

# Importance of Education on the Sustainability Improvement in Residential Areas

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**Abstract-** Sustainability issues become important in two specific cases: a) when the impact on the environment is associated to a high volume and concentration of wastes and b) when the contamination capacity / harming effect of the waste is severe, no matter the amount of the residues involved. General actions are taken to reduce CO<sub>2</sub> emissions, to optimize fuel efficiency in transport, to prevent the industry to pollute air, water and soil, but domestic wastes require for a specific strategy. In residential areas there are plenty of opportunities for the implementation of sustainability initiatives, as the sum of the wastes may be significant. Should this be the case, the primary separation at origin is of primary importance to allow for a selective management and process. As a result, individual members of residential areas must be aware of the importance of caring for sustainable procedures, which may lead to advantages on the economy, the resources and the environment. This paper deals with the implementation of education initiatives carried out on a typical medium-size city, aimed at reducing the amount of “non-profitable wastes” through the knowledge of the potential benefits of the different types of wastes generated in residential areas. The identification of harmful wastes, such as batteries, electronic wastes, asbestos reinforced elements, is included too, because they are of utmost importance to prevent soil and water contamination and toxicity for people.

**Keywords:** Environment; recycling; wastes; wastes classification; recycling procedures; final deposition; education.

## I. INTRODUCTION

When concept as “wastes” and “residues” are used, it is important to know the roots of the words; i.e. “residue”, *mid-14c., from Old French residu (14c.), from Latin residuum "a remainder, that which is left behind," noun use of neuter of adjective residuus "remaining, left over," from residere "remain behind"*, according to Merriam Webster English Dictionary.

The increasing importance of sustainable growth and the development of the concept “circular economy”, as well as the significant role of wastes and residues on sustainability have led to change the concept “...material left behind” and “reminder”, to a new one which involves different and innovative alternatives to reuse – recycle and take profit of the “waste and residues”.

Wastes and residues become important because of many different reasons: volume, potential to pollute air, water or soil, harmful character, among other characteristics. Thus, pretending to elaborate a complete classification may be a hard task, and there always exist the risk of special cases that cannot be considered in any of the proposed classes. Nevertheless,

thinking of the need for education of young pupils, a broad classification will be shown, with a special focus on domiciliary wastes, typical for a “medium to small city”.

Special wastes that require a specific treatment after disposal, like pathogenic (blood, syringe, compresses, etc.) are excluded from this generic analysis; nevertheless, the risks associated and the importance of prevention are highlighted.

Different choices other than final disposal can be implemented, extending the life cycle and adding complementary benefits for both, the user and the environment. Sometimes, the “waste” can be considered as a new “raw material” for a cycle different than the waste comes from. Moreover, different stages can be drawn to optimize the benefits, aimed at achieving a “non-waste o 0 residue” process.

For any waste, recycling and reuse are necessarily preceded by processes such as recollection, sorting and pre-treatment, when required. When domiciliary wastes are concerned, the community participation is necessary, as primary sorting must be performed at home-level. Thus, family members have to be motivated, trained and conscious of the importance of such activities to prevent pollution and to reduce the potential risks for health.

In any case, education and primary procedures should be adapted to the common habits and it is better to focus on young people as they are easily motivated and trained.

## II. LEGAL AND STANDARDIZATION ISSUES

Constitution of Argentina states, in Art. 41° “All inhabitants have the right to a healthy, balanced environment ... Environmental damage will generate the primary obligation to recompose it, as established by law.”

*“The authorities will provide the necessary support for the protection of this right, for the rational use of natural resources, for the preservation of natural and cultural heritage, for the protection of biological diversity and to environmental information and education”*

In 2004, Law No. 25,916 [1] was passed, which defines household waste as “those elements, objects or substances that, as a consequence of the processes of consumption and development of human activities, are discarded and / or abandoned”, also including other waste from urban cleaning and other similar to those.

Regarding the management of waste, it establishes its integrated management, considering the appropriate valuation and final disposal. This management is “the set of

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*interdependent and complementary activities that form a process of actions for the management of household waste in order to protect the environment and the quality of life of the population."*

In particular, the valorisation of household waste is promoted through the implementation of appropriate methods and processes, minimizing negative impacts on the environment and minimizing waste destined for final disposal.

In the City of Buenos Aires, by Res. 1444/14 / MAYEP [2], all urban solid waste generators are obliged to separate them at source and ensure their correct differentiated disposition. This includes both individuals, buildings, houses and PHs (special type of apartments) as well as businesses, companies, public and private institutions within the scope of the Autonomous City of Buenos Aires.

### III. SITUATION OF THE SELECTED CITY

The party of Pergamino, which occupies an area of 2990 km<sup>2</sup>, has a total population of about 110,000 inhabitants, of which 95,000 inhabit the main city, 10,000 reside in the twelve party campaign Villages and 5,000 correspond to the rural population. Geographically it is located north of the province of Buenos Aires, at the following coordinates: (south) latitude -33.8899498 and (west) longitude -60.5735703.

The Parchment Party is recognized for being an agro technological pole with worldwide potential. There is an increasing importance of the appropriate treatment of waste, both residential and urban, due to the high urban concentration, to reduce the negative impacts on the environment, considering that it is a community that bases its economy on agricultural-livestock production and derivatives (textile, among others).

Pergamino authorities have identified sustainability as one of the thematic axes for management, through the "Acting in green" [3] program, a local campaign within the integral sustainability policy.

In this very recent program, a system of containers for the separation of waste at origin was implemented, discriminating materials that can be reused or recycled, PET bottles, non-pet plastics, cardboard and waste paper that are garbage (SIC).

In such a recent action, it is timely and relevant to identify opportunities for improvement; for example, we could replace "...of waste that is garbage" with "of other waste that deserves another type of use according to its type and quantity", with environmental and economic advantages.

### IV. LIFE-CYCLE OF WASTE AND CIRCULAR ECONOMY

Constitution of Argentina states, in Art. 41° "All inhabitants have the right to a healthy, balanced environment ... Environmental damage will generate the primary obligation to recompose it, as established by law."

For each type of waste, it is possible to imagine a life cycle that does not always close in itself but can integrate another process, as if it were a new raw material. The design of these

successive and coordinated cycles is a task that exceeds the community but, at the beginning, it would be sufficient for them to understand the importance of identifying the requirements of a suitable classification at source and the required pre-treatment for inclusion in the new cycle.

The image shown in Fig. 1 illustrates two coordinated cycles that could represent the recycling of used cooking oil as a raw material for the production of biodiesel or as an alternative fuel for processes of high energy demand and in which replacement of fossil fuels by renewable sources is sought. For small scale, it is feasible to produce handmade soaps, compatible with social enterprises, due to intensive though low-skill labour required.

Precisely, the circular representation of the cycles and the possibility of designing processes that, in addition to contributing to environmental care, represent opportunities for economic and social development led to the identification of the "circular economy".

The importance of this concept is that it transforms sustainable initiatives into "feasible ones", moving from a "statement of interest" to a more concrete initiative where economic aspects show advantages for all the actors in the process and the community, i.e. a win-win situation.

The importance of achieving this level of applicability is that the dependence on external financial contributions to the process is reduced, although sometimes it may be necessary to induce the initial development of these initiatives, by means of tax exemptions, subsidies, soft loans, etc.

For certain wastes it is not easy to find complementary cycles and their collection only aims to avoid environmental pollution; this is the case of batteries and electronic waste. The citizen should only be aware of the environmental danger of the waste and he/she should take it to specific collection centres where specific treatment will be applied.

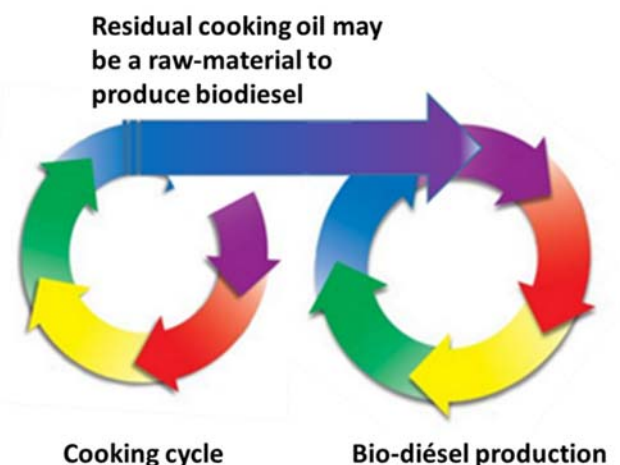


Fig. 1 The combination of cycles allow for new applications of the waste

## V. PRELIMINARY CLASSIFICATION OF DOMESTIC WASTES

The Secretary of Municipal Affairs dependent of the Ministry of Interior and Transportation published a training module for the Management of Urban Solid Waste (RSU), which establishes a primary classification that is transcribed in Table 1.

TABLE 1  
PRIMARY CLASSIFICATION OF URBAN DOMESTIC WASTE, FROM [4]

Organic or "wet wastes"	Inorganic or "dry wastes"
Cooking residues	Paper and hardboard
Gardening wastes	Glass
Tree-trimming wastes	Plastic and rubber
---	Multilaminar packages (i.e. tetrabrick)
---	Wastes from textiles
These wastes can be biodegraded and thus, can be included in organic recycling procedures	These wastes can be feasibly included in recycling and reuse processes

From Table 1, it can be seen that organic recycling cycles (composting, biofuel, etc.) could be derived for the group of organic waste, while for inorganic waste specific procedures that technically and economically justify their reuse or recycling should be identified.

The spectrum of these specific procedures is continuous evolving and it is up to public research organizations and universities to identify new opportunities, design ad-hoc processes, evaluate their prefeasibility and make their developments available to the community.

The industrial scale implementation of these processes could justify the collection and selective treatment with a view to the integration of new alternatives for a circular economy development, with economic advantages, in addition to environmental ones.

## VI. IMPORTANCE OF THE INTERACTION BETWEEN COMMUNITY-UNIVERSITY

The university and other public research organizations, such as institutions that generate knowledge, are agents capable of propose new alternatives for waste reuse, incorporating innovative procedures and processes.

These new alternatives provide new ways of reuse wastes that, until not too long ago, could only be disposed of safely or were even discharged without control with the consequent environmental impacts, such as used cooking oil.

It has been shown that the use of used edible oil for the production of biodiesel is possible [5] [6], so it would only be necessary to build the specific reactors that justify the planning of a primary collection at home. In addition to having a renewable raw material for the production of fuel, the discharge to the sewage network is avoided, with the consequent environmental advantages.

Another example of novel applications is the immobilization of finely ground glass in cement matrices, the use of coffee waste as an improver of farmland, a practice

encouraged by a commercial cafeteria company with the "Grounds for your Garden" program [7].

In the field of organic waste, there are even bioreactor developments for composting household organic waste by self-management [8].

Once the processes for reuse, recycling, composting or the corresponding technique have been defined, it is possible to identify the pretreatment and collection methods applicable to these wastes. For example, in the composting system by self-management, the transport of waste is avoided, because the proposed reactor is domiciliary.

These requirements must be communicated to the people so that the collection, separation and conditioning are effective to protect the environment and justify its subsequent process. The change of habit in the population is only achieved through awareness of the importance of environmental conservation through a gradual incorporation of good collection, separation and pretreatment practices (cleaning, drying, among others).

## VII. HOW SATISFACTORY RESULTS ARE ACHIEVED?

According to international and regional experience, the introduction of new habits should be done as a collective response to the expectations of change, which arise from the understanding of the phenomena associated with sustainable development. [9]

This collective approach is also shared by the Municipal Program for Solid Waste Treatment, proposed by the Municipality of Santa Catarina, Brazil [10]. In this Program, a Quiriri Consortium, a consultative and advisory body, was created that based the actions to be carried out on the wishes of the community, selecting the programs according to local priorities, with a premise that the process should be initiated from the base to converge on the top of the pyramid.

The importance of incorporating different issues that merge into sustainable development, associated with the issue of waste, have already been a concern in the European Economic Community where the MultiR concept, which displaces the "three R concept", could be described as the sum of rethinking, redesigning, remanufacturing, repairing, redistributing, reducing (waste), reusing (waste) and recovering (energy embedded in waste). [11]

## VIII. DESIGN OF A PILOT EDUCATION PROGRAM

A pilot program for education was designed, targeting the youngest pupils as future agents of dissemination, also considering that the incorporation of school-age habits is easier than for the elderly.

This program is based on a UBANEX project [12], aimed at the consolidation of Educational Social Practices, founded by Universidad de Buenos Aires; its main objective is to transfer the technical knowledge on environmental protection acquired at the national university level to a rural location through recycling and reuse of their waste.

## VIII. ADRESSEE

The participating Social Organization will be the “Asociación Cooperadora del Instituto Comercial Rancagua” (Cooperating Association of the Rancagua Commercial Institute) that has been identified as a pilot school, to create a space of opportunities for students to exercise their role in the learning process based on creative, innovative and content articulating experiences. The institutional trajectory has many past experiences on how fruitful the efforts are when the objectives are clear and the processes are carried out jointly with the community and all participants are committed with the Project.

### VIII. GROUP OF WASTES IN THE EDUCATION PROGRAM

Aimed at simplifying the understanding of wastes types, for the education program wastes were grouped into four categories:

- a) Compostable (organic matter)
- b) Recyclable with later use (paper, used edible oil, glass containers, plastic containers, etc.)
- c) Not recyclable but with potential adverse effects on the environment (batteries)
- d) Not recyclable but without associated environmental problems (construction and demolition waste, coal ashes, etc.)

For each of these categories, a common sequential scheme will be addressed, although with the corresponding specificities, in coordination with the Asociación Cooperadora del Instituto Comercial Rancagua. This scheme can be summarized as follows:

1. Induction talks on environmental issues – Potential impacts of environmental risks
2. Information related to the types of waste considered in the thematic axes identified, potential uses, risks and opportunities
3. Dissemination and discussion of a Procedures Manual and its corresponding instructions, with specificity for each group
4. Starting data for impact quantification through indicators
5. Implementation of the selective collection program, in a trial period
6. Impact of education program assessment and quantification of potential impact on the environment and related issues

## IV. CONCLUSIONS AND FUTURE PERSPECTIVES

From the implementation of joint actions between University - Community - Government (municipal / regional) and companies in charge of the technological process a synergistic effect with multiple impact, the following advantages may be obtained:

- Improvement of environmental awareness in urban communities.

- Development of local and regional strategies, with specificity to the types of wastes and common habits.
- Assessment of the contribution of scientific and technical research of the university.
- Design of local government strategies in associative schemes with university and business enterprises.
- Development of new business opportunities, with economic, environmental and social impact.

## REFERENCIAS

- [1] Congreso de la Nación. “Ley N° 25.916. Ley de Gestión de Residuos Domiciliarios”. <https://www.argentina.gob.ar/normativa/nacional/ley-25916-98327/texto>
- [2] Boletín Oficial del Gobierno de la Ciudad de Buenos Aires. “Res. MAYEP 1444/14 (G.C.B.A.)” <https://boletinoficial.buenosaires.gob.ar/normativaba/norma/254851>
- [3] Partido de Pergamino. <http://www.pergamino.gob.ar/2019/01/11/pergamino-productivo-moderno-y-sustentable>
- [4] Ministerio de Ambiente y Desarrollo Sostenible. “Gestión Integral e Inclusiva de Residuos Sólidos Urbanos, Módulo de capacitación Secretaría de Asuntos Municipales, Ministerio del Interior y Transporte”. [https://www.argentina.gob.ar/sites/default/files/2021/12/guia\\_para\\_la\\_implementacion\\_giirsu\\_24\\_feb\\_2022.pdf](https://www.argentina.gob.ar/sites/default/files/2021/12/guia_para_la_implementacion_giirsu_24_feb_2022.pdf)
- [5] M. García-Díaz, J. Gandón-Hernández, y Y. Maqueira-Tamayo, “Estudio de la obtención de biodiesel a partir de aceite comestible usado”, RTQ, vol.33 no.2, pp. 162-169, agosto 2013. <[http://scielo.sld.cu/scielo.php?script=sci\\_arttext&pid=S2224-61852013000200005&lng=es&nrm=iso](http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2224-61852013000200005&lng=es&nrm=iso)>. ISSN 2224-6185.
- [6] L. López, J. Bocanegra, y D. Malagón-Romero, “Obtención de biodiesel por transesterificación de aceite de cocina usado”, Ing. Univ., vol. 19, no. 1, pp. 155-172, junio 2015.
- [7] Starbucks. <http://www.starbucks.com.ar/responsibility/environment/recycling>
- [8] C. A. Falcó, “Desarrollo de un biorreactor para la autogestión domiciliaria de residuos sólidos urbanos orgánicos”, Tesis doctoral, Facultad de Ingeniería, Universidad de Buenos Aires, 2015.
- [9] Autoridad para el Manejo Sustentable de la Cuenca del Lago de Atitlán y su entorno. “Proyecto Fortalecimiento del Sistema de Gestión de los Desechos Sólidos en la Cuenca del Lago de Atitlán”. <https://www.amsclae.gob.gt/descargas/memoriadelabores/mem2015.pdf>
- [10] Municipio de Santa Catarina, Brasil. “Programa municipal para el tratamiento de residuos sólidos”. <http://habitat.aq.upm.es/dubai/04/bp1656.html>
- [11] L. Fernández-Luco. “El hormigón, material de relevancia en la economía circular”, Seminarios Torroja, Instituto de Ciencias de la Construcción Eduardo Torroja, 30 de abril de 2019.
- [12] C. Vázquez, L. Fernández-Luco. “El cuidado del ambiente a través de las prácticas sociales educativas”, Proyecto UBANEX, Res. N° 1081/2019 UBA (CS).