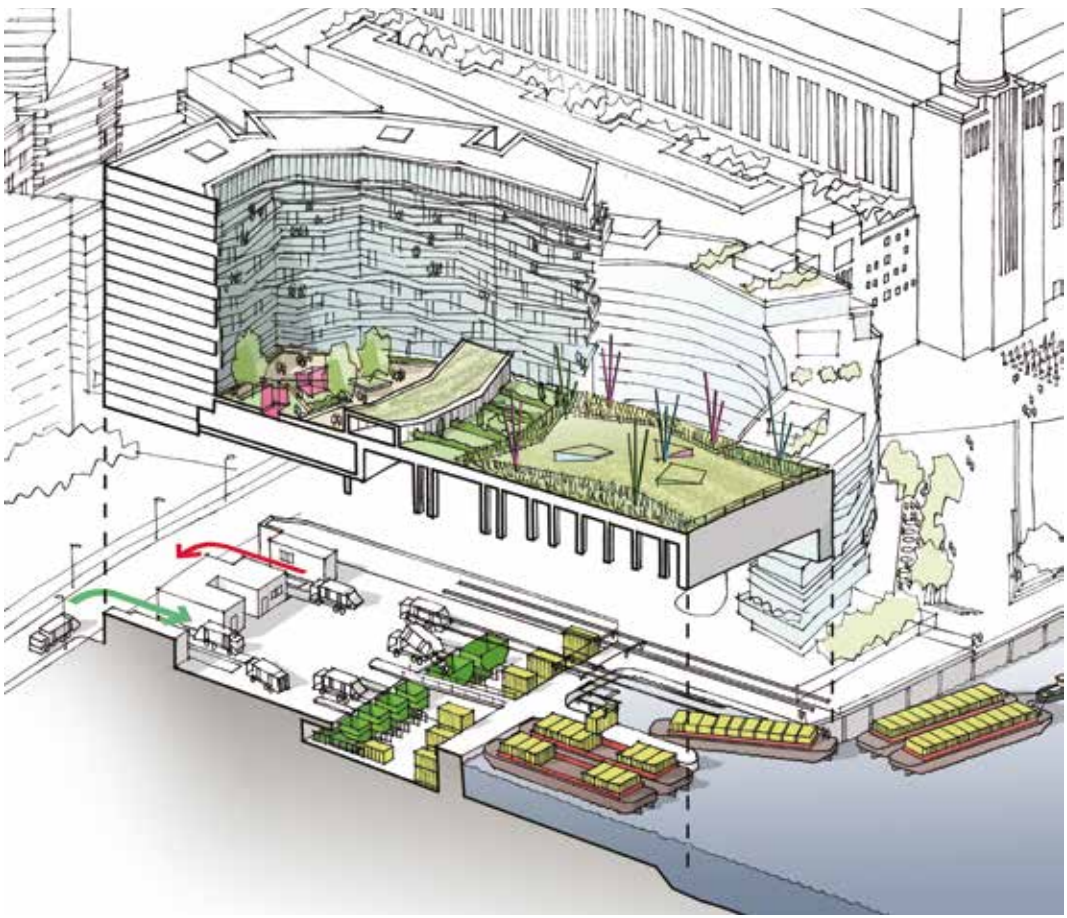


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**Fig. 8** – Prototype for a Neighbourhood Recycling Centre in Honk Kong. Source: Sepia Design.
**Fig. 9** – The Cringle Dock's waste transfer station along the river Thames, London. Project by arch. Rafael Vinoly, 2015. Source: www-wrwa.gov.uk.

*Infrastructures*

A decentralized model underlies the need to think of convergence and *infrastructural ecology* as key principles to draw possible synergies between various systems. Here infrastructures include mobility, transportation and logistics. Since the 19$^{th}$ century, architects are looking to find possible interconnections between infrastructural systems, as in the case of Rue de Future for the city of Paris, proposed by Eugen Henard.

Interpreting proximity in physical terms involves the treatment of waste at reduced distances from the production site, favouring the reduction of polluting impacts and minimizing the criticalities of car traffic resulting from transport activities.

Private transportation and logistics are rapidly changing, under the pressure of ecological goals and technological innovations. It is necessary to consider how the vehicular transport of waste, and the consequent production of $CO_2$, is one of the factors with the most negative impact. In most of the case studies shown, facilities are often located next to railways, despite having different sizes and programs. If we think that many cities are adopting urban railways for the transportation of goods and waste in the city centre, it is clear that new design possibilities need to be tested in this direction.

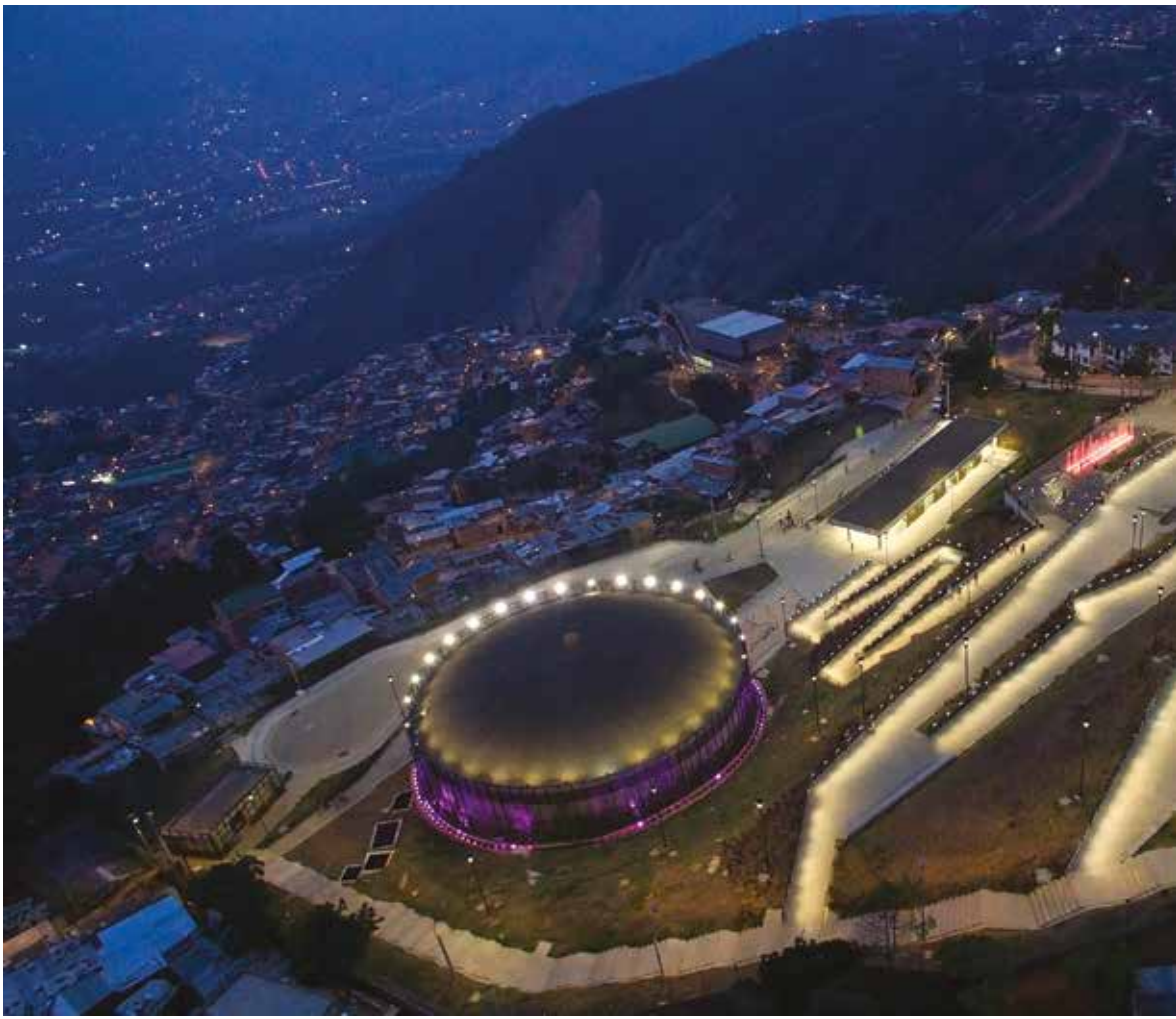
Secondly, strategic connections are found with car mobility, particularly with the network of fuel stations. This typology is also typologically similar to sorting centre, and this factor can constitute an advantage in terms of design. Who writes proposed a strategy for the suburban area of south Rome, developing an incremental strategy in which waste facilities regenerated existing drosscapes nearby the fuel stations (Massaro, 2016). Good examples of connections can be found with rivers, as for Isseane in Paris or the upcoming Cringle Dock in London.

*Knowledge networks*

Education and public awareness are one of the main pillars in the prevention strategy. It's necessary to map public and private spaces for education and knowledge, from schools to community hub, from civic centre's creativity and innovation laboratories. These spaces can catalyse good practices and micro-scale interventions, especially in the first phase of the strategy. In order to legitimate waste management spaces as social and civic places, it has required a functional mix including education and cultural activities. Therefore will find place conference and seminar rooms, offices and services.

*Production and commerce*

Tourism, industry and logistics represent the areas of greatest entropy rate that need interventions



(Acebillo, 2013). Markets, supermarkets and commercial districts are convergence nodes where developed local synergies and close metabolic loops. Locating everyday places as 'producer' spaces leads to waste management being regarded as a system similar to the proximity economy and solidarity networks. Moreover, going to the market citizens can simultaneously confer waste and buy new goods, and thanks to reverse vending services, they shift attitude from users to active prosumers.

The evolution of territorial chains, along with the rapid diffusion of innovation spaces and digital manufacturing laboratories (see FabLab and MakersSpace), is an incentive factor for reviewing the symbolic and functional status of collecting centres and transfer stations. By leveraging on hybridization, digitization and service delivery, they can be considered part of a wider ecosystem.

**Unblackboxing: an Architectural Agenda for Waste**

Waste management model is easily associable with a 'black box' model: the composition of flows is not known exactly and the behaviour of the man-

**Fig. 10** – Top view of an UVA project (Medellin), 2015. Predominant are pedestrian paths and the use of artificial lighting, Source: www.epm.com.co

agement system remains unclear (Graham & Thrift 2007). In the so-called 'era of transparency' of Orwellian memory, the notion of 'unblackboxing' aims to subvert the black box logic of dumb and mono-functional facilities (Graham 2010). The term is borrowed from science and sociology and here has a double meaning. Firstly, it has an operational and aesthetic value for design purposes in order to reveal and make visible management and treatment processes; improve accessibility by creating new connections, services and public spaces; avoid marginalization by opening up boundaries. In this frame the design actions to apply are intended both for the renovation of existing buildings or for new interventions.

Secondly, from a civic, social and relational standpoint, unblackboxing is understood as a political act (Domínguez Rubio & Fogué 2015) aiming to suggest an integrated approach, which means creating enabling conditions to foster multiple processes of self-organisation, civic engagement and prosumership. These categories are systemically applied in the UVA - *Unidades de Vida Articulada* (Articulated Life Units) project series, activated since 2012 in the metropolis area of Medellin (Colombia). The program provides multiple interventions aimed for space reclamation near the water treatment plants and the municipal water reservoirs. Four main aspects link all the different projects. The first is the creation of paths that engage the existing artefacts, by connecting adaptively different points of the city, at different rates. Then the creation of new multifunctional public spaces and the insertion of functions in accordance with the specific needs of the various contexts in which they are located. The second is the reinterpretation of boundaries and fences defined by tanks, in order to foster social inclusion; the third is the lighting design used as a changing layer that makes water tanks as urban attractions recognizable from long distances and finally, the building

of a shared imaginary through participatory processes with locals and stakeholders.

**Conclusions**

In the intermediate spaces identified by the mapping, there happens a conflict between an industrial model and a civic approach to the issue of waste. There a transition takes place. Architecture is called to define new hybrid models and to find new urban coexistences, enabling relations and changing cultural patterns previously considered incompatible.
The proposed scenario shifts the terms of the discourse from the building as a solution to an operational strategy that identifies the fields of intervention, where flows and vectors are the elements that regulate the joint and the use of urban space. The intention to operate in terms of fields and flows is guided by the precise intent to reconnect interrupted ties, reactivating cycles, reduce inefficiencies and generate new values. A focus on waste as a driver for urban changes introduces in the architecture discipline significant innovation aspects, whose singularity emerges to the different design scales. Starting from territorial level, where infrastructure and facilities affect the value of the landscape, to urban settlements scale, where the redevelopment of abandoned or marginal areas can help to regenerate physically and socially some urban fields, until the scale of the building, where communal areas can be reconfigured to welcome new devices for the daily waste collection.
The current reflection outlines how crucial is to provide a combinations of activities and functions, in order to avoid marginalization and failure of waste management infrastructure. Its architectural and social legitimation comes across the assimilation of waste utility facilities to any other kind of public facilities.

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