4

THE NEW INDUSTRIAL REVOLUTION: CIRCULAR ECONOMY IN EUROPEAN UNION

4.1 THE PRODUCTIVITY OF RESOURCES IN EUROPE UNION

The European Union has been developing successive action programs in the last years whose purpose is to create more sustainable cities and make them more resilient to face better the Climate Change effects. In this way, the next objectives have been established:

- Conserve and improve the EU's natural resources.
- Create a more efficient economy in the use of resources, more competitive and low- carbon use.
- Protect the citizen of member countries from the health risks caused by damage to the environment.

Along the last action programs EU focus on creating adequate legislation, providing more basic knowledge, increasing investments in environmental and climate policies and fully integrating environmental considerations into other policies. For this reason, the present report tries to explain the importance of the sustainable use of natural resources in our economy to preserve the welfare state in a future.

The ***productivity of resources*** is defined as the economic result per unit of material used. An increase on the productivity of resources leads to a reduction in the use of virgin material and greater protection of our environment.

According to the 2018 data of the European Environmental Agency (EEA), the productivity of resources has been increasing from the year 2000 to 2017, reaching an increase of 39%. The main reason of this increase is the reduction in the use of fossil fuels and non-metallic minerals due to the low level of construction activity, especially between 2008 and 2013, during the economic crisis.

Since 2013 a deceleration of this indicator is observed, remaining below 1%, due to the increase in the use of material for the construction sector again.

Analyzing the data from 2000 to 2017, countries whose economy is mainly based on the service sector, have more efficiency in the productivity of their resources than countries whose economy is based on industry, since the demand for resources in this case is usually greater. However, in the countries where the service sector predominates the amount of resources used is not necessarily less.

It is a priority to act in the industrial sector, especially in manufacturing processes, to improve the performance in the use of raw materials.

As it is reflected in the graph below (Fig. 4.1) such as Switzerland, Holland or the UK are positioned as leaders in resource productivity in 2017, while other countries are still far below. For this reason, it is necessary to establish improvements in the efficiency of resources throughout the life cycle, incorporating fundamental changes in production and consumption patterns in each country, so that industries were able to use fewer natural resources and could extend the products life for a longer time.

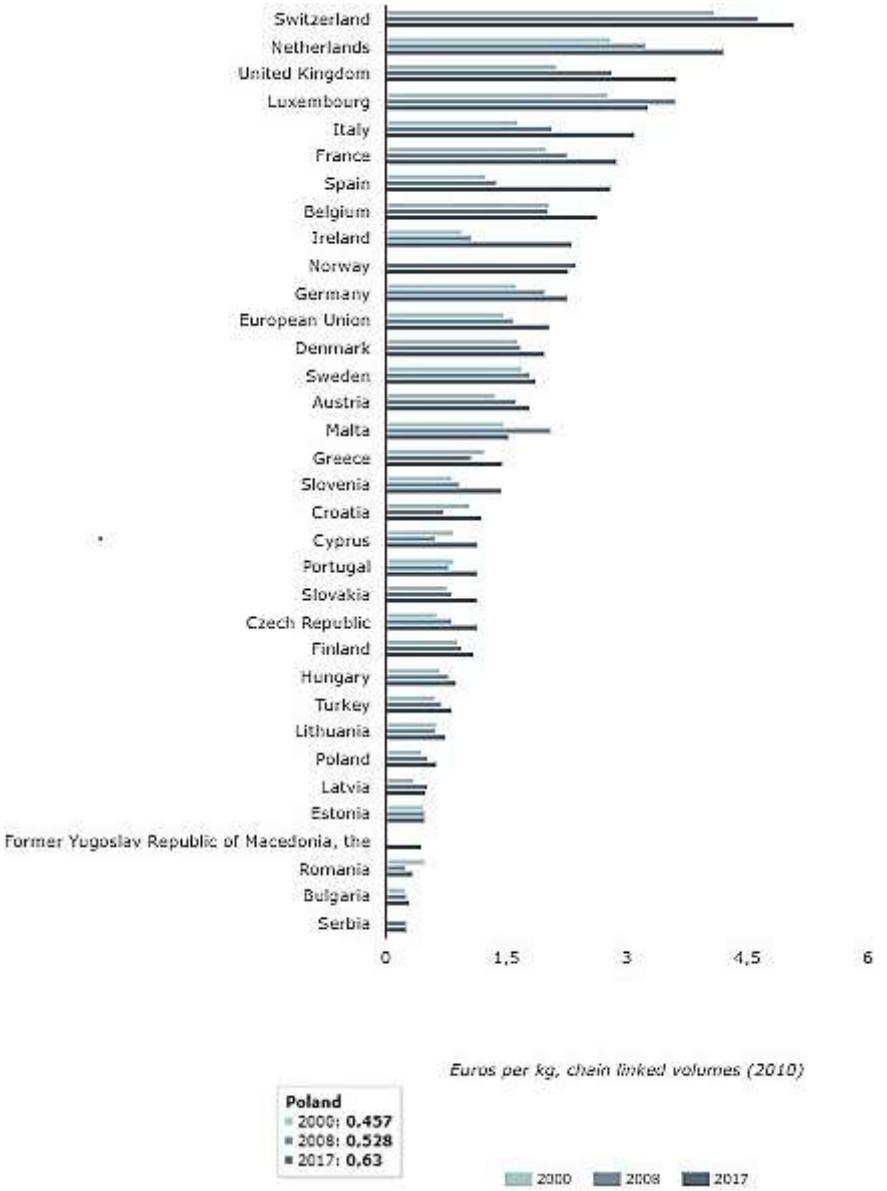

Fig. 4.1 Resource Productivity by country

Recently, a sustainable economy that ensures the appropriate supply of resources with less dependence on imports is being implemented by different countries in EU, increasing investments in innovation and achieving the improvement of global

competitiveness. In this way, countries such as Austria, Germany or Finland have adopted over the last few years national policies and strategies to improve the efficiency of their resources, considering the waste generated, energy efficiency or industrial development in their activities [1].

On the other hand, in 2016 the total waste generated in the EU by all economic activities and households amounted to 2.533 million tonnes; this was the highest amount recorded for the EU during the period 2004-2016. Construction activities contributed 36.4% of the total of waste generated by construction and was followed by mining and quarrying (25.0%) (Fig. 4.2).

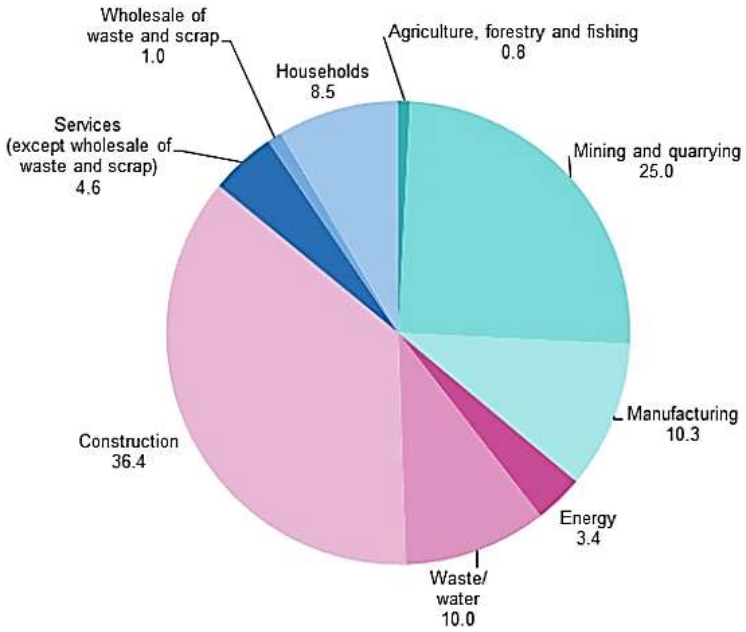

Fig. 4.2 Waste generation by economic activities and households, EU-28, 2016 (%)

During 2016, in EU slightly more than a half (53.5%) of the waste was treated in recovery operations: recycling (37.5% of the total treated waste), backfilling (10.1%) or energy recovery (5.6%). The remaining 46.5 % was either incinerated without energy recovery (1.0%) or disposed of otherwise, mainly by landfilling (45.5%), which entail a large loss of valuable resources in a year [2].

4.2 THE CIRCULAR ECONOMY IN THE INDUSTRY

4.2.1 What is circular economy?

The first concept that should be defined is *Industrial Ecology*, as the type of industry that focus on the industrial design of products and processes inside sustainable manufacturing strategies, based on the simulation of the natural ecosystem.

The objective of the *Industrial Ecology* is the optimization of the total lifecycle of materials, from natural resources to raw material transformed, considering the end of its use. In other words, is a modality within the industry where the waste of one activity serves as raw material to another. This entails the reduction of dependence on external raw materials, since the bulk of material comes from processed waste

that feeds as secondary material to the same industry or to another with different activity.

From this concept arose other model in economy called ***Circular Economy***, which is defined as the regenerative system by design focused on keeping products, components and materials at their highest value during most of the time as possible. (Fig. 4.3).

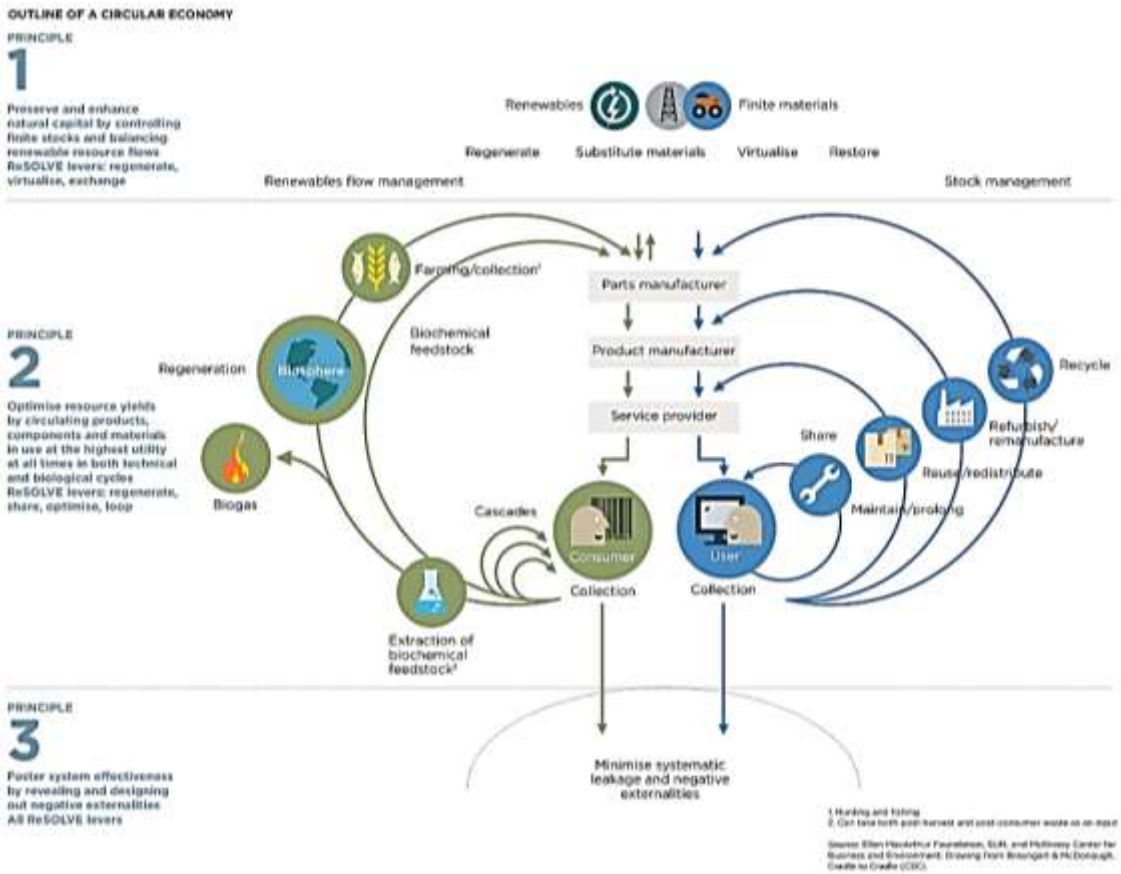

Fig. 4.3 Outline of a Circular Economy

This implies abandoning the idea of the traditional linear economy where the consumption of finite resources prevails, and begin to design other models that built economic, natural and social capital, whose priorities are; value the waste generated, keep products and materials in use and regenerate natural systems [3].

4.2.2 The current situation of the circular economy in europe

Based on the Strategic Waste Directive (Directive 2008/98/EC), EU member states are required to establish waste prevention programs by 12th of December of 2013, date from which the proposed objectives and both qualitative and quantitative indicators must be achieved.

In the 1st of January of 2016 the seventeen Sustainable Development Goals (SDG) 2015-2030 were officially submitted the roadmap launched by United Nations [4] (Fig. 4.4).

Fig. 4.4 The Sustainable Development Goals

In this context, circular economy represents a clear opportunity to change EU production and consumption model from the industrial revolution, as well as to achieve the SDG throughout 2030 Agenda by each member country.

The EU Circular Economy Action Plan was presented in 2015, and focused on the promotion of products: durability, reparability, value contribution and recyclability of ecological design.

Therefore, waste prevention programs were established in 20 countries of EU, whose objectives focused on the reuse of waste. Some of these objectives were:

- Poland→ increase the reuse of electrical and electronic devices through networks that encourage both the repair and collection of waste and the reuse.
- Spain→ reuse furniture, textiles and electronic equipment.

In order to monitor the progress and achievement of the objectives by each member country, quantitative indicators must be established. However, there are very few EU countries that have established these indicators in order to measure the rate of waste reuse, and these are: Spain, focusing on waste electrical and electronic equipment, Sweden, on textiles, and the region of Flanders, on the set of waste reused per inhabitant. The most likely cause for EU countries to find difficulty in establishing quantitative indicators could be the complexity of classifying the different waste [5].

Recently, in May of 2018, the "package" of directives was published, modifying the previous Directive 2008/98/EC. The purpose is to promote and increase the objectives established by the member countries to encourage the reuse and waste recycling, and thus move towards the circular economy. This "package" of directives are: the Directive (EU) 2018/851 on waste; establishing quantifiable objectives of reuse and recycling of waste, Directive (EU) 2018/849 on the waste of batteries,

accumulators, vehicles out of use and electrical appliances and electronic; introducing administrative improvements in the treatment of information on their management, Directive (EU) 2008/850 on waste disposal; in order to contribute to the progressive reduction of the deposit of waste in landfills, and Directive (EU) 2018/852 relating to packaging and packaging waste; which establishes clear objectives for the recycling of packaging for the years 2025 and 2030.

Through these legal instruments, each member of the EU is expected to establish the bases to achieve the next sustainability objectives:

- Reuse and recycling of municipal waste to at least 55% of Municipal waste by 202, 60% by 2030 and 65% by 2035.
- Increase recycling of packaging waste to at least 65% by the end of 2025 and 70% by the end of 2030.
- Reduce landfill to a maximum of 10% generated municipal waste by 2035.

4.2.3 Key elements to change from linear model to a circular model

In order to develop more competitive business models based on sustainability, there are some lines of action that should be followed:

1. Develop appropriate **legislative tools**. The legislative framework of each country is essential for the change of the economic model to a more sustainable one. The established legal requirements can force companies and administrations to reformulate the models of production and consumption in a society.
2. Implement **eco-design**. The first step in the new perspective of manufacturing is to introduce the eco-design criteria to reduce the amount of virgin material and encourage a longer life of the manufactured product. For this reason, it is essential to consider in the design the next parameters: durability, repair, renovation/remanufacturing and recycling.
3. Make use of **digital technology**: the monitoring of indicators from which the efficiency in the use of resources can be analyzed throughout the life cycle of the product.

   Reconsider the **business model**. Consider new opportunities to create greater value and transform business models into more *servitization**.

   **Servitization* is a process where a product is transformed into a service. Example: rent a car instead of buying it.
4. Use the **waste as a resource.** Giving value to the waste to be transformed into a secondary material is a basic key for the circular economy, either through reuse or recycling.
5. Prioritize **regenerative resources**. Ensure renewable, reusable and non-toxic resources for the environment in the manufacture of products.
6. Investigate the **processes** so that they are **eco-efficient.** Optimize the water, energy and materials consumption, through the best available techniques (*Best environmental management practices*) and the preventive maintenance of facilities and equipment.

7. Work together along the entire **value chain of the product**. Organizations should make to change all the supplier business strategy, raw materials suppliers and services suppliers along their value chain.
8. The **support of Administrations for innovation** in private sector. Financial aid is the key for innovation in companies to create new productive models. Likewise, the public sector should favor those organizations whose projects consider the circular economy in their activities as well [6, 7].

4.2.4 Some successful cases of circular economy in businesses

There are three ways to consider the business model according to the circular economy; based on the **product value**, based on the **service value** and based on the **product-service** combination **value**.

In Europe many new business models have emerged from these new concepts in the last years. Nowadays, most of the companies have the economic model in which the property of the product is the customer. In this way, there are companies that bring to market ecological or biodegradable products instead of toxic material, or companies that offer garments of high quality that can be repaired to be used after during a long time (**product-value**). Some businesses have focused their activities in a product made from *upcycling*, giving higher value to this product than before.

On the other hand, there are companies that offer to travel by sharing-car (**service-value**).

From the combination of **product-service value** is possible to design a business where the supplier is the owner of the product. Some examples are companies that rent a washing machine or a printer with maintenance included, or those that provide a car for a punctual use in a very accessible way.

Recently, a famous company of furniture has just implemented different ways to contribute to "circularity": by a used furniture sale service, by a home textile donation service or by bulbs recycling service [7].

Another example of new business model is based on *refurbishing* technology, such as mobile phone production from pieces of old ones.

Furthermore, new businesses are arising these days from the collaboration between organizations, through platforms or associations created to cooperate and support companies in order to implement the "circularity" in their activities.

4.3 ENVIRONMENTAL CHALLENGES IN SPAIN

According to the latest data collected in Spain for 2015, of the total waste collected, 53.3% went to recycling, 39.3% to landfill and 7.4% to incineration. Therefore, Spain is currently below the European average in waste recycling [9].

The "package" of circular economy directives will make necessary their transposition to the ordering spanish legal system through a regulartory system.

At the same time, it will be necessary to update the existing regulations to adapt them to the current situation, facilitating thus the fulfillment of the recycling objectives established in the directives.

Through the Spanish Strategy in Circular Economy (February 2018), Spain expects to achieve the "Connected Industry 4.0" which motto is "the digital transformation of Spanish industry ", that will allow the Spanish industrial sector benefits from the intensive use of information and communication technologies in their production processes and other activities.

Within the different industrial sectors, some action plans will be developed by Spanish Government for the 2030 Agenda, and they are considered as priority actions in different areas:

- **Building industry**. Present technical regulation of building is attending exclusively safety and healthy criteria. The reuse of materials and products in building has been limited, so that the technical building regulations will be analyzed (the Technical Building Code) to identify the existence of possible barriers to the use of recycled materials and being incorporated as secondary materials.
- **Eco-label products**. Working to promote public procurement by the Administration to companies that use of eco-label products and circular economy criteria in their activities.
- **Agri-food industry**. Promoting the correct environmental performance of agri-food industries and facilitate guidelines to reduce the impact of their activities on the environment, as well as support for organic food production.
- **Forestry**. Increase the sustainable management of distributed forest resources throughout the territory, in order to generate positive economic synergies, prevent the risk of forest fires and create jobs in rural areas.
- **Fishing**. Develop *Spanish Blue Growth Strategy* which include specific lines of action in terms of promoting sustainable fishing, such as the improvement of the fisheries inspection system, the fight against illegal fishing, undeclared and unregulated (IUU) and the expansion of marine reserves protected.
- **Hotel Industry**. Promote energy efficiency in tourist accommodation [8].

4.4 CONCLUSIONS

Recently, there has been growing interest in the fight against the unsustainable production and consumption model of our society. Specifically, in the EU different action plans have been established since the publication of sustainable development objectives, with the aim of redirecting industrial activity, having as a fundamental pillar the circular economy. In this way, new companies and new business models have emerged that provide greater value and use of natural resources, increasing their productivity, and extending their life cycle as much as possible.

In order to promote the circular economy, there are some key elements that are essential for the change, from legislative and financial tools, to eco-design or digital transformation, through the valuation of a waste as a resource with market value.
In Spain, different actions are being followed to implement the circular economy in the industrial sector, especially in construction, agriculture and tourism, emphasizing the efforts in consumption area to prevent the waste generation in landfills and the excessive use of water.

REFERENCES

[1] European Environmental Agency (EEA). Resource efficiency report 2018
[2] Statistics Explained. November 2018. https://ec.europa.eu/eurostat/statisticsexplained
[3] Ellen MacArthur Foundation. https://www.ellenmacarthurfoundation.org/circular-economy/infographic
[4] The Sustainable Development Goals Report 2018. United Nations. https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf
[5] Waste prevention in Europe policies, status and trends in reuse in 2017. European Environment Agency.
[6] The Circularity Gap report. 2019. Circle Economy.
[7] Cerrar el círculo. El Bussiness Case de la economía Circular. Julio 2018. Forética.
[8] España Circular 2030. Estrategia Española de Economía Circular. Febrero 2018.
[9] Estadísticas sobre la Recogida y Tratamiento de residuos. Estadísticas sobre generación de residuos. Instituto Nacional de Estadística (INE). Año 2015.
[10] The Best Environmental Practice. https://ec.europa.eu/jrc/en/research-topic/best-environmental-management-practice

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Abstract: The industrial activity and consumption habits are using the natural resources disproportionately over the time. Meanwhile, waste generation is increasing too fast, causing continuous accumulation of waste in landfills and contamination to the atmosphere. Decoupling economic growth and rising living standards from waste generation is urgent for our survival. The objective of this article is to provide an overview of the environmental problem that European Union (EU) is facing and how can change the business model in industries to prosper in the society without detriment to future generations. In this way, this document describes the lines of action to achieve sustainable economic models, as well as some examples of new business framed within the circular economy, and how are being implemented in Spain, as a member country in EU, with the purpose of contribute to the common improvement.

Key words: productivity of resources, industrial ecology, circular economy, raw material, eco-design, servitization, upcycling, refurbishing

NOWA REWOLUCJA PRZEMYSŁOWA: GOSPODARKA CYRKULARNA W UNII EUROPEJSKIEJ

Streszczenie: Działalność przemysłowa i nawyki konsumpcyjne powodują korzystanie z zasobów naturalnych w nieproporcjonalny sposób. Tymczasem wytwarzanie odpadów rośnie zbyt szybko, powodując ciągłe gromadzenie się odpadów na składowiskach i zanieczyszczenie atmosfery. Oddzielenie wzrostu gospodarczego i rosnącego standardu życia od wytwarzania odpadów jest pilne dla naszego przetrwania. Celem tego artykułu jest przedstawienie przeglądu problemu środowiskowego, przed którym stoi Unia Europejska (UE), oraz tego, jak zmienić model biznesowy w branżach, aby prosperować w społeczeństwie bez szkody dla przyszłych pokoleń. W ten sposób w niniejszym dokumencie opisano kierunki działania mające na celu osiągnięcie zrównoważonych modeli ekonomicznych, a także niektóre przykłady nowych przedsiębiorstw w ramach gospodarki o obiegu zamkniętym oraz sposoby ich wdrażania w jednym z krajów członkowskich UE - Hiszpanii, w celu przyczynienia się do ogólnej poprawy.

Słowa kluczowe: produktywność zasobów, przemysłowy

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