

ECONOMIC ADVANTAGES OF THE RECYCLING BUSINESS AVANTAGES ÉCONOMIQUES DE L'ACTIVITÉ DE RECYCLAGE

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Abstract

This paper tries to emphasize the economic importance of the activity of recycling waste, especially household waste, by giving some theoretical concepts related to the activity of recycling; then we gave the economic advantages and justify the importance of this activity through some examples of countries that have managed to achieve high rates of recycling.
Keywords: waste, recycling, household waste, recycling rate, waste recovery.

Résumé

Le présent article tente de mettre l'accent sur l'importance économique de l'activité du recyclage des déchets notamment les déchets ménager, en donnant quelques concepts théoriques relatives à l'activité du recyclage ; puis on a donné les avantages économiques et justifier l'importance de cette activité à travers quelques exemples de pays qui ont réussi à atteindre des taux élevés de recyclage.
Mots clé : déchets, recyclage, déchets ménagers, taux de recyclage, valorisation de déchets

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Introduction:

The question of waste has become a real dilemma at the global level, not only on the environment with a growing volume of waste to be treated exceeding 2.0 billion tons per year according to the World Bank, but also in terms of trade and geopolitics. This has led governments to seek and adopt more cost-effective solutions than the technical re-packaging of waste, among these solutions we find recycling.

The recycling activity is not only considered as a solution to this problem but also as an economic and social opportunity which allows to solve the problem of waste and to contribute in a direct way to the improvement of the financial incomes of the states, to the reduction of the consumption of raw materials and to the creation of jobs from an economic point of view, this activity has also ecological advantages through the reduction of the emissions of the toxic gases in particular the CO₂.

The points dealt with in this paper are outlined as follows:

- 1-Definition of recycling;
- 2-Type of recycling;
- 3-Recycling chain;
- 4-Economic advantages ;
- 5-Recycling across the world.

1. Definition of recycling:

Several authors have tried to give a definition to the activity of recycling, each according to his point of view as follows:

"Recycling is the process of converting waste into usable products to avoid waste of useful raw materials as well as reducing the consumption of raw materials and energy"(collection and treatment of electronic and electrical Equipment waste, OULDKADDOUR Leila, graduation project, University of Tlemcen).

"Recycling is the process of collecting and reusing waste materials, whether biological, mechanical, chemical or thermal, and converting them into new products"(Marjolane SOLARC, I REDUCE MY WASTES; first edition; France;2017).

"Recycling is the reuse of the product once it has been used or parts of the product and transform them into materials for the same production or for other products"(<https://www.recycling.wikipedea>. Consults on 02/12/1019).

2. Types of recycling :

There are several types of waste that require the operation of recycling because of their high pressure on the environment due to their significant size, as the usual inert waste, or because of the dangers they represent for

human life and nature, according to these types of waste we can classify the types of recycling as follows(<https://www.recycling.wikipedia>)²:

2.1. Recycling of inert waste: this type of activity includes several products such as paper, plastic, glass, food bricks, steel ... we will simply name a few examples of this type of recycling(<http://cogetrad.com>"colecting-recycling, consults on 20/12/2019):

a- Paper and cardboard recycling: it has a significant importance in the recycling activity and is increasing every year in the countries.

b-Plastic recycling: the production of plastic products, especially packaging, has generated a considerable pressure on the environment, which has led states to find solutions to this problem, such as recycling(<https://www.valorplast.com>, consults on 20/3/2020).

c-Recycling of batteries and waste of electrical and electronic equipment: This type of recycling includes all devices or components of objects that operate using electric or electromagnetic current supplied by electric current or by batteries or cells; the processing of this type of product poses real technological challenges: extraction and recovery of precious metals, treatment of flat screens, control of toxic products, dismantling, etc(<https://www.economie.gouv.fr>"cedef waste electric and electronical Equipment treatment and management, consults on 09/03/2020) .

2.2. Recycling of worksites wastes: Every year, all countries of the world generate millions of tons of building site waste, often buried or incinerated. These wastes are only rarely recovered (<https://www.mekaglobal.com>"recyc consults on 09/03/2020).

2.3. Recycling of common industrial waste (CIW): Common industrial waste is non-hazardous waste generated by a number of industries, such as production offcuts and residues, used packaging, glass, metals, plastic, paper, cardboard, wood and metals.(<https://www.Franceenvironment.com.consults> on 09/03/2020).

2.4. Recycling of hazardous industrial waste (HIW) : Hazardous industrial waste is industrial waste that can cause danger to human life and the environment such as used oils, solvents, cosmetics, paints, batteries, soiled packaging, aerosols, pharmaceuticals, phyto-sanitary waste, industrial sludge... This type of waste requires special collection and treatment methods that must meet the regulatory constraints specific to each

sector, in terms of responsibility and traceability(<https://www.hunbency.com/dechets...consults> on 09/03/2020).

2.5. Recycling of end-of-life vehicles (ELV): Every year millions of tons of vehicles become unserviceable generating millions of tons of waste that requires a whole recycling process(for exemple in France we estimate 1.5 millions of vehicles)(<https://www.valoservices.suez.fr>” consults on 09/03/2020) .

2.6. Energy recovery: When the recovery of materials comes to the end of its logic, energy recovery can intervene; it constitutes today an extremely important additional offer for energy importing countries. The production of energy from waste is possible thanks to innovation and the permanent progress of technologies, most of the waste which cannot be recovered in the form of material can now constitute, in solid or gaseous form, fuels and even to produce energy, without risk to the environment<https://www.paprec.com>”second-life. ENERGY

RECOVERY:AND ENERGY WAS! Consulted on 09/03/2020).

2.7. Agronomic recovery: organic waste of agricultural, municipal or domestic forestry origin can constitute a quality organic amendment for the soils. Compost is obtained after degradation of non-recyclable wood waste, green waste and organic waste (sewage sludge, bio-waste); composting makes it possible to fertilize the soils([https://www.paprec.com,second life ,ORGANIC](https://www.paprec.com,secondlife.ORGANIC) RECOVERY: A RETURN TO THE LAND, consults on 09/03/2020).

3. The recycling chain: The recycling process is based on several steps starting with the collection of waste, through the sorting and processing of this waste to the marketing of recycled products or raw materials(<https://www.Recycling.wikipedia>, consults on 01/01/2020).

3.1. Waste collecting: the collecting operation is done in different ways in the countries according to the level of civism and industrialization, for example in the developed countries, the waste collecting is done in a selective way called "selective sorting", while the operation is done in the underdeveloped countries in a manual way by people or employees while sorting the waste by nature according to the demand.

3.2. Sorting of waste: following the collection, the products are sent to a sorting center where they will be sorted in a mechanical way to optimize the operations of transformation, this operation can be completed by a manual sorting using a conveyor belt.

3.3. Transformation: once the operation of sorting is finished, the waste is ready to be integrated in the operation of transformation by factories that will transform them to materials ready to use.

3.4. Marketing and conservation: once the waste is transformed into raw materials after the recycling process, the materials are used to make new products that will be marketed to consumers.

4. Economic advantages of the recycling activity:

The activity of recycling which consists in the recovery and the development of large quantities of waste generate important economic and environmental advantages, which contribute in an effective way to the sustainable development. These advantages can be seen in the reduction of raw material consumption, the creation of investments and jobs, the creation of added value...(<https://maisonrangee.com>"avantages; the economic and environmental benefits of recycling; consults on 05/22/2020)

4.1. Creation of new jobs: The recycling activity has become a huge global industry, according to Cyclops Institute (economic advantages and development of waste materials in Quebec, www.Recy-Quebec, consults on 01/01/2020) rich countries spend 120 billion dollars yearly, to which are added 150 billion dollars for those of the waste of the industrial sector which allows to create thousands of jobs related to these investments.

a. As for the needed qualifications; a low-skilled workforce is required by companies investing in the first phase of the recycling chain (collection and sorting of waste), but institutions operating in the transformation of recycled materials; as well as the workforce are required to qualify according to the requested job. In this regard, we can cite the example of France, which has managed to create 33,000 new permanent jobs in 2012 through the activity of recycling.

b. Creation of new economic activities: recycling is considered as an independent activity, thus it allows the creation of new economic activities capable of creating wealth for the institutions operating in this sector(<https://www.actu-environnement.com>, consults on 08/01/2020).

c. Providing raw material for different industries: the recycling activity allows avoiding the waste of raw materials; for example the companies that use copper fibers rely on recycled copper wires and not on copper extracted from nature; the recycling activity also allows the regular

supply of raw material and allows the institutions to have several relationships with different suppliers(Brahim DJEMACI, “municipal waste management in Algeria prospective and element of efficiency”, doctoral thesis in economics, Rouen’s universite).

And finally, it can be said that recycling contributes to strengthening the independence of national economies with regard to the supply of raw materials.

d. Creation of added value: The recycling activity goes through three necessary stages which allows the creation of added value at each stage, first the recyclable material must be recovered by means of a collection or a deposit, then it is sorted and conditioned to be saleable on the market, finally it is recycled to become a new finished product; each of these stages adds the most value as the recovered materials are transformed into finished products(<https://www.act-environnement.com>, consulted on 31/04/2020).

This added value is measured mainly in terms of the selling price of the product that is created; and it includes a set of activities such as the hiring of personnel, the acquisition of equipment, products and services from suppliers, and the returns received.

All these dimensions are therefore part of the economic advantages related to the development of residual materials.

e. Recycling an industry more integrated with the international trade of waste materials: the international trade of waste materials is growing, in 2006; Cyclope Institute estimated that the value of international trade in waste materials exceeded 100 billion dollars.

Among the top 20 exporting companies in the United States of America, seven were related to the recycling field in 2007; and until 2017, China was also a major destination for electronic waste products, it received up to 70% of the world shipments(Sophie Bernard, Damien Dussaux and others, wastes international trade, discovery edition,Paris,2012).

5. The Recycling activity worldwide:

According to the World Bank, only 13% of our household waste is recycled and only 5.5% is composted. Until 2017, most of the waste produced by industrialized countries was recycled in China: paper, cardboard, plastic... The Chinese government has put an end to these massive imports, which has left industrialized countries with mountains of waste to process.

Under this title we will present some figures concerning some countries which recycle their waste and in the four continents.

5.1. Recycling in the European Union:

In 2014 each inhabitant of the European Union generated an average of 475 kg of municipal waste. These figures vary greatly from country to country; Denmark produced the highest amount of municipal waste per capita for the same period, at 759/kg. Conversely, Romania has recorded the lowest amount of waste production; to face this problem the member countries have chosen several methods of treatment, including among others, recycling([https://www.toutel' Europe.eu](https://www.toutel'Europe.eu/recycling%20in%20the%20European%20Union)"recycling in the Eropean Union, consults on 08/31/2020).

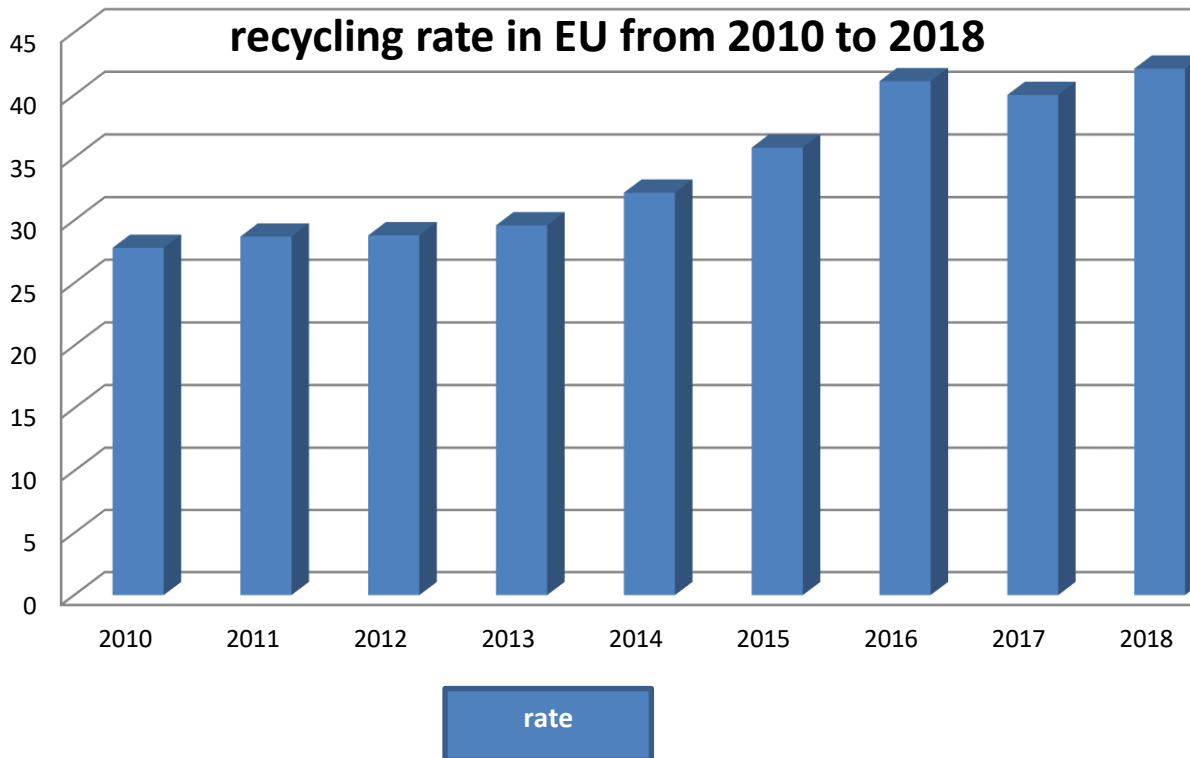
Recycling activity in the European Union has been growing steadily since 2006, with the EU recycling nearly 55% of all waste in 2016 compared to 53% recycled in 2010 according to statistics released by Eurostat, excluding the main mineral waste. The recycling rate of construction and demolition waste amounted to 89% for the same year and the recycling rate of packaging exceeded 67% in 2016 against 64% in 2010, while the recycling rate of plastic packaging was over 42% in 2016 against 24% in 2005. The following table gives us an overview of the recycling rates in the European Union from 2010 to 2018([https://www.ec.europa.eu/Eurostat](https://www.ec.europa.eu/Eurostat/web/product)"web"product, consults on 09/02/2020).

Table N° 01: Recycling rates in the EU from 2010 to 2018 :

Year	rate (for UE 28 countries)
2010	27.8%
2011	28.7%
2012	28.8%
2013	29.6%
2014	32.2%
2015	35.8%
2016	41.3%
2017	40%
2018	42.1%

Source:[ec.europa.eu/ Eurostat](https://www.ec.europa.eu/Eurostat)

From the table it can be seen that the recycling rates are still growing for the period from 2010 to 2018, which indicates the importance of the recycling activity for the environment and for the economies of the EU member states. To better visualize the development of the recycling activity in the EU we present the following histogram:



Source: histogram prepared by the researcher.

However, the above figures vary from country to another and also vary according to the type of waste treated; the following tables illustrate this situation.

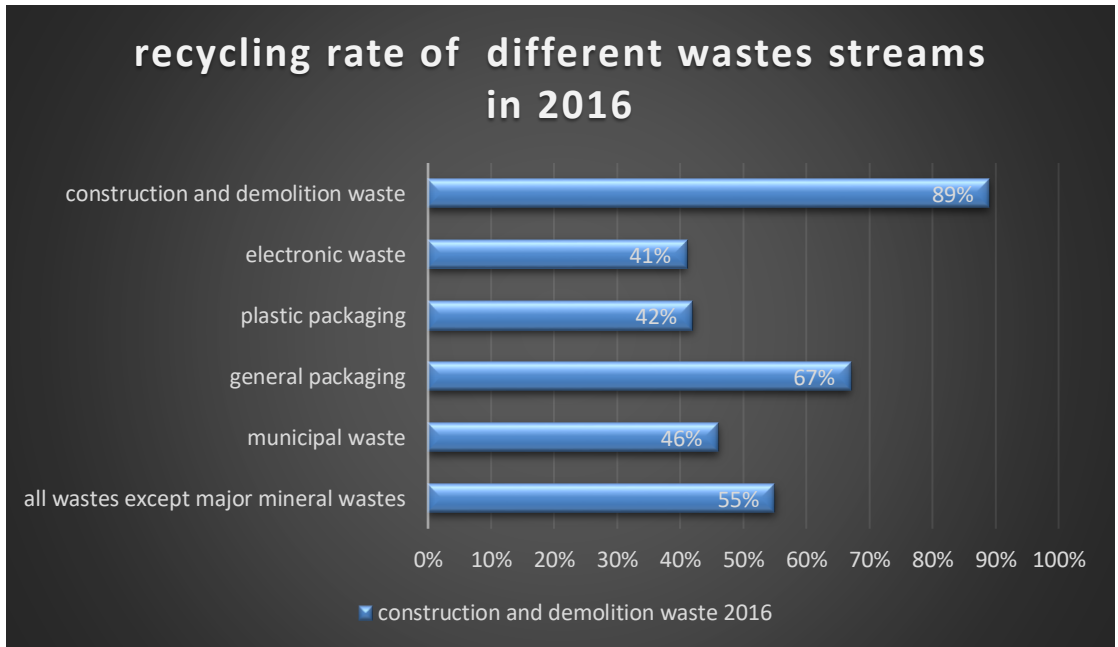
Table N 02 : Recycling rates according the type of waste:

Type of waste	Recycling rate
All wastes except major mineral wastes	55%
Municipal waste	46%
Common packaging	67%
Plastic packaging	42%
Electronic waste	41%
Construction and demolition waste	89%

Source : [https:// ec. Europa.eu »Eurostat »stati circular economy in the EU.](https://ec.europa.eu/eurostat/statistics-explained/index.php/Circular_economy_in_the_EU)

From the table we can see that the recycling rates for different types of waste have exceeded 40% which is close to the target rate set by the EU, i.e. 50% for 2020.

We will try to see the above statistics better by the following histogram:



source: ec.europa.eu/Eurostat.

To conclude, and according to the provided statistics, we can see that the recycling rate of the European Union member countries has been growing positively since 2010, this rate has reached nearly 55% of all waste recycled in 2016 against 53% in 2010 according to statistics released by Eurostat (excluding the main mineral waste).

5-2-Recycling in North America: for this part, we give the example of the largest industrialized countries that produce large quantities of waste.

a-Recycling in the USA: According to Steel Recycling Institute., North America has achieved several record figures in recycling with a rate of 92% of its scrap metal in 2011, or 95 million tons and 70.8% corresponding to 1.5 million tons of steel packaging that were recycled, as for the rate of steel recovery in the automotive sector, the latter had reached 94.5%, or 2.9 million tons of material recovered; it is also worth mentioning that the recycling activity has allowed to achieve financial revenues equal to 236 billion dollars with a figure of 1.1 million jobs and 56,000 companies working in this field.

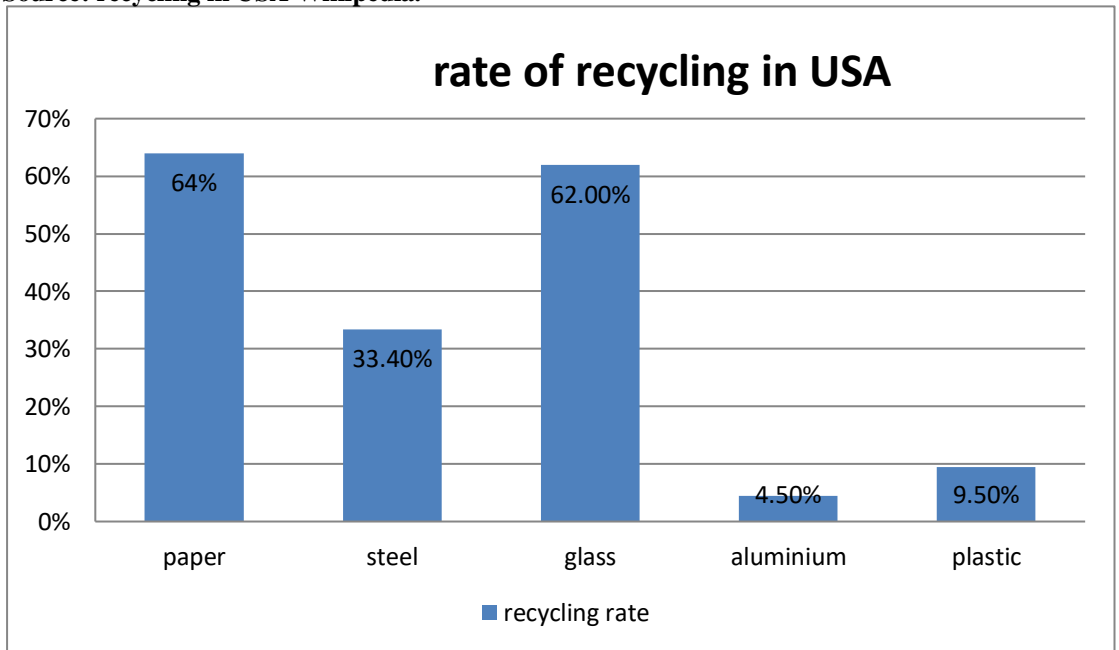
For other types of waste, recycling rates remain low even though the U.S. is the world's largest producer of waste, due to the lack of national guidelines forcing states to work toward reusing recycled materials, yet these states

recycle only 35% of their waste and rank 18th among the world's top recyclers(<https://www.geo.fr/environnement/consults> on 08/08/2021); While pointing out that the recycling rate varies from one state to another, for example Oklahoma and Indianapolis recycle less than 4% of their waste, while the city of San Francisco treat all of its waste(recycling in USA ,Wikipedia .org, consults on 08/07/2021); to better see the situation of this activity we will give some figures relating to the activity according to the following table:

Table N 07: Recycling rates for different types of waste in 2014 :

Type of waste	Recycling rate
Pap er	64%
Steel	33.4%
Glass	26.0%
Aluminum	19.8%
Plastic	9.5%

Source: recycling in USA Wikipedia.



b-Recycling in Canada: despite the many policies of selective sorting and the will to recycle, the results remain insufficient according to international organizations in Canada, we can cite the example of the Province of Quebec which recycled in 2018 a quantity equal to 1. 425,000 tons of paper and cardboard; a quantity of glass equal to 131,000 tons and 833,000 tons of ferrous and non-ferrous metals; as for plastic, the sorting centers have

declared to have sent 39,000 tons of plastic 1 to 7 to the conditioners and recyclers of Quebec plastic; and 34,000 tons of plastic have been exported to different destinations outside Canada(<https://www.RECYC-QUEBEC.gouv.qc.ca>"2018 report).

5-3- Recycling in ASIA: some Asian countries are leaders in the recycling sector such as South Korea. We will also cite the example of Japan (one of the largest industrial countries) to see the figures relating to this activity.

a-Recycling in Japan: Japan, one of the major industrialized countries, produces 43 million tons of waste every year. To face the problem of environmental pollution, the government has set the goal of reducing household waste by 25% and corporate waste by 35%; for this purpose, a strict policy has been put in place; at the household level, each bag of garbage collected is charged. In 2020, an ambition based on three principles: Reduce, Reuse, Recycle (3R principle) is set, something that has allowed the evolution and growth of recycling rates each year according to the figures in the following table (annual report on the environment in Japan 2016,MOE):

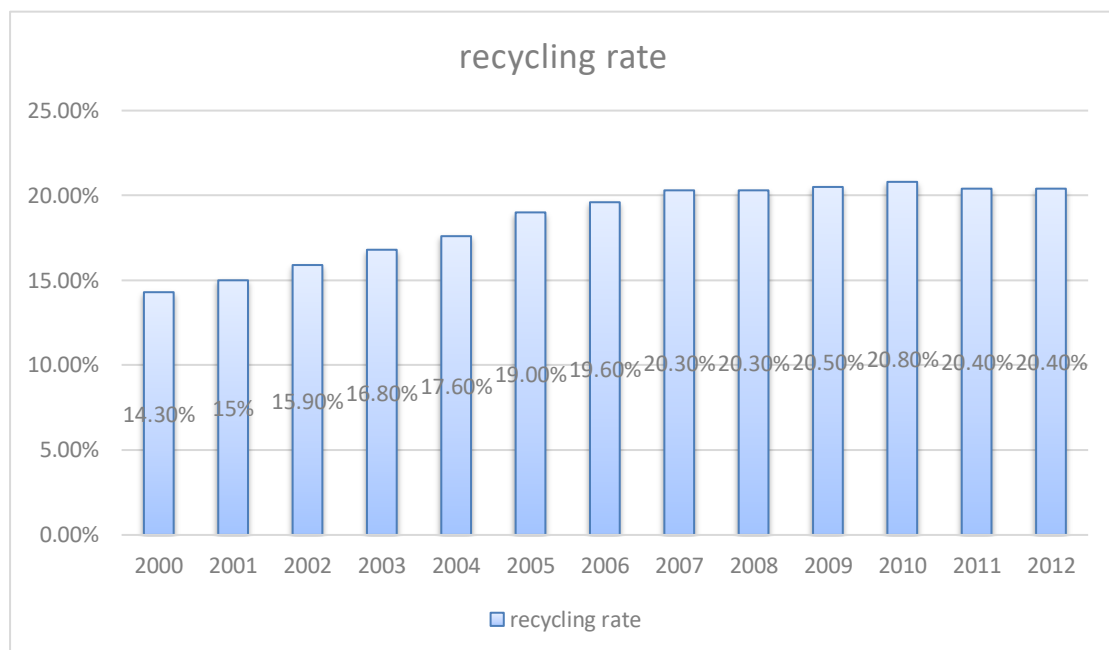
Table N05: Evolution of recycling rates in Japan :

Year	Recyling rate
2000	14.3%
2001	15.0%
2002	15.9%
2003	16.8%
2004	17.6%
2005	19.0%
2006	19.6%
2007	20.3%
2008	20.3%
2009	20.5%
2010	20.8%
2011	20.4%
2012	20.4%

Source: waste management in Japan.

From the table it can be seen that recycling rates in Japan have been growing positively since the year 2000, while pointing out that the rates given are low because Japan emphasizes the 2Rs (Reduce and Reuse) rather than Recycle.

To better see the growth of the recycling rates we present the following histogram



Source : by the researcher based on the data in the table above.

The following table gives the statistics of waste recycling rates by type for the year 2016, i.e. waste collected by municipalities with a total recycled volume equal to 6.52 million tons and recycled waste collected by resident collectives with a total volume of 2.27 million tons.

Table N 05: Recycled waste in Japan by type in 2016 :

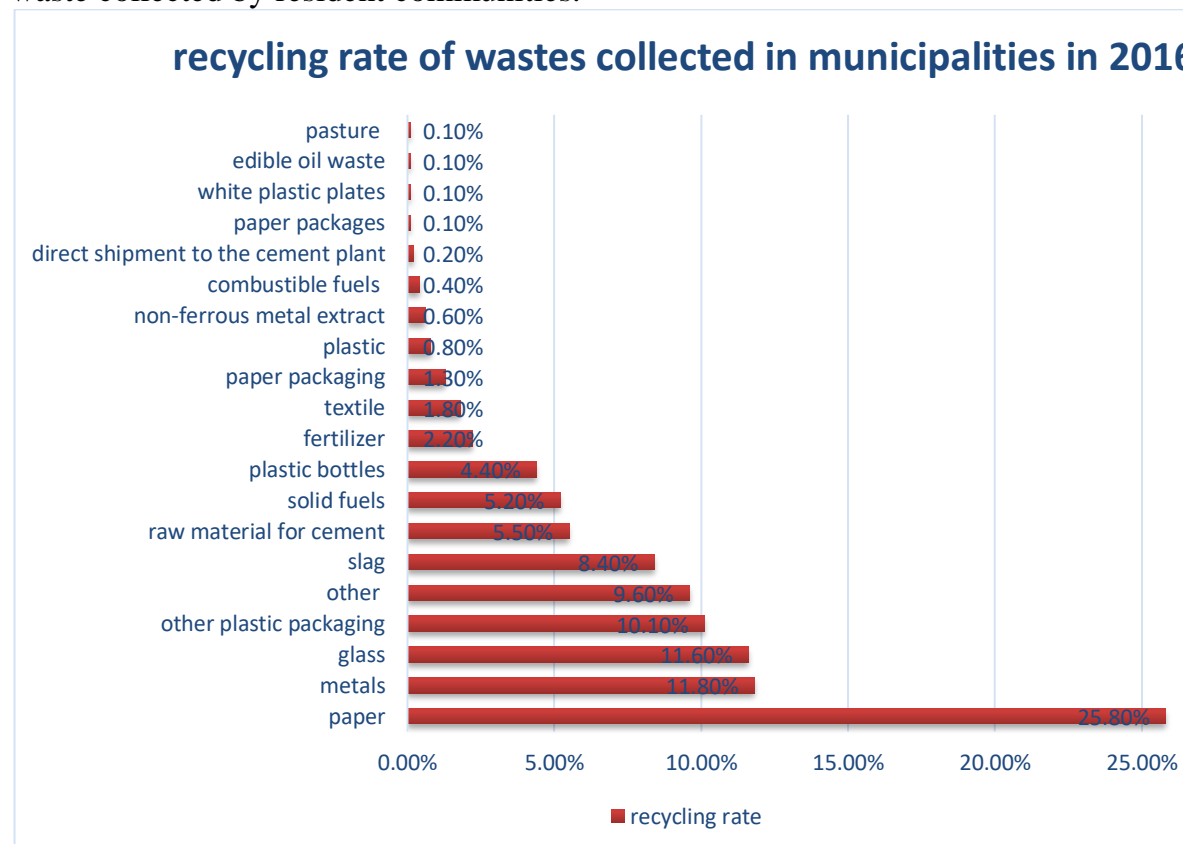
Type of waste	Recycling rate of collected waste, municipalities	Recycling rate of waste collected by resident communities.
Paper	25.8%	91.0%
Paper bundles	0.1%	0.4%
Paper packaging	1.3%	1.6%
Metals	11.8%	2.1%
Glass	11.6%	1.1%
Plastic bottles	4.4%	0.3%
Other plastic packaging	10.1%	0.0%
White plastic plates	0.1%	0.0%
Plastic	0.8%	-
Textile	1.8%	3.1%
Fertilizers	2.2%	-
Pasture	0.1%	-

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Slag	8.4%	-
Solid Fuels	5.2%	-
Fuels	0.4%	-
Raw material for cement	5.5%	-
Direct to cement plant	0.2%	-
Non-ferrous metal extract	0.6%	-
Edible oil waste	0.1%	-
Other	9.6%	0.4%

Source : Waste management in Japan

The table shows that the recycling rates of the different wastes vary from one type to another and from low to medium rates; it can also be seen that the highest rate corresponds to paper recycling with a total rate of 27.2% for the waste collected by municipalities; and from low to high rates for the waste collected by resident communities.



c-Recycling in South Korea: South Korea ranks second among the world's champion recycling countries with a rate equal to 60%; this success has been achieved through the establishment of a circular

economy based on Jongnyargje, which is an organized waste management system that aims to collect and reuse waste and resources efficiently and turn the waste of some into raw material for others.

For example, every year in Gyeonggi Province, 24,000 tons of waste is processed into quality plastic bales or flakes; these are then sold to industries that use them as production inputs for multiple goods.

All waste must be separated into general waste, food waste, recyclable items or bulky items (all waste items that are too large to fit into issued disposal bags such as furniture, electrical appliances and office items)(<https://www.perspective.usherbrooke.ca/success> of recycling in South korea, consults on 06/22/2020).

6-Recycling in Africa:

In 2012, Africa produced 125 million tons of solid waste, and this figure is expected to double by 2025. Waste collection services in most African countries are inadequate and as a result only 55% of municipal solid waste is collected.

Recycling represents an important socio-economic opportunity for the continent; according to some studies, waste recycling and recovery could inject an additional \$8 billion annually into the African economy (https://wedocs.unep.org/afr_p2, consulted on 10/10/2021).

Recycling rates vary from one country to another depending on the degree of development and the social-economic and environmental strategies followed by the states; the following table gives us a vision of the recycling activity in the African continent.

Table 7: Ranking of African countries by recycling rate :

Countries	Recycling rate year 2000	Recycling rate year 2005	Recycling rate year 2010	Recycling rate year 2015
Algeria	-	0.10%(2003)	0.10%(2003)	10%
Morocco	2.00%	2.00%(2003)	2.00%(2003)	10%
Zimbabwe	-	-	-	-
Ghana	2.00%	3.00%	3.00%	5.00%
Niger	3.49%	4.00%	-	-
Mauritius	-	-	2.80%(2009)	-
Egypt	-	-	6.68%	2.10%(2012)
Togo	-	-	-	2.03%(2012)
Tanzania	-	0.78%	0.83%	0.64%
Botswana	-	-	-	1.16%
Cameroon	-	-	0.37%(2009)	-

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Tunisia	-	0.07%(2001)	-	-
Cape Verde	-	-	-	-
Madagascar	-	0.00%	0.00%	0.00%

Source : Atlascio.com

From the table we can see that recycling rates are very low compared to those of developed countries, even though the recycling rate set by the African Union for the year 2023 is 50% of waste produced.

Recycling in Algeria: The Algerian production of waste reached in 2020 a quantity equal to 13.5 million tons of household and assimilated waste (HAW) is 0.80Kg/inhabitant/day, knowing that the HAW are the flows resulting from the households, small trade, markets, restaurants, craftsmen, administrations, constructions and industrial installations(report on the waste management situation in Algeria, 2019/2020, waste national agency,p34).

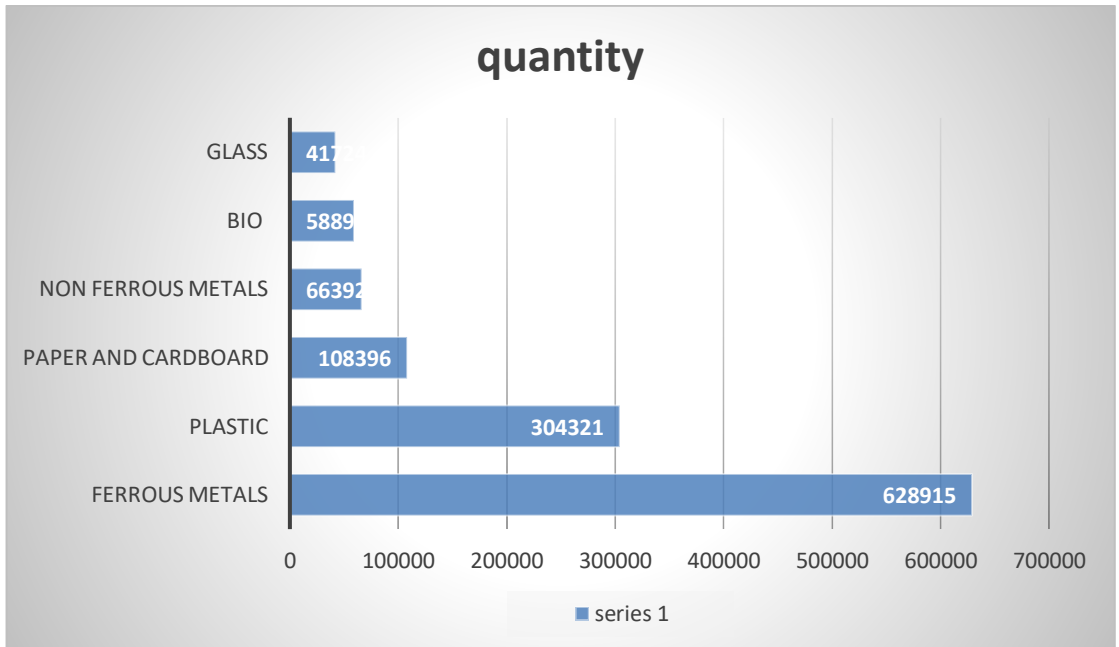
Recovering of the Waste in Algeria: recovery meant the collection and the recycling, it varies from a category of waste to the other, and the following table gives us the figures of valorized waste in 2020.

Table N8: Quantity of waste recovered in 2020 (ton/year)

Type of waste	Quantity
Ferrous metals	628915
Plastic	304321
Paper and cardboard	108396
Non-ferrous metals	66392
Wood	58895
Glass	41724

Source : report on the status of waste in Algeria, year 2019/2020, , p66.

From the above table it can be seen that ferrous metals constitute the most important recovery sector with a quantity of 628915 tons/year; it includes steel and iron wastes which are generated in large quantities in several sectors, in particular the building sector; In second place is plastic with a quantity of 304321 tons/year recovered then cardboard with a quantity of 108396 tons/year; the quantity of non-ferrous metals recovered is 66392 tons/year; wood with a quantity of 58895 tons/year and glass with 41724 tons/year.



Source: by the researcher based on the data in the table above.

Recovery rate: concerning the recovery rate of household and assimilated waste (HAW), it is equal to 9.83% all channels combined, it can be said that it is low compared to the annual production of waste which is equal to 13.5 million tons for the year 2020 and could exceed 20 million tons in 2035, the following table gives us the recovery rates by waste type:

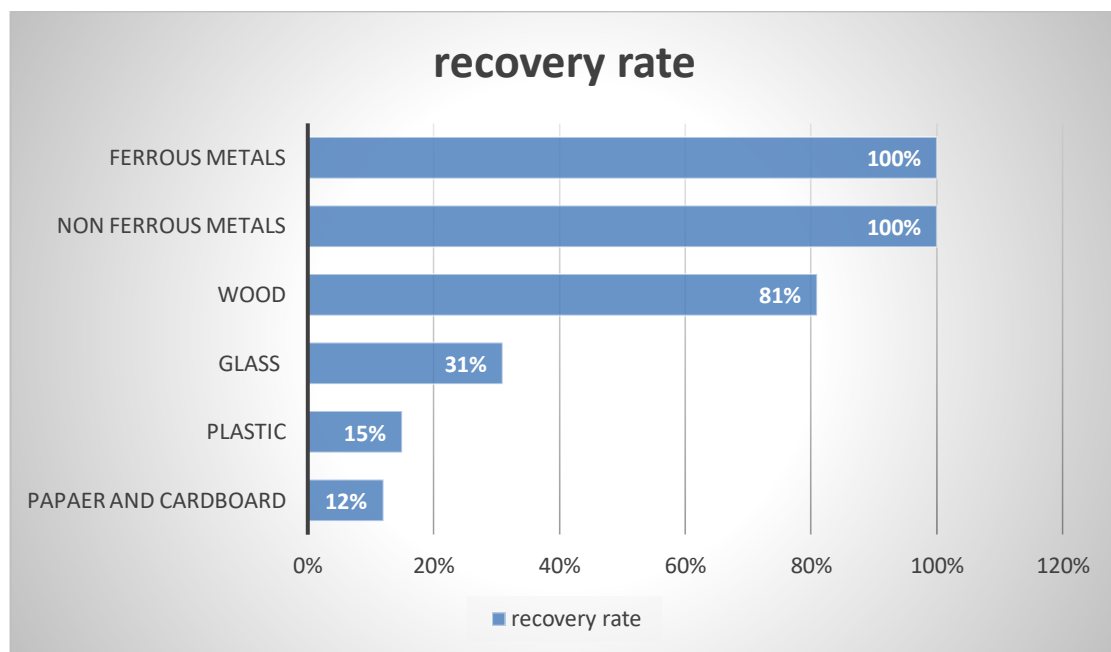
Table 9: Waste recovery rate by type :

Waste type	Rate of recovery
Paper and cardboard	12%
Plastic	15%
Glass	31%
Wood	81%
Non ferrous metals	100%
Ferrous metals	100%

Source: report on the status of waste in Algeria year 2019/2020, page68.

From the table we can see that the recovery rates are different according to the types of waste and vary from high recovery rates such as ferrous and non-ferrous metals, which come from industrial activities and are totally recovered; and the recovery rate of wood (81%) which covers wooden packaging (pallets and crates); and average recovery rates which concerns glass waste with a rate of 30% and which mainly concerns glass bottles and flasks. Plastic, with a recovery rate of 15%, is low compared to the large

quantities produced each year; as for the paper and cardboard sector, it is close to plastic with a rate of 12%.



Economic indicators: the recovery activity (recovery and recycling) has direct positive effects on economic growth in terms of financial income and number of jobs created; a value of 78.4 billion Dinars was recorded in 2020 with a number of employees equal to 4813 and this in the formal activities related to the recovery of waste; this figure is more important if we take into consideration the informal activities, however, each worker could recover a quantity of 22 tons/month of waste (Report on the waste management situation in Algeria 2019/2020).

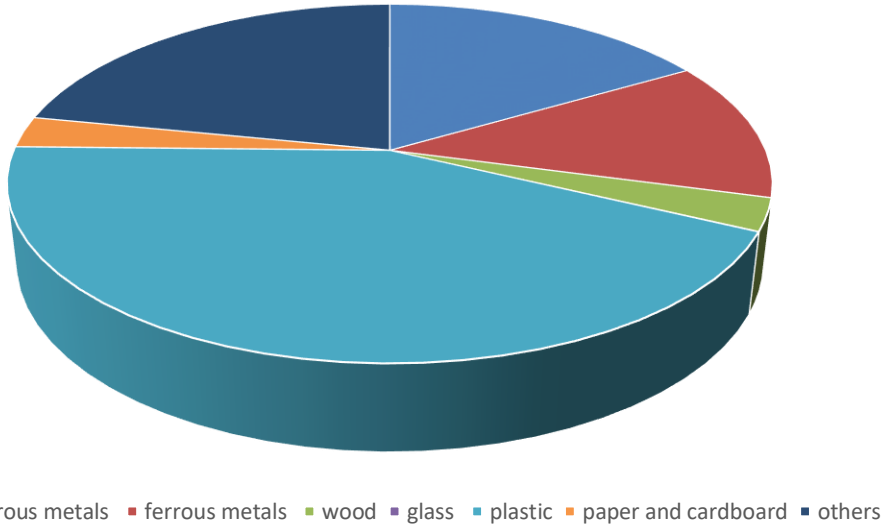
The figures of the economic value of the recovered Waste by category of waste are presented in the following table:

Table N 10: Economic value of the recovered waste by category of waste:

Waste type	Economic value of the waste recovery activity
Non-ferrous metals	16.6
Ferrous metals	12.6
Wood	2.9
Glass	0.03
Plastic	43.2
Paper and Cardboard	2.8

Source: report on the waste management situation in Algeria, year 2019/2020, p69.

Economic value from the waste recovery activity



Source: prepared by the researcher.

To conclude we can say that in spite of the importance and the economic and environmental advantages of the activity of recycling, the sector of waste recovery HAW (collection and recycling) is little exploited in Algeria according to the rates and quantities advanced if above, moreover this activity is hardly born, what requires additional efforts in term of regulation and directives aiming at increasing the conscience of the citizens with regard to the problem of waste; and inciting the investors to create other companies.

Conclusion

This paper has pointed out the importance of recycling activity from an ecological and economic point of view due to its multiple benefits, such as wealth creation and new jobs, preservation of non renewable raw materials.

It was also concluded that the recycling rates are different according to the countries and the degree of industrialization, and vary from high rates for most of the EU countries and other industrialized countries such as Japan and South Korea, and low rates achieved by African countries.

It has also been deduced that the recycling activity is just emerging in Algeria, however the rate of recycling achieved is low which requires the establishment of incentives for investors in this sector to increase the number of businesses and jobs, and laws and regulations that encourage citizens to reduce their waste.

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