MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

Ministero dello Sviluppo Economico

Towards a Model of Circular Economy for Italy

Overview and Strategic Framework

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Ministers' Statement

This document aims to provide a **general framework for the circular economy as well as to define our country's strategic positioning on the theme**, in continuity with the commitments adopted under the Paris Climate Change Agreement, the United Nations Agenda 2030 on Sustainable Development, the G7 Communiquè and within the European Union.
This document is an important part of the implementation of the wider National Strategy for Sustainable Development, adopted by the Italian Government on 2 October 2017, contributing in particular to the definition of the objectives of a more efficient use of resources and of more circular and sustainable patterns of production also thanks to more aware and conscious consumption habits. In this context, the great challenge that Italy, along with the most industrialized countries, will face in the next decade is to adequately and effectively respond to the complex environmental and social dynamics while maintaining the competitiveness of its productive system.
It is necessary to establish a paradigm shift in order to launch a new industrial policy aimed at sustainability and innovation that can increase the competitiveness of Italian production and manufacturing, forcing us to rethink the way we consume and do business. Italy has the characteristics and capabilities to do so and needs to seize this opportunity **to develop new business models in order to maximize the value of Made in Italy and the role of Small and Medium-sized Enterprises (SMEs)**.
The transition towards a circular economy requires a structural change, and innovation is the cornerstone of this change. The digital transformation of the production system and the enabling technologies of the so-called "industry 4.0" already offers solutions to make more sustainable and circular productions possible and efficient. In order **to rethink our way of production and consumption**, to develop new business models, and to transform waste into high-value-added resources, we need creative technologies, processes, services, and business models that shape the future of our economy and our society.
Therefore, support for research and innovation will be a key factor in boosting the transition, which will also contribute to strengthening competitiveness and modernizing our industry.

We are convinced that the objectives above are widely shared. This is confirmed by **the outcome of the public consultation** aimed at **gathering in full transparency the contributions of all the operators involved in the field of the circular economy**.

The participation in the consultation was very wide: over 300 representatives of public administrations, small, medium, and large companies, associations, consortia, certifying bodies, and private citizens provided a timely contribution both to the document and through the questionnaire answers. **This participation demonstrates that the "Italian system" is active and eager to act**, because its components understand that the circular economy is an opportunity for change and innovation.
During the consultation, the necessity of an intervention has been strongly manifested on the following lines:

1) **Regulatory amendment** aiming to simplify its implementation and improve its consistency;
2) **Economic instruments** aiming to promote the adoption of circular and sustainable models of production and consumption by supporting the transition towards environmental tax reform.
3) **Communication and awareness raising** aiming to inform citizens about new ways of consumption, and to inform central and local administrations about opportunities and benefits linked to the issue of the circular economy, encouraging the collaboration among all operators in the circular economy field - public administrations, enterprises, scientific and technological research institutions.
4) **Promotion of research** aiming to foster innovation and technology aquisition, increase the competitiveness of industrial sectors and train managers and technicians in order to meet the new needs of the Circular Economy.

Measuring circularity is another key requirement to concretize the actions to be pursued in the field of circular economy, towards a greater transparency for the market and the consumers.
Given the complexity of this topic and the need for further analysis, based on the inputs collected during the consultation, we decided to set up a "technical table" jointly aimed at identifying appropriate indicators in order to measure and monitor the circularity of the economy and the efficient use of resources at macro, meso, and micro level. This process will be carried out through a constant debate with the competent public bodies and will have a variable structure, involving, in relation to the topics discussed, also other subjects.

The challenges, therefore, are many and all strategic for the future of the Italian system.

In this context, this document must be seen as a starting point, a shared platform for the realization of what will be the actual "National Action Plan on the Circular Economy", which will timely indicate the goals, policy measures, and implementing tools at the heart of the new circular economy model for Italy.

We leave to the next government, which will have the task of elaborating the Action Plan, a document bearing the merit of being the result of a widely participated and shared process.

Carlo Calenda *Gian Luca Galletti*

Source: www.matrec.com

1. Introduction

This document aims to provide a general framework on the principles of the circular economy and to define the strategic position of our country on this issue. It is an important part of the implementation of the wider National Strategy for Sustainable Development, contributing in particular to the definition of the objectives of efficient use of resources and sustainable production and consumption patterns.

Since the end of World War II, a period characterized by the rapid increase of populations and improving living conditions, a potential conflict between economic growth and environmental protection has emerged. Many reports, including the 1972 Massachusetts Institute of Technology report and Club of Rome's report on the "Limits of Growth", created concerns about the current economic development model based on unlimited growth in the consumption of available resources and natural capital. In spite of the opportunities of modern market systems increasingly based on international relations, innovative financial instruments, and globalization, this model of development risks compromising the conservation of ecological safeguard thresholds.

In this framework, the great challenge Italy faces in the next decade is to adequately and effectively respond to the complex environmental and social dynamics while maintaining the competitiveness of its productive system.

A new sustainability and innovation-prone industrial policy, that can at the same time increase the competitiveness of Italian production and manufacturing, requires a paradigm shift leading us to rethink the way we consume and do business. Italy has the characteristics and capabilities to do so and needs to seize this opportunity in developing new business models in order to maximize the value of Made in Italy and the role of Small and Medium-sized Enterprises (SMEs).

The transition towards circular economy requires a cultural and structural change: a profound revision of our patterns of consumption and innovation are the cornerstone of this change, along with abandoning the linear economy, shifting from the recycling economy to the circular economy (See chart 1). The digital transformation of the production system and the enabling technologies identified by Industry 4.0 (see Box 7) already offer solutions to make possible and even efficient more sustainable and circular productions. In order to change our patterns of production and consumption, to develop new business models, and to turn waste into high added value resources, we need creative technologies, processes, services and production models shaping the future of our economy and our society.

Therefore, support for research and innovation will be a key factor in boosting this transition, which will also contribute to strengthening competitiveness and modernizing our industry. In this process, it is also important to consider businesses and employees that could be penalized. With regard to businesses, it is necessary to assist the phase out of obsolete activities while preserving the reallocation of the workforce in other sectors and the proper disposal of potentially polluting installations.

With regard to the workforce, it is crucial that the human resources employed in sectors and businesses that are no longer in line with the requirements of modern and sustainable development are not excluded from the socio-economic system. Such resources should be prepared to occupy new jobs, aligning their skills to the productive activities promoted and created by the transition process. Creating new jobs (fair and properly paid) will depend on the degree of innovation of our production system.

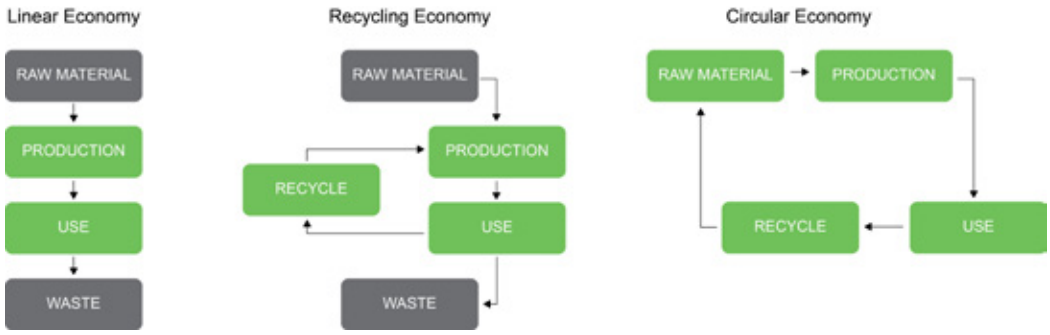


Chart 1 – From linear economy to circular economy

2. Circular Economy: Assumptions and Goals

2.1. Circular Economy for a More Efficient and Sustainable Use of Resources

The United Nations 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change, both adopted in 2015, are two fundamental contributions to the transition to a model of economic development having as its goal not only profitability, but also social progress and environmental protection. This necessity is now acknowledged by everyone and has become indispensable to ward off a future that keep to worsen social and environmental issues.

In this context, a crucial aspect is the more rational and sustainable management of natural resources, which is increasingly under pressure due to the growing population, rising demand for raw materials, and increasing social inequality even in the less wealthy nations.

The issue is characterized by a double dimension. Upstream, this means managing resources more efficiently, increasing productivity in production and consumption processes, reducing waste, while keeping the value of products and materials as much as possible. Downstream, it is necessary that everything which has a residual utility is not disposed of in landfill but, on the contrary, recovered and reintroduced into the economic system. These two aspects are the essence of the circular economy, which aims through technological innovation and better management to make economic activities more efficient and lower their impacts on the environment.

The transition towards a circular economy, managing more rationally and efficiently material and energy resources, requires a coherent system of regulatory and economic instruments as well as the involvement and sharing of all components of the social system (businesses, public administrations, consumers/citizens, associations).

2.2. Circular Economy as a New Integrated Model of Production, Distribution, and Consumption

Over the past 40 years, the analysis of the circular economic model has continuously evolved. Currently, issues such as sustainable supply of raw materials, production processes and eco-design, the adoption of more sustainable distribution and consumption patterns, and the development of secondary

raw materials markets became key elements of the concept of circular economy. Transitioning from the current linear model of economy towards a circular model requires a rethinking of market strategies and models in order to safeguard the competitiveness of industrial sectors and the wealth of natural resources.

A model of circular economy model involving consumer habits as well as processes of production and manufacturing, not just in large companies but also in the network of SMEs that characterize our country, is able to create new jobs and, at the same time, to significantly reduce the demand for untapped raw materials.

In the near future, it will be necessary to devise and develop more efficient systems for regeneration, reuse and repair of goods, facilitating their maintenance and increasing their life expectancy. Therefore, operators will have to conceive their products being aware that these, once used, are intended to be repaired and reused.

The change must also go through a regulatory review that simplifies its implementation and improves its consistency, structuring the collaboration between all the actors of the circular economy - Public Administrations, companies, scientific and technological research institutes - and fostering the innovation and technology transfer and the competitiveness of industrial sectors.

Box 1
The of economic and environmental paradigm shift: a new concept of relationship between economy and environment

The circular economy is based on a fundamental paradigm shift. Economic system and ecological system are not on the same level, as in traditional economic analysis, exchanging their natural resources, factors of production, economic goods and services, scraps and waste (Chart 2).

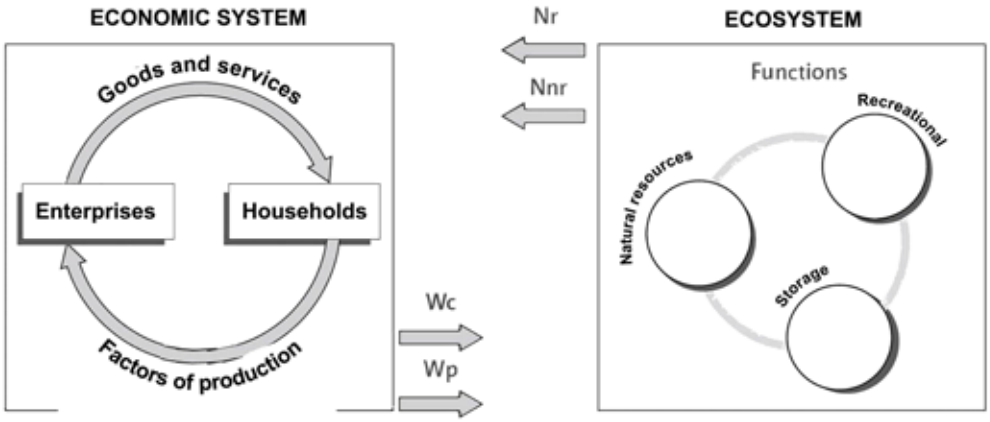


Chart 2 – Classic vision of natural relationship between economic system and ecologic system (2009)

In fact, the traditional economic model was based on the assumption that the environment was a "waste tank" but soon emerged the need to analyze the global economic system as a closed system, where economy and environment are not characterized by linear correlations, but by a circular relationship (K. Boulding, "The Economics of the Coming Spaceship Earth", 1966; D.W. Pearce e R.K. Turner, "Economics of Natural Resources and the Environment", 1990). The economic system exists within a wider ecological system and, while exploiting its natural resources and its ecosystemic services, must respect its operating rules and physical, biological, and climatic limits (Chart 3).

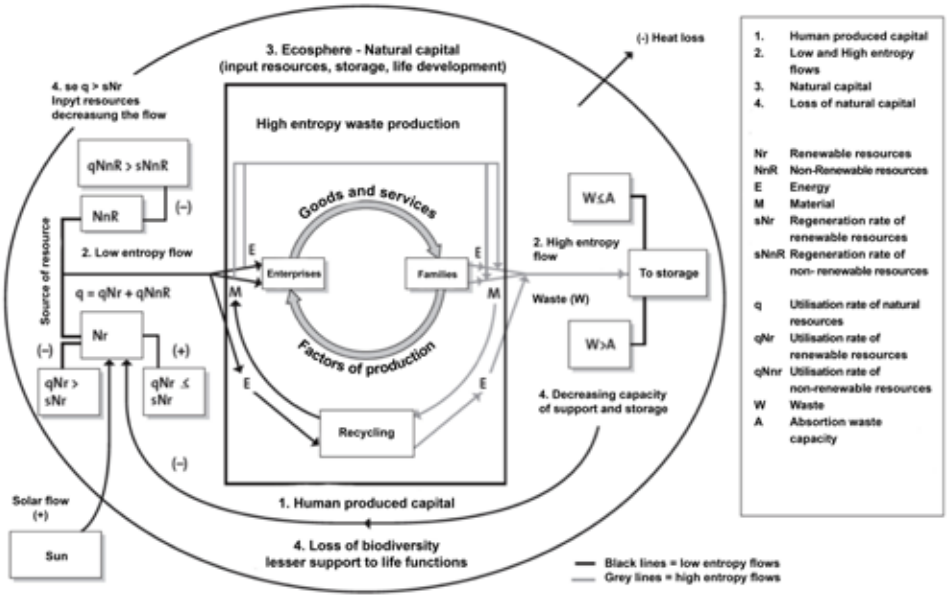


Chart 3 – Vision of economic system as a component of the ecologic system
Source: La Camera (2009)

Unlike the system defined “linear”, which starts from raw materials and ends in waste, an economy where today’s products are tomorrow’s resources, where the value of materials is as much as possible kept or recovered, where waste and impact on the environment are minimized, can be defined as “circular”.

Source: www.matrec.com

3. An Overview of the Current Situation

3.1. The International Context

The transition towards an economy resource-efficient, low-carbon, and resilient to climate change is the current global challenge to achieve a sustainable and inclusive growth.
With a world population of more than 9 billion people expected for 2050 and the rapid economic growth in developing countries, demand for natural resources, especially raw materials, is expected to keep growing exponentially in the coming decades. This trend will also lead to an increase in environmental and climatic impact if we do not take policies and measures for a more efficient use of resources.
In this context, the development of a new "circular" model of production and consumption is a strategically important element in achieving the global goals of sustainability and at the same time a factor in boosting the competitiveness of our country.
At an international level, over the last few years, many initiatives developed the broader concept of efficiency of resources, such as OECD, UNEP International Resource Panel (UNEP-IRP) (Box 2) and G7 / G8 / G20.

The initiative of the G7 German Presidency in 2015 is on the same path outlined by the G8 Japanese Presidency in May 2008, which adopted in Kobe the "3R Action Plan - Reduce, Reuse, Recycle", planning a series of actions aimed to improve the productivity of resources, to promote the "society of recycling" and the international market for recycled products, and to reduce the emissions of greenhouse gas.
On the basis of the results of the 2015 Elmau G7 Summit, of the 2016 Ise-Shima Summit, of the Toyama Framework on the Materials Cycle, the 2017 G7 Presidency of the Italian Government actively contributed to this process, promoting in Bologna the adoption of a working plan in order to develop joint actions on the issue of resource efficiency and circular economy (Box 3).

Box 2

Birth and Development of the Concept of Circular Economy

The Origins of the Current Work on the Resource Efficiency

Many international organizations have been dealing with the issue of circular economy and resource efficiency over the years: beside the OECD and the UNEP-IRP (seat of the scientific reflection, comparable to IPCC for the climate issues), it is worth mentioning the World Resources Forum, seat of the scientific-academic debate; the work of the European Resource Efficiency Platform (EREP) and the work of the Expert Group "The Economics of Environment and Resources Use" organized by the European Commission; the Resource Efficiency Flagship Initiative included in the Europe 2020 Package; the work of the European Environment Agency, including the report "More from less: material resources in Europe" (2016). All of them find their roots in the Report to the Club of Rome "Factor 4: Doubling the Wealth, Halving the Use of Resources" by Ernst Von Weizsaecker and Amory Lovins (1998).

UNEP-IRP and OECD Reports for the G7

Following the G7 summit in Elmau under the German Presidency, UNEP-IRP and OECD were asked about the most promising solutions to improve resource efficiency and about some suggestions on policy choices that could be made to facilitate the transition towards a circular economic model based on sustainable material management. Reports were submitted to the 2017 G7 Environment under the Italian Presidency.

The UNEP-IRP report "Resource Efficiency: Potential and Economic Implications" (2017) is an excellent overview on the subject. It analyzes historical trends, presents a series of "good practices", evaluates possible future developments, defines the major challenges and opportunities of this transition. The main message of the report is that moving towards a circular economy offers advantages both from the economic and the environmental point of view. Well-designed policies could reduce the global use of resources while stimulating economic growth, moreover fostering new jobs and greatly reducing greenhouse gas emissions.

Over the last 20 years, the OECD has produced a series of studies on the topic of material flows, sustainable management of materials, resource efficiency, and the circular economy, which originated useful guidelines for both policy makers and companies, reported in the "Policy Guidance on Resource Efficiency" (2016) report. Product and process technology innovation, stimulated by appropriate public policies and incentives, is the key to moving towards a new paradigm, oriented to quality of products and services, both in their design and in their consumption and post-consumption. It means being able to close the loop without losing important economic resources contained in those that are traditionally considered useless scraps or waste. Concepts such as eco-design, extended producer responsibility (EPR), product durability, hierarchical pyramid in waste management, industrial symbiosis, decoupling between added value and the amount of resources used) are peculiar elements of the transition towards a "lighter" economy.

Box 3

Five-Year Roadmap (2017-2022) for an Efficient and Sustainable Use of Resources (Annex to the G7 Communiqué of 2017) - Bologna, June 12th, 2017

(*http://www.minambiente.it/sites/default/files/archivio_immagini/Galletti/G7/communique_g7_environment_-_bologna.pdf*)

Priority areas identified for joint actions at G7 level:
– Resource efficiency indicators
– Resource efficiency and climate change
– Sustainable material management at international level
– Economic analysis of resource efficiency
– Citizen involvement and raising public awareness
– Food waste
– Plastics
– Green Public Procurement
– Lifetime extension product policies
– Resource efficiency and next production revolution

Box 4
International Experiences

JAPAN
In 2000, Japan adopted a law promoting the circular economy and transforming its own society, characterized by high production, high consumption, and high waste production, into a "recycling-oriented society".
In the 3R Kobe Action Plan in 2008 and in the Toyama Framework in 2016, the Japanese approach has been then clearly defined and shared by all the G7 countries: "Our common goal is to realize a society which uses resources including stock resources efficiently and sustainably across the whole life cycle, by reducing the consumption of natural resources and promoting recycled materials and renewable resources so as to remain within the boundaries of the planet, respecting relevant concepts and approaches. All this is to ensure that society circulates resources repeatedly, minimizes waste emissions into nature, prevents the diffusion of waste and manages environmental burdens within an acceptable limit so that the material circulation in nature can be kept undisturbed. Such a society not only provides solutions to waste and resource challenges, but also achieves a sustainable low-carbon society in harmony with nature that can create jobs, strengthen competitiveness and realize green growth".

China
The circular economic model was introduced as a new model of development to help China make its economy more sustainable*. The main goal of the circular economy, implied in the original concept, has been gradually shifted from the stage of waste recycling to the broader concept of resource efficiency in the production, distribution and consumption.
*Biwei S., Heshmatt A. e Geng Y. (2012), A Review of the Circular Economy in China: Moving from Rhetoric to Implementation, http://www.akes.or.kr/eng/papers(2012)/7.full.pdf

United States
United States adopted the Sustainable Materials Management (SMM) approach, which aims at a more productive use of materials throughout their life span. It represents a change in the way our society thinks about the use of natural resources and the protection of environment. Examining how the materials are used throughout their life cycle, the SMM approach aims to:
- use materials in the most productive way with a stress on their lesser use,
- reduce toxic chemicals and their environmental impacts throughout the material life cycle;
- ensure sufficient resources to meet today's and future's needs.

3.2. The European Context

The Seventh Environmental Action programme, promoted by the European Union, defines the coordinates of the European environmental policies from 2014 to 2020. Its distinctive feature is to strengthen the protection of the environment and natural resources by promoting a resource-efficient and low-carbon economic development[1].
On December 2nd 2015, the European Commission presented a European package on circular economy[2] in which it analyzes the interdependence of all the processes of the value chain: from the extraction of raw materials to the design of products, from production to distribution, from consumption to reuse and recycle of materials.
The package includes:
- an Action Plan that identifies key measures and specific areas of intervention,
- four proposals for the revision and amendment of the main waste management directives, which in their turn include measures aimed at stimulating a greater circularity of "waste that could return to being resources".

[1] http://ec.europa.eu/environment/action-programme/
[2] http://ec.europa.eu/environment/circular-economy/

In particular, the Plan integrates the proposals related to waste legislation establishing measures that impact on all phases of the product life cycle. The Plan also includes specific actions for certain sectors or flows of materials, such as plastics, food waste, critical raw materials, construction and demolition, biomass and bioproducts, besides horizontal measures in areas such as innovation and investment.
Among the measures envisaged by the Plan, particular importance will be given to those affecting the design of products aimed at their reparability, durability, and recyclability. Furthermore, the revision of all the specific legislation, currently being finalized by the European Union, will pay particular attention to the consistency of the different measures, with particular reference to the product-waste interface and the content of chemical substances. Finally, it is important to reaffirm the necessity to allocate additional funding for research and for technology transfer aimed the development of the circular economy, also supporting public-private partnerships.

Box 5
Experiences from other European countries

European Environment Agency

The European Environment Agency, in recent years, issued a series of reports on experiences related to the European Circular Economy. The 2016 report "More from Less"*, which is being updated in 2018, provides an overview of the measures taken in different European countries to improve efficiency in the use of resources through the use of indicators and data sheets for each country. Furthermore, a recent 2017 report, "Circular by design - Products in the circular economy" **, presents the technological and systemic perspectives for the transition to the circular economy.

*https://www.eea.europa.eu/publications/more-from-less
**https://www.eea.europa.eu/publications/circular-by-design

Germany

The first European country to adopt a circular economy law was Germany (closed cycle and waste management, 1996) for waste management in a closed cycle and to develop a system for waste disposal compatible with environmental protection. Consequently, on February 29th 2012, the German Federal Cabinet adopted the National Resource Efficiency Programme (ProgRess)*. The aim of the Programme is to structure the extraction and use of natural resources in a sustainable way, to reduce the impact on the environment and strengthen the competitiveness of the German economy. ProgRess focuses on abiotic factors (fossil fuels, minerals) and on the material use of biotic resources. The use of raw materials is linked to the use of other natural resources such as water, air, land (soil and subsoil), biodiversity and ecosystems. However, because these resources are already the subject of other specific programmes, processes or regulations, they are not addressed in detail in ProgRess. The programme covers the entire value chain. It deals with ensuring a sustainable supply of raw materials, increasing resource efficiency in production and consumption, improving the life cycle management. In March 2016, the German government adopted ProgRess II which includes an analysis of possible specific indicators for the circular economy.

*http://www.bmub.bund.de/en/topics/economy-products-resources-tourism/resource-efficiency/german-resource-efficiency-programme/overview/

France

In the law on the energy transition for green growth* (Law 2015-992, 17th August 2015) Title IV is dedicated entirely to the "fight against waste and the promotion of circular economy". The articles from 69 to 172 deal with this topic in detail. Circular economy in France is based on the concept of decoupling (with a target of increasing 30% GDP/DMC - indicator of the productivity of resources on a national basis - due 2030 compared to 2010), on the conservation of resources, on the extension of the durability of products, on sustainable production and consumption patterns, eco-design and recycling. Circular economy is recognized as an important lever to guide the transition towards the green growth and is identified as one of the five pillars of sustainable development (Article 70 I). France will adopt a strategy for a national circular economy "every five years "(Article 69).

*http://www.gouvernement.fr/action/la-transition-energetique-pour-la-croissance-verte

United Kingdom
In the United Kingdom, the WRAP (Waste and Resource Action Programme)*, operational since 2010, summarizes the national economic vision with a horizon to 2020 (compared to 2010):
– 30Mt of material input reduction in the economy,
– 20% less waste produced (around 50Mt).
The four key ways to realize these savings are: reduction of material input for the production of goods; waste reduction in production and trade; reduction of the quantity of discarded processed products; increase in the percentage of products that are used (rented or borrowed) and not bought.
In addition, between 2003 and 2013, the NISP (National Industrial Symbiosis Programme) actively involved 15,000 UK companies in projects of industrial symbiosis, generating £ 1 billion in sales and £ 1.1 billion in cost reductions for the participant companies, mostly SMEs. It also reduced carbon emissions by 39 Mt, diverted 45 Mt of material from the landfill and saved or created over 10,000 jobs. Since 2007, the NISP model has been exported to more than 25 countries including Italy.

*http://www.wrap.org.uk/
** http://www.nispnetwork.com/

Netherlands
In 2016, the Dutch Government set a dual objective at national level: reduce the use of virgin raw materials by 50% due 2030 and become a 100% circular economy due 2050*. Key areas of focus will include: biomass and food, plastics, manufacturing industry, construction sector. The guiding principles are: eco-design for a lower and better use of resources, more sustainable consumption and production through an extension of life and use, waste as materials to be recovered.

*https://www.government.nl/documents/policy-notes/2016/09/14/a-circular-economy-in-the-netherlands-by-2050

3.3. The Italian Context. Necessities and Opportunities

Italy has a domestic material consumption (DMC) equal to about 10 tons per capita, among the lowest in the G7 countries (Chart 4) and in the EU28 area. The downward trend in the last few years has been very strong, similar to the trend of net imports of resources, which fell from around 225 million tonnes in 2005 to 155 in 2015 (OECD, Green Growth Indicators). This important result is due in part to the international economic downturn but also to the substantial growth in efficiency in the use of resources (Chart 5), which however still shows a strong gap with countries such as United Kingdom and Japan.

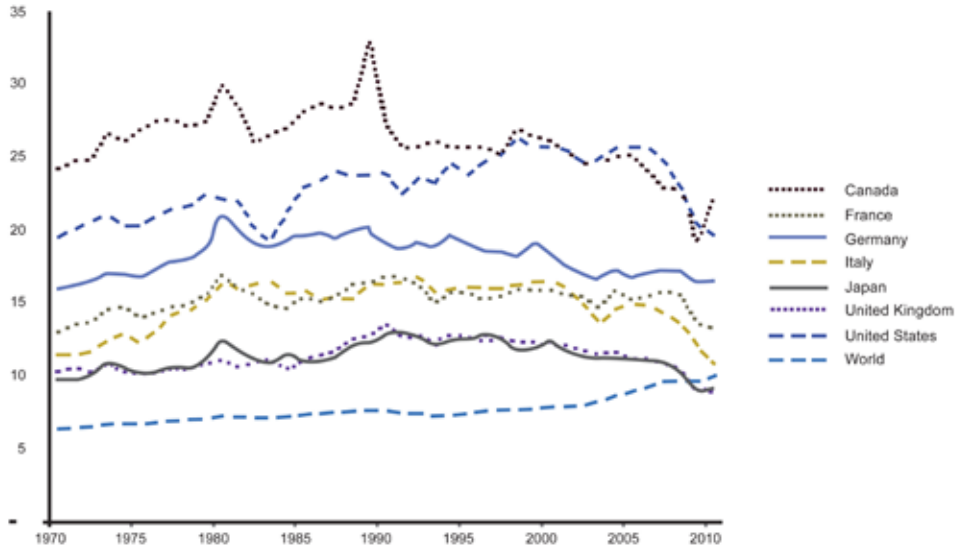


Chart 4 – Per capita domestic material consumption (DMC) in G7 economies and the global economy, 1970 - 2010, in tonnes
Source: UNEP (2017)

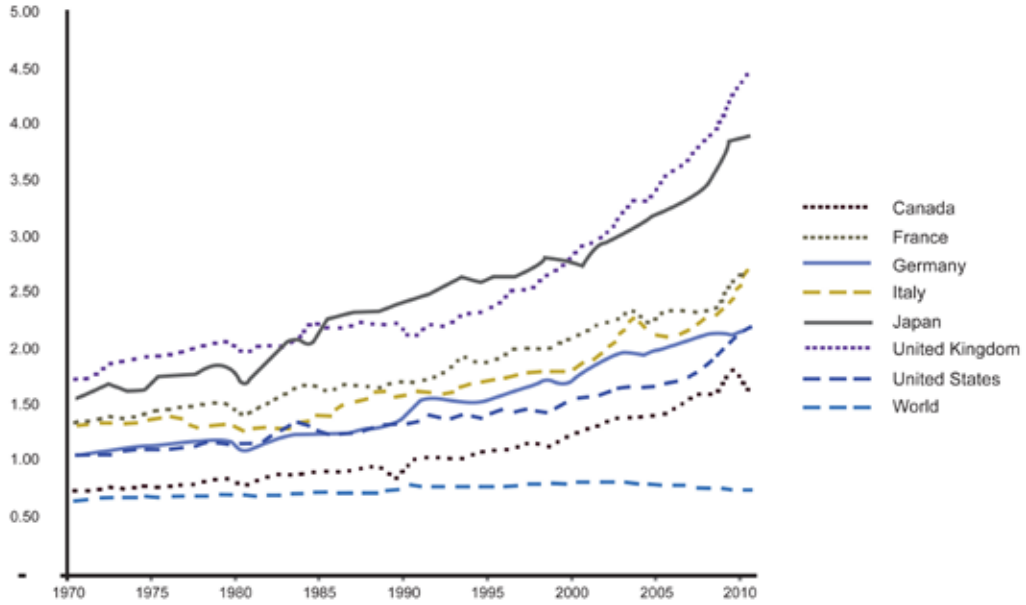


Chart 5 – Material productivity (MP) in G7 economies and the global economy, 1970–2010, in US$/kg
Source: UNEP (2017)

With regard to the waste sector, in 2015 its production amounted to 159 million tonnes (29 urban and 130 special)[3]. Compared to the aggregate data, remaining constant over the last 5 years, the fraction suitable for recycling processes is growing, thus increasing the potential to make the Italian economy more and more circular.
The data on the secondary raw materials generated starting from the urban separate collection is particularly interesting. Considering paper, wood, glass, plastics, and organic materials, around 10.6 million tonnes were put back on the market in 2014 (over 60% as material recovery), up 2% in 2015 on the basis of preliminary data[4]. This figure must be compared to the 15.6 million tonnes recovered: the difference is due both to the returns linked to the technologies used (very low productivity, especially for the organic materials) and to the generation of waste from the recycling processes. Box 6 presents an overview of the Italian situation in the various sectors.

The start of a transition towards the circular economy is an important strategic input, implying a passage from "**necessity**" (efficiency in the use of resources, rational management of waste) to "**opportunity**", designing products in order to use what is now destined to be waste as a resource for a new production cycle.
Italy, a technologically advanced country, hystorically used to compete thanks to innovation and sustainability, must necessarily move into a European vision of transition towards a circular economy, exploiting the opportunities and promoting concrete initiatives.

[3] ISPRA, Rapporto Rifiuti Urbani – Edizione 2016, http://www.isprambiente.gov.it/it/pubblicazioni/rapporti/rapporto-rifiuti-urbani-edizione-2016
[4] Fondazione per lo Sviluppo Sostenibile (2016), *L'Italia del Riciclo – 2016*.

Circular economy brings environmental and social benefits. From the environmental point of view, the preservation of natural capital - and of the related ecosystem services – is also achieved through a reduced pressure on resources and a reduced use of land for the disposal of waste in landfills. This goal is fundamental in a country like Italy, where the natural factor can be one of the main levers of economic development, as shown by the growing demand for sustainable and cultural tourism.

From an economic point of view, building a circular economy means stimulating the creativity of the Italian entrepreneurial system as a function of the economic exploitation of the reuse of materials: materials never become waste.
Investing in research and development through a cooperative network is a real possibility for our SMEs, especially the manufacturing ones, to rethink and change their production model and to consolidate their presence in global value chains.

Moreover, the creation of a circular economy spread throughout the country helps transform a series of problems, typical of our national production system, into opportunities.
Firstly, it is necessary more information on production processes (use of resources, quantity of recycled material used or not sent to landfill, etc.). The resulting greater transparency on the one hand helps reduce illegal practices, both in phase of production and waste disposal, on the other hand, thanks to traceability, allows consumers, who are increasingly attentive and aware, to reward virtuous enterprises for the quality of their productions.

Furthermore, the use (and reuse) of internally generated recycled materials allows a country like Italy, poor in raw materials, to be less dependent on foreign procurement, with lesser vulnerability to price volatility, especially at a time of great instability in countries owning the greatest endowments of these resources.

The reduced dependence on foreign countries, together with the rationalization of production systems, allows to optimize the costs of production activities with benefits for both businesses and citizens, with a consequent positive impact on international competitiveness, based on higher quality at lower prices. To this end, development and consolidation of the secondary raw materials market are also necessary.

With regard to employment, it is necessary to invest in the training of new skills (at planning and operational level), which become instruments and at the same time beneficiaries of the circular-oriented economic process: in hard times in the creation of new employment, circular economy could start a virtuous process, useful to reduce the massive egress of young Italians abroad, to decrease the number of those who are not engaged in education, employment or training (NEET) and to ensure sustainable, fair, and acceptable jobs, limiting the contrasts among the growing population (Italians and foreigners) who have difficulty living adequately.

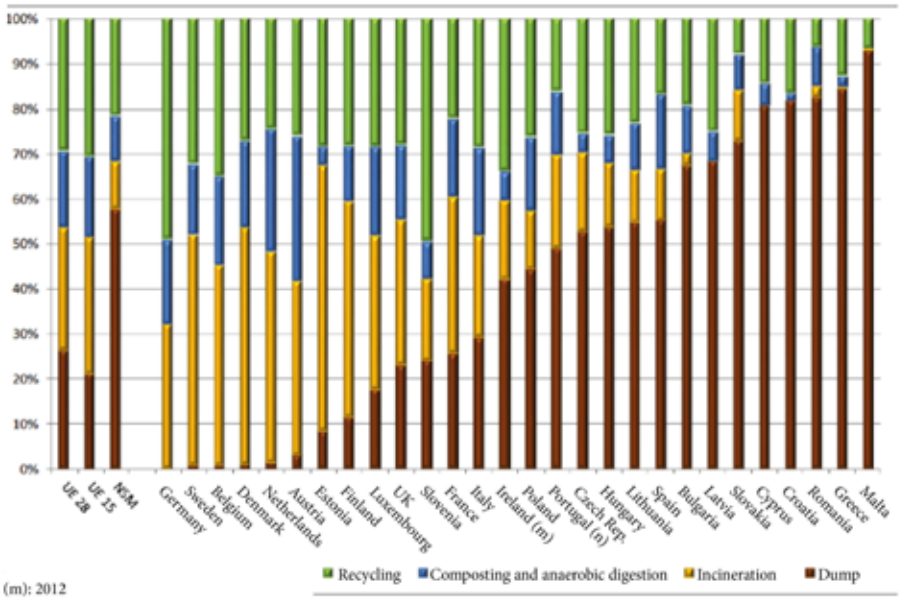
Box 6
Waste management in Italy

Since the Ronchi Decree, Italy has begun to introduce the necessary reforms in favor of developing a circular economy. In 2016, Italy had a very advanced level of recovery and recycling, especially for municipal waste, and a level of excellence in Europe for industrial and commercial waste. In order to further increase the levels of recovery and recycling and to meet the requirements of the European legislation, undergoing the reform, it is also necessary to homogenize the performances between the North and the Center-South of the Country.

Furthermore, it should be stressed that the action of production chains, in addition to a general reduction of environmental impacts, must aim at a more efficient use of resources, and in particular to set the goal of closing the material cycles as far as possible, making sure that production waste, materials, and products can be reintroduced into production cycles or reused, in the same production cycles that produced them or in others that are territorially or functionally connected with the previous ones. Basically, we must achieve to implement what has been defined as "industrial symbiosis".

The two charts below show (according to the latest EUROSTAT data) the national performance in recovery, recycling, and composting compared, respectively, to final disposal in landfills for municipal waste and for industrial and commercial waste.
The chart shows that, as far as municipal waste is concerned, the share of recycled, composted, and recovered waste is significantly higher than that of landfilled waste. It should also be noted that some of the countries showing lower landfilled waste than Italy obtain this result thanks to the incineration of waste (energy recovery) and not through recycling and composting.

Figure 1.5. – Percentage Distribution of EU Municipal Waste Management 2015 (Data Ordered by Increasing Percentages of Landfilling)

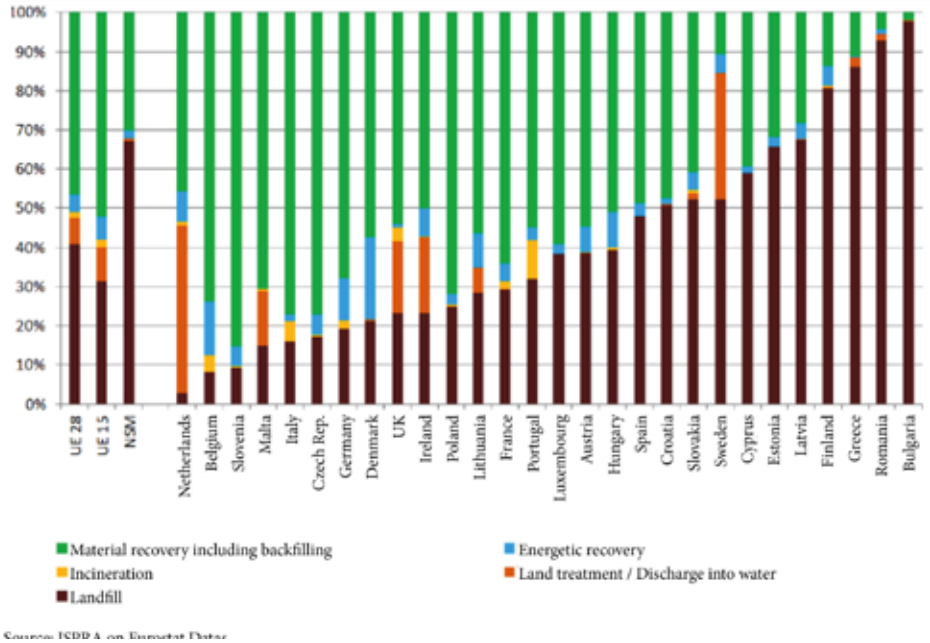


(m): 2012
(n): 2013
Source: ISPRA on Eurostat datas

Chart 6 – Share of municipal waste management options in Europe

Chart 7, relating to industrial and commercial waste, shows that Italian performance is absolutely relevant, with a rate of landfill disposal among the lowest in Europe.

Figure 1.7. – Percentage Distribution of EU Waste Management 2014 (Data Ordered by Increasing Percentages of Landfilling)

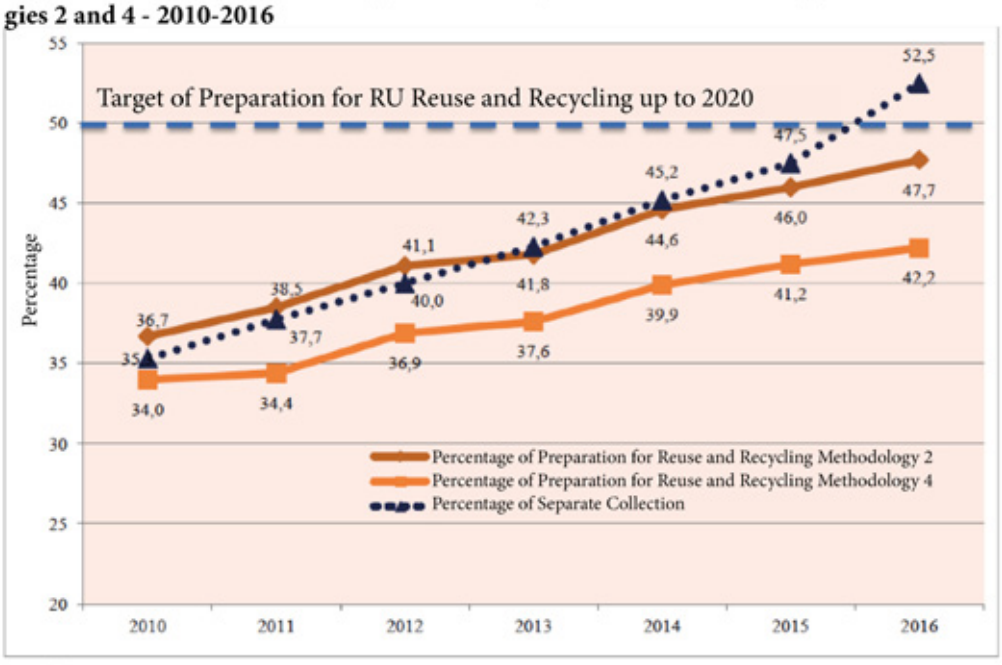


Source: ISPRA on Eurostat Datas

Chart 7 – Share of industrial waste management options in Europe

With regard to the recycling performance of municipal waste (Chart 8), it should also be noted that there is a steady growing trend suggesting the imminent exceeding of the 50% threshold set by the European legislator as a target for 2020. Through the progressive increasing of the separate waste collection and its extension to all waste fractions (including the organic one) in a uniform manner across the national territory (bridging the delay of the southern regions), Italy will be able to further increase the recycling performance, lowering to a minimum the amount of landfilled waste.

Figure 2.31. – Recycling Percentage Obtained by Simulations According to Methodologies 2 and 4 - 2010-2016

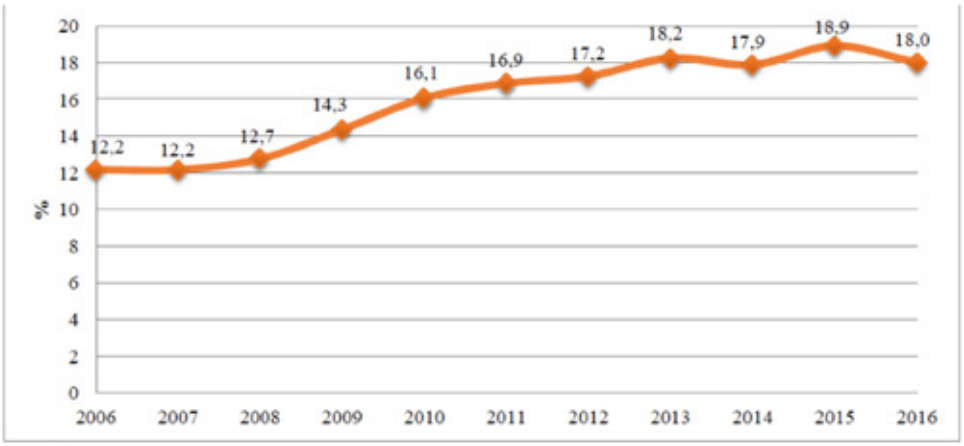


Source: ISPRA

Chart 8 – Municipal waste preparing for reuse and recycling percentage

With regard to energy recovery, Italy, with its 5.4 million tonnes of municipal waste incinerated, reaches a percentage of 18% in 2016. As outlined in the DPCM 10 August 2016, the role of waste incineration in Italy is residual and yet necessary for closing the waste management cycle, replacing the transfer of waste to landfills exclusively for those quantities of waste that cannot be collected separately.

Figure 3.3. – Incineration Percentage of Urban Waste in relation to the RU production 2006-2016



Source: ISPRA

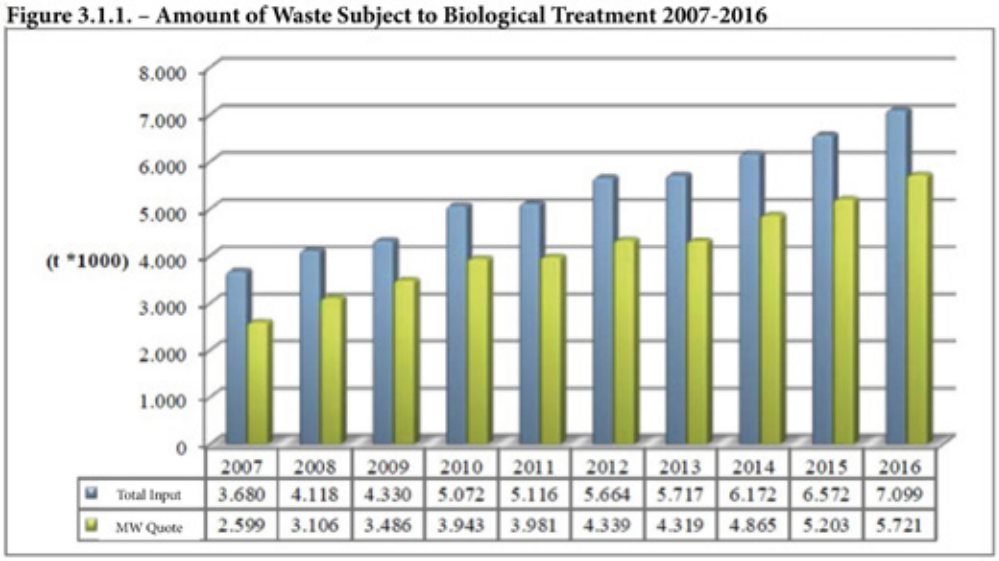
Chart 9 – Percentage of municipal waste incineration by total municipal waste production

In Italy there are several best practices both in the field of municipal waste and in the field of industrial and commercial waste:

Waste oils: Italy is the second highest country in Europe for quantities of regenerated waste oils. In many other European countries, waste oils are used for energy recovery rather than sent to recycling. It is necessary to notice that the regeneration of waste oils is a virtuous recycling operation and that this operation is superordinate in the waste hierarchy to energy recovery. For this reason it is considered essential to set a binding target at European level for the regeneration of oils. Italy has already supported such proposal in the revision of the European directives of the "waste package" and will have to keep supporting it at the European Commission.

Composting and anaerobic digestion: Italy has one of the most advanced systems of organic waste management in Europe, both considering the quality of the collection and compost obtained and for quantities of treated organic waste. With 5.7 million tons of municipal waste collected and treated in 2016 (Chart 10) out of about 9 million tons of organic waste produced, Italy currently achieves a 63% recycling rate. Its system also still has enormous margins for improvement as regards the interception of organic waste still not collected separately, the completion of the plants necessary for recycling the collected waste, the creation of a quality system of collection and treatment, beside the identification of the appropriate methods for financing the system.

Figure 3.1.1. – Amount of Waste Subject to Biological Treatment 2007-2016



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Input	3.680	4.118	4.330	5.072	5.116	5.664	5.717	6.172	6.572	7.099
MW Quote	2.599	3.106	3.486	3.943	3.981	4.339	4.319	4.865	5.203	5.721

Source: ISPRA

Chart 10 – Amount of municipal and total waste treated in composting and anaerobic digestion plants

Packaging: a system of packaging management based on the principle of producer responsibility has been well established for twenty years in Italy. This system ensures the achievement of recycling rates well above those set by the Community legislation with certain particular sectors (wood) being able to turn the lack of raw materials into an opportunity for their own development.
The national recycling rates of the various sectors (2015) are shown in the following graph. The recycling targets imposed by the Community legislation are all widely exceeded. Despite this, there is still room for improvement to be exploited together with the harmonized development of the separated collection throughout the national territory. Plastic, on the other hand, is the waste component that needs further efforts in research and development in order to find technological solutions increasing its recycling rate.

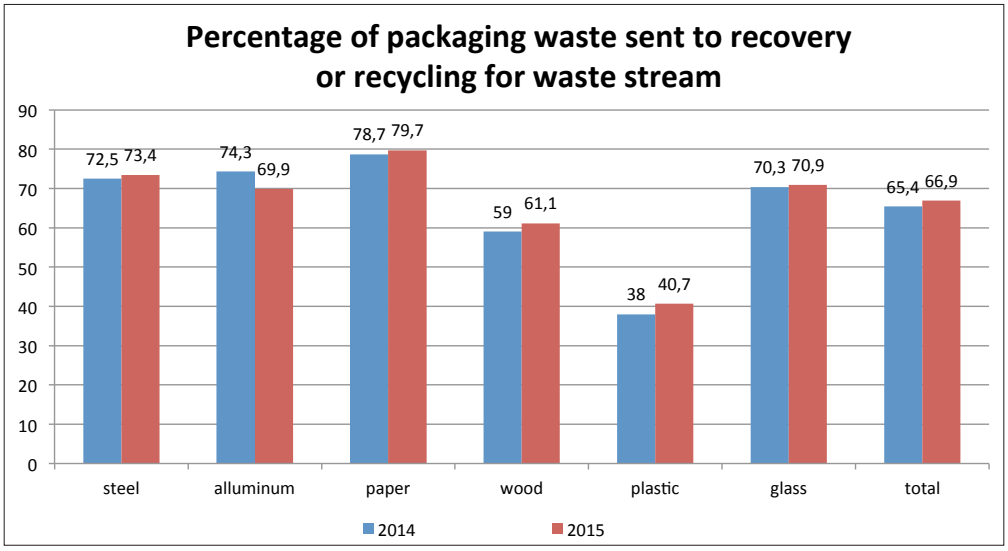


Chart 11 – Percentage of packaging waste sent to recovery or recycling for waste stream
Source: General Prevention and management Programme of packaging and waste packaging. CONAI: general report year 2015

Source: www.matrec.com

4. Circular Economy: a Paradigm Shift

4.1. The Companies

4.1.1. The Product Design

Design plays a fundamental role in the development of products reflecting as much as possible the principles of the circular economy. During the conceptualization, design, and development phases, decisions can significantly affect the sustainability of products during their life cycle (Chart 12).
Therefore, it is necessary to carry out preliminary assessments during the conceptual and design phases, configuring the possible market scenarios in order to clarify the requirements of environmental and economic sustainability.
To this end, it is fundamental to rely on *Life Cycle Thinking* approaches, i.e. through analysis and evaluation, applying standardized methodologies that take into account the impact products generate throughout their entire life cycle and not just focusing on the end of their life.
The development of a new product must follow the principles of *eco-design*, through the use of tools allowing us to evaluate the different environmental impacts.

Materials: rationalizing the use of material resources (efficiency in the use of materials), trying to replace non-renewable materials with renewable, recycled, permanent, biodegradable, and compostable materials. Valuing resources at a local or neighborhood level in order to reduce the environmental impacts of transports and to create a local product identity.
The need is "to create" new materials reflecting sustainability and circularity. Knowledge of the environmental and social characteristics of materials is essential to avoid pursuing project choices that do not favor the circularity of resources.

Production processes: increase efficiency in the use of raw materials; improve procurement and distribution logistic; minimize the production of processing waste or make sure that these are handled as by-products. The processes of industrial symbiosis offer an important contribution to give value to the waste of production processes, reducing their costs and obtaining revenues from sales. Using energy supplies from renewable sources.

Disassemblability: allowing easier separation of the various components of a product in relation also to the types of materials used.

Recyclability: favoring the recovery and recycling of materials, avoiding multi-material components with irreversible joints that cannot be separated and sent to the recycling process.

Modularity: favoring the design of products following the principle of modularity in order to allow the replacement of parts, the recovery and reuse of systems and sub-systems.

Repairability and Maintenance: allowing the replacement of technologically obsolete or damaged parts and favoring forms of maintenance that allows the extension of the life cycle of the product itself.

Substitution and Management of Hazardous Substances: choosing materials that do not contain hazardous substances to make more easily recyclable products, also according to the European legislation on chemical substances. However, in many products, the presence of specific hazardous substances is required by the need to guarantee specific performance and characteristics (including durability) that, based on current knowledge and available technologies, cannot be achieved through alternative substances. It is therefore also necessary to guarantee an appropriate management and recovery of hazardous substances.

Re-use: favoring the re-use of the products for the same function even thanks to their maintenance.

Collection: fundamental phase for the closure of the circle and to include a product or part of it in a phase of maintenance, preparation for reuse, or recycling.

Regeneration: allowing the working and reusable parts of a used product to be reused in a new product.

The Quality of Recycling: encouraging the recycling process keeping the characteristics of the materials as stable as possible. A reduction in the quality of the material inevitably leads to a lower economic value.

Producing Only What Can Be "Recirculated": in the new paradigm there is no produced waste that cannot be recycled or there are no residues that cannot be reused in other production cycles.

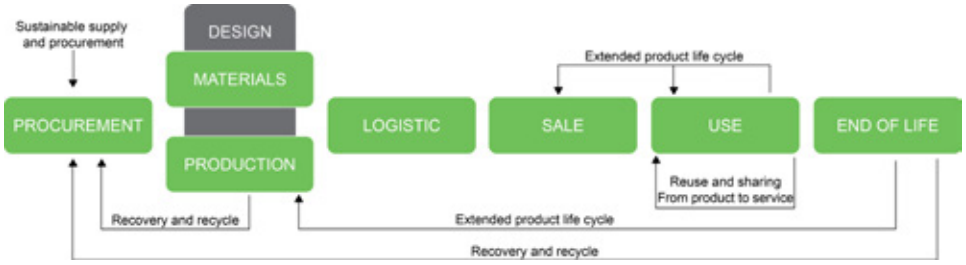


Chart 12 – The design process for circular products development

4.1.2. New Business Models

Pursuing the principles of circular economy represents an opportunity to create new business models. In order to evaluate the possible solutions, it is necessary to move from a linear approach to a circular approach, sometimes questioning the business models pursued up to now and confronting the new market demands.
Below are the main models of reference for the circular economy, which in turn can be applied to further business activities (Chart 13):

Sustainable Supplies or Purchases

The ability to provide supplies of resources totally coming from renewable sources, from re-use, and from recycled, recyclable or biodegradable materials and which are themselves based on circular production chains for the production and consumption aspects.
This model allows to push the market demand towards a lesser use of non-renewable and sometimes scarce resources, as well as reducing waste quantities and removing system inefficiencies. It is a model that already implies advantages for supplies to Public Administrations thanks to the green public procurement (GPP) and the Minimum Environmental Criteria (CAM) introduced for some commodity sectors.

Recovery, Reuse, and Recycling of Resources

This model is based on the ability of a company to withdraw a product at the end of its life cycle in order to re-use it. The re-use can involve some components or the whole product as a result of a maintenance phase (if necessary). This is a business model that promotes the return of resource flows and transforms potential waste into value through innovative reuse and / or recycling services.

Extension of Product Life

This business model is based on the marketing of products designed for longevity. The design phase of the product, even applying the principles of modularity, is essential to provide for and facilitate maintenance and replacement of its components, the updating of its functions and in some cases its aesthetic restyling.
Several cases of companies at international level demonstrate how this model, when applied to certain types of products, is appreciated on the market because it also offers the possibility of additional free services such as maintenance / updating during use or replacement of the damaged product.

Sharing Platforms

Thanks to a more advanced digitalization, in recent years there has been a multiplication of collaboration platforms between users for product groups, specific products, or ideas proposals. A sharing that sees the active participation of individuals, public bodies, organizations, and businesses, which also create value through the dissemination of information.

From Product to Service

A business model that in recent years has been adopted for cars, IT equipment, music and film streaming, sports equipment, etc. and is taking hold in other sectors such as clothing, furniture, gadgets, toys, and packaging. With this model, the products are not purchased but used by one or more users through a "pay-per-use" contract.

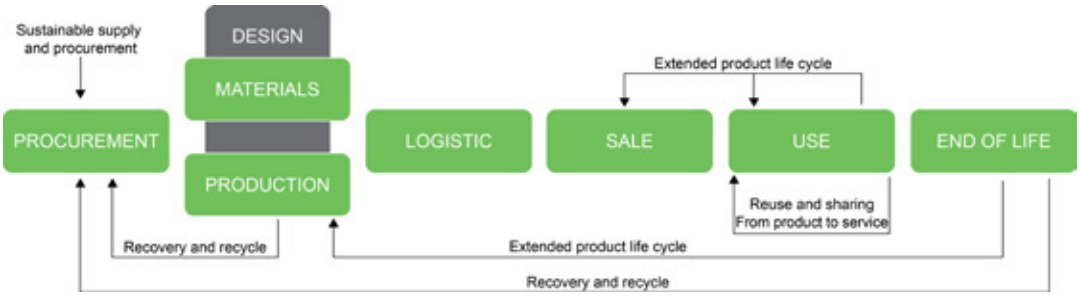


Chart 13 – Circular approach for products and services development

Box 7
Industry 4.0

The fourth industrial revolution, the so-called "Industry 4.0", thanks to the diffusion of digital technologies, is deeply changing the industrial sector and the mechanisms through which it has historically produced value, innovation, employment, and well-being. Thanks to the increased ability to interconnect and co-operate productive resources (physical assets, people, and information, both within the factory and along the value chain), digital technologies cannot only increase competitiveness and efficiency, but also act as a lever in the introduction of new business models, overcoming the traditional distinction between product, production process, and service.
The Industry 4.0 Plan adopted by the Italian Government could be an opportunity to accompany the transition to a circular economy, both by generally supporting investments in research and development, and innovative technologies, and by encouraging the diffusion of systems based on collection and analysis of large amounts of data. All this with the aim of making production processes more efficient in terms of time and resources used.
In fact, digitization will be an enabling factor for the transition towards the circular economy model: the connection between products and factories, of value chains and users will allow companies to design the product manufacturing cycle together with its use and reuse cycle in a logic of environmental and economic sustainability. At the company level, it will be possible to optimize the consumption of resources, reducing energy waste and scraps generated in the production process. Warehouse management will be made more efficient by connecting requests from production and supply chain. The impact of this innovation extends beyond the single company. It will concern the whole production system, enabling the design and management of integrated production and de-production chains, favoring also the industrial symbiosis.

4.1.3. Industrial Symbiosis

Circular economy requires actions throughout the life cycle of materials aiming at closing cycles and at resource efficiency. It is no longer just "recycling economy", but the focus is on the whole value chain involving a plurality of public and private actors and stimulating virtuous processes of cooperation and new business models.
Industrial symbiosis (or industrial metabolism), expressly referred to in the 2015 EU Circular Economy Action Plan as one of the most important tools for transition towards the circular economy, involves traditionally disconnected indus-

tries into an integrated approach aiming to promote competitive advantages through the exchange of materials, energy, water, and / or by-products[5]. The benefits are economic, environmental, and social for the whole territory involved.

Industrial symbiosis is a tool for eco-innovation of the system, for the efficient use of resources, and involves dissimilar companies through the creation of networks of resource sharing. The networks are also based on appropriate platforms for meeting demand and offer and to make known the characteristics of residues, in order to carry out evaluations and investigations on the possibilities of use in new production processes, addressing the problems related to the exchange of confidential information and specific know-how. For example, with regard to industrial symbiosis, it is necessary to set up an organic and systematic portfolio of economic instruments to support companies in their development processes, with specific regard to overcoming critical factors and fully exploiting new opportunities.

In addition to the experiences developed by ENEA in Sicily, Lazio, and Emilia Romagna (Chart 14), we note the existence of the first national network of industrial symbiosis "SUN - Symbiosis User Network". This network aims to promote, through industrial symbiosis, a cultural change towards circular economy, encouraging the meeting of the various stakeholders involved, the creation and sharing of knowledge, and the identification of new opportunities for economic, social, and territorial development in our country.

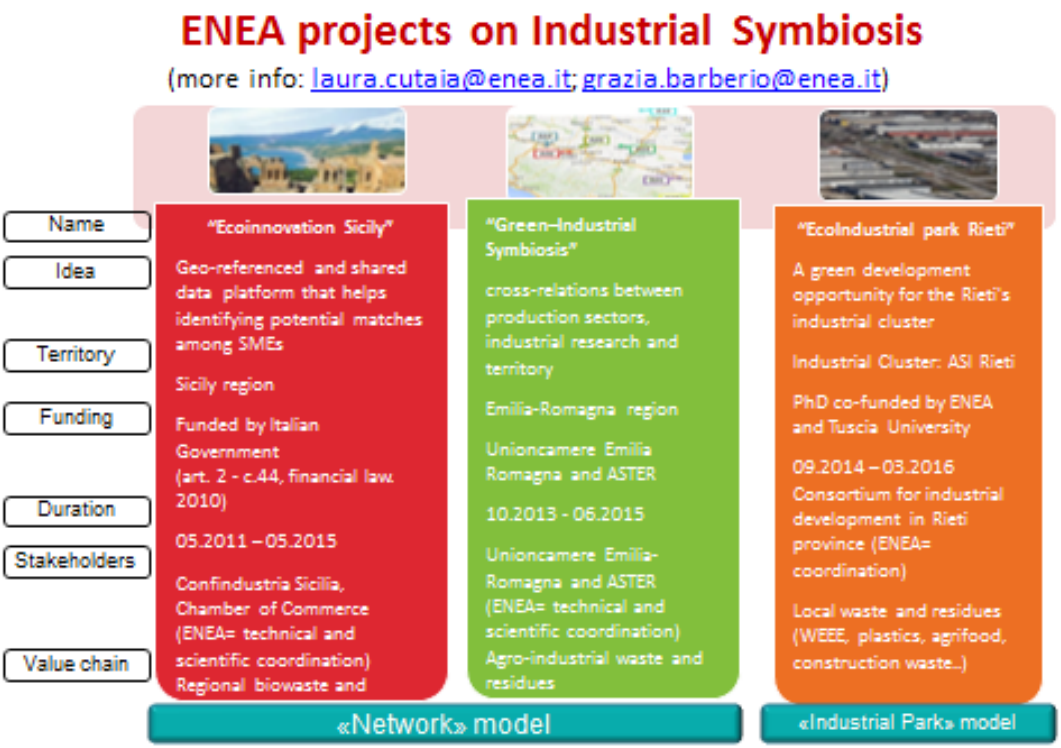


Chart 14 – Experiences of Industrial Symbiosis in Italy and main characteristics
Source: ENEA

[5] Chertow M.R., "Industrial Symbiosis: Literature and Taxonomy", *Annual Review of Energy and Environment*, 2000.

4.1.4. Bioeconomy

Bioeconomy, the socio-economic system including and interconnecting economic activities that use renewable bio-resources from land and sea to produce food, materials, and energy, is a fundamental attribute of circular economy. Besides relying on renewable resources, it feeds the "biological cycle" that is the recovery and the energetic valorization of the organic scraps of the production processes and / or waste. In fact, on April 20th 2017, it was officially presented the National Bioeconomy Strategy[6]. It aims at the convergence of actions on this field undertaken by the various central and territorial administrations, as well as at the active participation of our country in the revision of the European Strategy[7].

The global population increase, the climate change, and the decreasing resilience of ecosystems require an increase in the use of renewable biological resources, in order to achieve a more sustainable primary production and more efficient systems for the production of foods, fibers, and other biological materials of good quality and high added value. This can be achieved through decreased use of raw materials, less waste production, and less greenhouse gas emissions, with consequent benefits for human health and the environment. The enhancement of organic waste from production residuals and generated by agriculture, forests, cities, and industry (in particular agri-food industry), rather than from dedicated crops, completes the action, ensuring that bioeconomy plays a key role in the circular economy.

In order to fully respect the waste hierarchy and maximum environmental sustainability, wood scraps (from municipal waste, parks, and gardens) should be mainly used for the production of soil improver that can return to enrich soil with nutrients and organic substances rather than used for energetic purposes.

It is therefore necessary to pursue an economic transition, integrating bioeconomy and the circular economy models, within a framework in which the production and use of renewable bio-resources, as well as their conversion into products with high added value, are part of a productive system that makes in the long run economic activities sustainable from a technical, economic, environmental, and social point of view, at the same time making consumers more aware and involved in safeguarding human and natural capital.

An example is the process of energy recovery (anaerobic digestion) that is put before the recovery of materials (composting for the production of soil improvers) in the field of residuals / waste / organic by-products treatment in order to firstly extract the potential content in terms of renewable sources

[6] http://www.agenziacoesione.gov.it/opencms/export/sites/dps/it/documentazione/NEWS_2016/BIT/BIT_IT.pdf

[7] https://publications.europa.eu/en/publication-detail/-/publication/26b789d4-00d1-4ee4-b32e-2303dfd2207c

(eg. biogas and biomethane), thanks to the incentives in the energy field, to be only subsequently managed (composted) in order to enhance its fertilising content.
Another feature of the circular economic model carried out by the bio-economy, in particular by the bio-based industry, is to bring abandoned or marginal agricultural land and abandoned industrial areas into the economic system, through the conversion of production districts, in particular petrochemical ones, in biorefineries. In this way, territories can be revitalized non only from an economic point of view, but also environmentally and socially, creating intersectoral production chains and recovering both agricultural and industrial activities.

To complete the cycle, we should encourage the re-introduction into soil of quality organic matter to prevent carbon depletion; in this regard, the organic waste collection and treatment for the production of compost can provide an efficient solution.
A shared effort in research and innovation is essential for the development and consolidation of bioeconomy. The Italian Strategy indicates a series of actions and themes on which our country can express its potential.

4.1.5. Towards New Models of "Responsibility"

The EU "polluter pays principle" aims to make waste producers accountable in order to drive them to a reduced production and to the correct separation of waste. This also includes distributors, public collection services, consumers, and all the operators who are legally engaged in waste management and who must contribute logistically / organizationally and account for waste flows, ensuring the achievement of collection, recovery and recycling targets.

The Extended Producer Responsibility (EPR)[8] is a strategy of environmental protection, adopted at the community level, to encourage the collection, recovery and recycling of some types of products, through the empowerment of those developing a company business on the specific production. The basic principle is precisely the extension of the manufacturer responsibility (in addition to the responsibilities of designing and constructing according to the regulations in force, of selling in compliance with the competition, of guaranteeing suitable maintenance) to take charge of the product once this has reached the end of its life, with the obligation to achieve specific percentages of recovery and recycling of its materials.

[8] For more information see a recent OECD work and the European Commission guidelines http://www.oecd.org/environment/waste/extended-producer-responsibility-9789264256385-en.htm; http://ec.europa.eu/environment/waste/pdf/target_review/Guidance%20on%20EPR%20-%20Final%20Report.pdf.

To fulfill this responsibility and to achieve legal requirements, most of the producers preferred to set up "consortia" facilitating the recovery and recycling of materials.
The purpose of EPR is also to encourage producers to apply ecodesign strategies during the product design phase, preventing the formation of waste and encouraging the recycling and reintegration of materials into the outlet markets. For this reason it must be very clear who is the "responsible" subject for managing the product end of life, avoiding that EPR becomes a business model participated by subjects with different interests affecting the achievement of the final objectives, both in terms of material recovery and economic.

Without a doubt, the introduction of the EPR allowed to achieve results in terms of recovery and recycling of materials for different types of products, but highlighting areas of light and shade.
For example, the collection of the product at the end of its life, which becomes waste, is one of the aspects in the shade, because the owner of the good (the consumer) does not always adequately confers his own waste according to regulations or it does not allow its collection due to purchases off the books causing consequent attempts to conceal the product at the end of its life: a consumer called, directly or indirectly, to be financially responsible for management costs. It would be reductive to limit the EPR only to the financial part, excluding the organizational and management part. Organizational responsibility comes from financial responsibility and vice versa.

Nowadays, the consumer is an active component of the EPR in terms of financial responsibility and waste collection, but is a passive part of the economic benefits deriving from it or that could derive from it.
It is necessary and appropriate to revise the rules in order to foresee new models of EPR and new models of consumer responsibility (ECR or Extended Consumer Responsibility) or even community responsibility. In the first case it is a matter of establishing new structures for new waste flows or new systems for returning the waste produced by consumers to managers other than municipal management systems. It will be necessary to assess and measure the effects of these new systems on the economic sustainability of the municipal management system and their repercussions on the costs of waste service paid by citizens.
With regard to consumer responsibility, it is necessary to more actively involve them on the management of products before they become waste, such as encouraging the re-use market or conferring products to private managers in exchange for an economic contribution. This can and must occur both in single and in aggregate form.

It is advisable to introduce a collective responsibility for some sectors such as organic waste, which currently has no incentive or fee and represents a cost for the waste management system and for citizens. To this end, it is neces-

sary to endow the community with the knowledge and certainty of controls allowing a conscious assumption of responsibility. The approach must go beyond the disposal chain vision to move on to the recovery chain.
Developing new forms of responsibility is a necessity and an opportunity for our country, especially for those types of products not yet subject to EPR, and for which our country is the world leader for the quality of manufacture and materials. It is also worth highlighting that without a feedback oriented culture and regular and frequent checks, achieving an efficient and effective circular economy model becomes a utopian ambition. Without regular and professional checks, any incentive actions lose their effectiveness.
It is essential that the EPR principle is not pursued in a "monolithic" form but we need to leave the possibility to the "responsible" subjects to create different systems, competing with each other, establishing, if necessary, a Control Authority. In this way it is possible to guarantee a continuous improvement of the efficiency, effectiveness, and quality of the services, and therefore an improvement of the results in terms of circularity.

4.2. The consumers

4.2.1. New Models of Consumption

The development of the circular economy must concern both the improvement of efficiency in production and the change in consumption patterns. It is therefore necessary to intervene on the types and methods of consumption and consumer behavior, also addressing general issues such as the concept of well-being, cultural models, ethics. Changing behavior and personal choices is a very difficult topic to deal with, because it has to do with a variety of sensibilities, needs, necessities and desires, priorities, habits, places, personal stories. However, it is impossible to ignore the need to make people aware of the consequences that certain choices of purchase or certain behaviors have on the environment and the economy. In order to gain greater awareness (also by companies) of the guidelines and actions to be implemented, it might be useful to carry out analyses aiming at better understanding how much and how consumers are willing to prefer "eco-sustainable" products.

Therefore, it is necessary to draw a "National Environmental Education and Communication Plan", articulated at local level, which, starting from compulsory schools up to families, could contribute to form a generation of critical, aware, and informed citizens, able to consciously decide and to influence with their choices the various economic-productive and social mechanisms of their country.
The addressed issues must concern both behavior on more or less simple questions such as recycling, the use of equipment and tools, attention to waste (especially food), and more complex cultural questions such as:

– preferring sharing and use rather than ownership of some goods,
– having responsible and informed attitudes in consumption (both material and services),
– calibrating consumption on real needs,
– trying to fix products as much as possible instead of simply replacing them.

Families can play an important role if they are able to distinguish between similar products and services, favoring, perhaps even at a slightly higher cost, better quality products or products with a lower impact on the environment, renouncing to satisfy primary needs at the lowest price, purchasing imported goods and / or products made under a less severe environmental legislation and with a lower labor protection.
Naturally, to allow this to happen, in addition to work on environmental education, it is particularly useful to carry out a series of actions in the field of environmental and regulatory communication; among these we point out the need to:
– fighting misleading advertising,
– promoting the knowledge and the use of recognized brands, both as regards environmental and social aspects. Of particular use are the Type I brands (such as the European Ecolabel), which does not require particular skills from consumers,
– Incentivizing, even fiscally, repair activities and those that share products and services.

4.3. Fiscal and Economical Instruments

4.3.1. A New Concept of Value

Economic theory recognizes a series of market failures where the balance between demand and supply determined by price does not coincide with a socially desirable optimum. One of the most emblematic cases is that of negative environmental externalities, generated by the fact that those who produce an environmental impact on the community, even unintentionally, do not support its entire cost. These externalities can be of two types, connected both to the excessive use of raw materials, and to the management of the goods in the post-consumption phase as well as to the impact related to the production phase such as emissions into the atmosphere and water discharges.
The report "Financing the Future - Report of the Italian National Dialogue on Sustainable Finance" (MATTM & UN Environment, 2017)[9] states that "unpriced environmental externalities" and "limited access to finance for enterprises, especially for SMEs" represent some of the factors that hinder the process of transforming the Italian economy in a sustainable perspective.

[9] http://www.minambiente.it/sites/default/files/archivio/notizie/report_financing_the_future_en_2.pdf

The same report indicates a series of actions to remove obstacles and to support the transition towards sustainable forms of production, including financial innovation (eg. green bonds) and greater transparency on the markets (reporting of non-financial information on companies).
In particular, we can intervene with different tools to restore the balance between demand and supply "internalising" these external costs; measures such as taxation on carbon emissions (carbon tax), on landfill disposal (landfill tax), pollution in general (pollution tax), encourage the transition to less impactful technologies, promoting reuse, recovery, and recycling.
To combine the ecological and economic dimensions, methodology and criteria for the quantification of these costs must be scientifically validated, shared, uniformed, and adopted on a European and international scale.

Box 8
The instruments to facilitate the transition towards the circular economy

The OECD "Policy Guidance on Resource Efficiency" * identifies a set of instruments to guide the national systems towards the circularity of economic processes. They are analyzed and characterized depending on the stage of the production process - distribution - consumption - post-consumption:
– Regulatory instruments (Command & Control) such as restrictions or prohibitions on extraction and consumption, performance or technological standards, standards for recycled materials, prohibitions or restrictions for disposal in landfills,
– economic instruments such as taxes on virgin materials or products or waste disposal and incineration, "deposit refund" schemes, taxation based on recycled product content, public support for the creation of industrial symbiosis processes,
– certification and labeling rules in order to strengthen the image of the product and the company, making traceability of the production process more verifiable,
– Environmental management systems, for the standardization and management of the various stages of the production process including information on the origin of raw materials, management of waste and rate of use of secondary raw materials.

The first case (regulatory instruments) guarantees environmental effectiveness but not necessarily economic efficiency, vice versa the second case (economic instruments); voluntary tools (certification and environmental management systems) often fail to guarantee their targets, even being the result of appreciable efforts.

Whatever is the mix of incentive instruments adopted, it is essential to consider the following aspects: environmental effectiveness, economic efficiency, incentives for innovation, administrative costs of compliance for businesses and public administration, redistribution impacts and competitiveness.

* OECD (2016), *Policy Guidance on Resource Efficiency*, http://www.oecd.org/env/policy-guidance-on-resource-efficiency-9789264257344-en.htm

4.3.2. Economic Instruments Production-Side and Demand-Side

There are many economic instruments that can be used to facilitate the transition towards a circular economy model. They are also classifiable based on the subject on which the change of incentives falls. Enterprises evidently represent the main actor, being able to modify their production processes and their products in favor of a greater sustainability. However, consumers are also protagonists of this change, as the increase in demand for environment-friendly products and services is a further incentive for enterprises to improve their environmental performance.

Incentives for companies mainly concern the extraction of raw materials, research and innovation, design and production. Those for families concern the consumption phase. Incentives promoting recycling/recovery and discouraging landfilling can affect both categories.
It is worth noting that non-durable and durable goods used by families may require different forms of management. In the first case the production must be minimized by reducing waste (eg. food) or waste must be sent to the correct forms of disposal or recovery. In the second case, the recovery of materials and components must be adequately encouraged, because they still hold a significant economic potential, through schemes for the return of goods no longer desired by consumers to producers/distributors. For example, some European countries have promoted tax initiatives that incentivize repair activities.
In any case, the modification of the incentive system must be designed in such a way as to be internally coherent, therefore without vanifying the economic, environmental, and social objectives. And of course it must consider the business and social context in which the proposed instruments will work. For example, the intervention of the decision-maker must not induce companies to relocate their production to countries with less strict environmental regulations, to decommission production units and/or to shift the environmental problem from one side of the production chain to an other.
Moreover, the gradual but certain elimination of inefficient harmful environmental subsidies, requested by many[10], would reduce the pressure on the use of natural resources (above all fossil fuels) and restore greater competitiveness among the various alternative resources, with greater penetration potential for the most adaptable technologies for recycling/recovery/reuse. This path must be gradual in order to provide the industrial system with the time to implement technological innovations for transition without affecting the competitiveness of enterprises on the market.

4.3.3. Switching the Tax Burden in a Context of Circular Economy

Family side: The process of transition towards the circular economy should be promoted both on the "consumption" side and on the "production" side. This requires a change in incentives for the different economic agents. On the "demand" side, the tax burden must be shifted from income to consumption. However, this is not sufficient because it does not discriminate between types of consumption, as well as potentially generating problems of social equity. The process of transferring the tax burden requires a further step, that is to create a tax differential between "sustainable" and "non-sustainable"

[10] eg. Agenda 2030 of the United Nations, target 12c; 2011-2020 Strategic Plan of the Convention on Biological Diversity; UNEP-IRP's "Resource Efficiency: Potential and Economic Implications" Report; Communications in G7 and G20 also by Economic Ministers supported by OECD analysis; Review of the implementation of Italian environmental policies by the European Commission in March 2017.

consumption, based on the characteristics of the product and the production process, also operating, but not exclusively, on VAT rates.

Furthermore, it would be advisable to favor a wider diffusion of "pay-as-you-throw" models which, when applied, have given excellent results by increasing recycling rates to almost 90% in some municipalities as in the emblematic case of Treviso. The Decree of the Ministry of the Environment 20 April 2017 defines the criteria to respect for implementing a waste management model based on the tariffs proportional to the actual contribution of municipal waste.

Also going back to "deposit refund" schemes can be useful to reduce the amount of waste to be recycled, as stated by art. 39 of Law 221, 28 December 2015, and started experimentally and on a voluntary basis for packaging of beers and mineral waters with Decree 142 of 3 July 2017.

Business side: Technological innovation involves changes in production technologies that also pass through changes in the mix of production factors; these technologies can be stimulated by appropriate tax levers. In particular, the review of the implementation of Italian environmental policies by the European Commission in March 2017 suggests transferring part of the tax burden from the labor factor to natural resources, with the possibility of obtaining a double advantage: reduction of environmental impact and improvement of economic efficiency.
In fact, even if taxation in general is seen as distorting, because it alters the economic incentives of the free market system, seen as the most efficient form of allocation of resources, environmental taxation is instead considered corrective of a pre-existing distortion and therefore a way to limit the excessive use of natural resources.
Transferring the tax burden also makes possible to preserve and increase employment levels, while at the same time stimulating technological innovation in the recycling industry itself. It is however necessary that this instrument does not increase the tax burden for companies.

It is therefore necessary to create a more structured and compact picture of the modalities of action that are necessary to achieve in an integrated way the aims pursued by the circular economy during the entire life cycle of the product.

Source: www.matrec.com

5. Transition Phase

5.1. Rethinking the Concept of Waste

Although the concept of "waste" in the past has allowed for the solution of problems not otherwise resolvable, it is no longer relevant if we seek to meet a policy of minimization of waste. The challenge of transition towards the circular economy is to consider what is now waste as an element, a "brick" for a new production cycle.
Consequently, a profound revision of the Community legislation appears, in the light of the concept of circular economy, ever more necessary. If the green economy already considered waste as a solution and no longer a problem, even today the waste itself is subject to meticulous regulations, which significantly limits many of its intrinsic potential, in particular through restrictions regarding management and handling. In the past, restrictive rules for waste management were justified because the real problem of waste was considered its illegal dumping without an evaluation of its potential. Today, paradoxically, we could limit the concept of waste only to what "has no economic value" for the market; this is not true for materials such as used mineral oils, for which there is a market with an almost official quotation, used for trading them, and which have been the subject of international "disputes" for their acquisition, or for goods for which the withdrawal is regulated by law (as in the case of the consortia organized by the current environmental legislation for particular waste streams). Considering these cases, a restrictive regulation should be provided only for what is intended for dumping, in order to prevent its dispersal in the environment, while today regulation is also extended to noble materials with a high demand. The revision of the Community legislation will therefore have to go beyond the changes that led, in 2008, to plan a partial exit strategy from the concept of waste, with the recognition of by-products and the End of Waste status.
Once the necessary regulatory change has been carried out, we need to identify:
– waste flows for which waste status is no longer necessary, but which can be recirculated in the production and economic system as new raw materials or products,
– waste flows currently not re-used or recycled due to legislative, authoritative, organizational, economic, competitive obstacles, etc. For these flows it is necessary to set up ad hoc working groups to effectively remove the causes hindering the circularity in these sectors,

– waste flows currently not reusable or recyclable. On these flows it is necessary an intervention to activate applied researches able to develop new materials or products to be re-introduced in production cycles, to find new systems and new market outlets or to plan their progressive elimination from the market or their replacement with reusable or recyclable materials.

As mentioned above, the transition from an economy "from cradle to grave" towards the circular economy already represents a moment of strong change in the strategy of materials management with the tools at our disposition (End-of-Waste status and identification of by-products) and represents a strong impulse in the identification of new waste flows to be subjected to "end-of-waste" processes (EoW) and in the recognition of new by-products, especially as a result of the recent issue of the by-products decree.

In order to achieve the new paradigm, it is important that in the transitional phase we work on the instruments that can offer to the operators certainty regarding the qualification of by-product of the production residues they generate. It is also important working to establish specific criteria for those types of waste for which the EoW decrees have not been issued yet. In fact, for these types of waste we still apply the legislation of 1998 relating to the recovery of waste with a simplified procedure that should be updated to keep up with technological progress. The End-of-Waste status, in fact, represents the "prize" for those who recycle and recover waste by transforming it into the so-called "secondary raw materials", i.e. into materials that are reusable in economic cycles, thus contributing to reduce the consumption of raw materials and the amount of waste to be disposed of.

The End-of-Waste status thus becomes a major instrument for implementing the much-desired recycling society, a declared goal for the Community bodies, marking an important step forward in today's waste legislation in order to put an end to antiquated (and consumerist) concepts such as "all waste" and "waste forever". To this end, also to favor the saving of natural raw materials, it is necessary to identify the priority waste flows on which to intervene, preparing the related decrees so that the materials resulting from high quality recovery operations can again be introduced on the market, competing with virgin raw materials with full dignity, with a spotless "criminal record", and without a bad reputation.

Similarly to the question of the End-of-Waste status, too often the possibility of considering a residue as a by-product and allocating it to new production cycles clashes with the fear of demonstrating to the control authorities that the residue is indeed a by-product and not waste. Therefore, operators should be assisted in verifying the conditions qualifying residues as by-products and providing standardized criteria for as many residual flows as possible, in order to offer certainty to the producers of the residue and to the control authorities.

Furthermore, in pursuing actions aimed at reducing the quantity of waste and the way it is managed, it is necessary to take into consideration that the integration of environmental instruments (eg GPP), or fiscal instruments, could develop actions such as creating networks for the repair, dealing with planned obsolescence, facilitating the market of used materials etc., supporting the existence of demand for everything that has an economic value for the market. Actions in this direction have already been undertaken by some EU countries.

Box 9
In-depth: by-products and end of waste

Following the enactment of the Waste Framework Directive, the European Commission started to set up the community criteria on "End-of-Waste status" for some waste flows. The work, which began in 2007, lasted for many years and led to the issuance of some Regulations. The first was the regulation on metal scrap (333/2011), followed by the ones on glass (1179/2012) and on copper (715/2013). The Commission had also prepared a regulation on paper which, however, had neither the favor of the TAC (Committee for the adaptation of Community legislation to scientific and technological progress) nor the favor of the Council and the European Parliament. In addition, the Commission has worked for years on compost and digestate criteria and on plastics, but these Regulations were never proposed by the Commission to the TAC vote. The regulations on compost and digestate have now been partly included in the new fertilizer regulation, while the one on plastics has not undergone any further evolution. The Commission, after the rejection of the regulation on paper, carried out an evaluation of the usefulness of the issuance of the EoW community criteria, deciding that it was more appropriate to delegate this secondary regulation to the Member States.
With regard to the preparation of new EoW decrees at national level, the Ministry of the Environment, Land and Sea Protection (MATTM) has already been working for some time on some specific waste flows. In particular, for the EoW decree on asphalt milling and for the EoW decree on tires deriving from out-of-use cars, technical checks have been completed: both decrees are currently subject to legal controls. The MATTM, moreover, has prepared and submitted to the ISPRA examination further technical sheets for the recovery of materials from diapers, car batteries, and demolition/construction waste. In the short term, it plans to deal with the problem of the End-of-Waste status for materials deriving from paper, boat fiberglass, PET packaging, and other plastics. Furthermore, the MATTM begun a constant dialogue with the operators of the waste sector in order to collect every element that could be useful to identify waste flows for which EoW decrees must be prepared, pursuant to article 184-ter of Legislative Decree 152/2006.
With regard to the by-products, the MATTM issued the decree n. 264 of 13 October 2016 and an explanatory note, aimed at facilitating the demonstration of requirements for the qualification of production residues as by-products and not as waste.

5.2. Promoting Sustainable Models of Production and Consumption: PAN-SCP

The National Action Plan on Sustainable Production and Consumption (PAN SCP), provided for by Law 221/2015 (article 21), represents one of the instruments for implementing international and national policies and strategies on the circular economy, the efficient use of resources and climate protection, implementing in particular the objective 12 of the Agen-

da 2030[11] "Assuring sustainable production and consumption models" and, consequently, the National Strategy for Sustainable Development.[12]
The 6 areas of intervention of the PAN SCP (SMEs, production chains and districts, agriculture and agro-industrial chains, constructions and living, tourism, organized distribution, sustainable consumption and behavior) have been identified on the basis of the strategic productive sectors for our country and/or more impacting from an environmental point of view, also attributing an important role to consumption, and secondly to distribution, as indispensable levers on which to intervene to direct production itself.
The PAN SCP therefore provides specific lines of action for each area of intervention, in order to promote production-distribution-consumption models capable of integrating the various aspects of sustainability (environmental, economic, social) in an integrated way: elimination of environmental impact incompatible with the self-regenerative capacity of natural systems, contrasting climate change, closing of the material production-consumption cycles, elimination of waste (energy, water, food), increasing efficiency in the use of resources, reducing waste and pollution. As well as satisfaction of people's basic needs, even for the weakest parts of the population, distributive equity, decent income and working conditions, moreover a preference for conscious and "sober" lifestyle: in fact, greater efficiency in the use of resources in production systems is not sufficient if not combined with changes in consumption patterns, in purchase choices, in behavior and lifestyle[13].
Recovering the centrality of the territory, through governance processes contributing to build relationships among economic actors and to maximize synergies between institutional and non-institutional actors, we can create models of "circular economies" at local level (eg industrial symbiosis), thus offering to companies an alternative to defensive (and failing) strategies, such as worsening the quality of products, lowering wages, and exacerbating working conditions, or carrying out relocations of their production in newly industrialized countries.
Technological and environmental innovations, eco-design, product labeling, green procurement, environmental certification, analysis of the environmental performance of products, traceability along the life cycle, must therefore be developed together with organizational, social, and cultural innovations, shared social responsibility of companies, protection of workers and their rights, in order to guarantee the competitiveness of companies on national and international markets. On the other hand it is necessary to reduce environmental impact and to promote social cohesion allowing access to quality goods and services for everyone and ensuring adequate levels of general "well-being", no longer based and measured on the quantity of goods owned and consumed.

[11] http://www.minambiente.it/pagina/lagenda-2030-lo-sviluppo-sostenibile
[12] http://www.minambiente.it/pagina/la-strategia-nazionale-lo-sviluppo-sostenibile
[13] It has been demonstrated that a lower consumption of raw materials per unit of production, efficiency, miniaturization, could be offset by an overall increase in produced and consumed goods (paradox of Jevons or "rebound effect")..

5.3. The Public Sector

5.3.1. Green Public Procurement and Minimum Environmental Criteria

The Green Public Procurement (GPP), thanks to the provisions of the Procurement Code (Law 50/2016 and subsequent amendments) on the mandatory application of Minimum Environmental Criteria (CAM)[14], became one of the main instruments of environmental and production policy in order to reduce environmental impact, rationalize and reduce public spending in the long term with a view to Life Cycle Costing (LCC) promoting innovative companies from an environmental point of view. In fact, through this precious lever on the demand side, it is possible to influence the market, stimulating Italian companies to take paths of qualification and environmental innovation, strengthening their competitiveness.
Thanks to GPP, enhancing the quality and performance of products, their energy efficiency, the safety in terms of limits to the presence of hazardous substances, the recycled content, the repairability, the durability of the products themselves, not only environmental impacts are reduced, but some economic indicators are improved: either by rationalizing public spending, or by stimulating new economic activities that deal with aspects and themes valued by the CAM (repair and recovery, use of recycled materials, substitutions of energy and materials coming from non-renewable sources with those coming from renewable sources, enhancement of the bio-economy...).
Therefore, it becomes strategic to ensure that Public Administration makes a full application of this instrument, also by launching training programs at all levels (contracting stations, companies, etc.).
The powerful market lever represented by public purchases can become one of the main tools for directing production towards circular economy models. In fact, for example, while the CAM on the "municipal waste management service" promote the quality of separate waste collection, other CAMs stimulate the demand for products made with materials derived from separate waste collection (eg street furniture or the management service of public green, or office furniture).
Furthermore, some CAMs provide services (for example "rental") instead of supplies, while others, such as the CAM document for the supply of toner and inkjet cartridges, requesting, in part, the purchase of "regenerated" cartridges, promote the reuse of exhausted cartridges and the reduction of cartridges to dispose of.
In general, it should be emphasized that CAMs have complementary and synergistic prescriptions. Their joint application allows the simultaneous implementation of the indications referred to in all Communications of the European Commission, in particular those concerning the circular economy and the efficient use of resources.

With the new procurement code, the issue of the cost of a product/service must be referred to the LCC, which includes not only the cost of using the

[14] http://www.minambiente.it/pagina/critieri-ambientali-minimi

product and its disposal, but also the costs of related environmental externalities. The issues related to the "circularity" must therefore be addressed also during the tender, highlighting the lower costs of products better responding to the objectives of the circular economy.
The application, in Public Administration tenders, of considerations and criteria of a social nature is important not only for ethical and social aspects, but also for economic and environmental ones. The application of these criteria, especially in some product sectors, allows to guarantee, at the same time, better working conditions in Italy and abroad and the control of the environmental quality of production systems, thus reducing unfair competition of goods produced thanks to poor checks on working conditions and pollutant emissions from production.
The social criteria must be an essential element in every tender to ensure that purchases, not only those of the Public Administration, have a form of guarantee of compliance with all labor standards and declarations on human rights.

5.4. Resources and Products

5.4.1. Traceability of Sources, Products, Services, Production Chains

Traceability means the possibility of identifying the phases of production and marketing of a commodity. Generally the traceability starts from the point of origin of the material, and then extends to the subsequent processes of transport and transformation of the final good.
The goal of traceability is to provide an identity to the goods to know their history and the subjects who participated in its transformation and realization.
The traceability of a good can be structured at different levels of in-depth analysis, involving the subjects that participate directly and / or indirectly in the realization of the good or the final service. Depending on the results and the final objectives to be achieved, traceability can extend to the entire life cycle of the product, also evaluating, in some cases, the product's phase of use.

It is appropriate to distinguish the traceability of the waste from the traceability of the material because where the first one ends there the second one starts.
In a context of circular economy, and above all of safeguarding the employed natural resources, the traceability of an asset (intended both as a material and as a manufactured product) or the traceability of a supply chain, can be an indispensable requisite to guarantee:
– compliance with the rules on management and treatment of resources (eg materials, by-products, waste),
– the fight against fraud and unfair competition (compliance with environmental and social requirements),
– the quality of the produced goods,

– the content of the type of material present (eg if from a renewable source, recycled, permanently recycled, biodegradable or compostable),
– the territorial origin of the materials and the localization of the transformation processes.
In a wider scope of its function, traceability can also be a tool to verify the frequency of use of a product. This aspect can be essential to measure the circularity of a product in use in order to offer it to the market through a shared service or with another form of use. Traceability makes it possible to verify, compared to a defined time, how many times the good has been used and to compare the result with the same product with a non-shared function or other form of use.

In the case of waste, the traceability of a product and its production chain must be instrumental to guarantee to the market and the legislator a simplification of the rules related to management procedures, while ensuring compliance with all environmental and social requirements. This approach would make it possible to make the obtained materials more competitive in terms of quality and in some respects to reduce management costs.
Furthermore, the traceability of the production chain is a useful tool to reduce the dispersion of resources in the environment (waste) at the same time providing a more precise national framework of the possible improvement actions to be made to products.
In this sense, the creation of a "Register of Traced Chains" or RFT, would allow a constant monitoring of the management methods of the resources used for the different product sectors:
– it would support the realization of an accurate map of material flows,
– it would allow a complete measurement of products circularity,
– it would favor industrial symbiosis.
The RFT could also be a reference tool for the legislator in order to promote incentive actions aiming at the whole production chain.
In Italy, some companies in the collection-recovery-recycling system are already active with traceability measures qualifying the materials and providing greater guarantees to the market and to the consumers.

5.4.2. Efficiency in the Use of Resources

Efficiency in the use of resources means choosing the materials that can most appropriately balance the product function with the circularity of resources and the impact on the environment. The goal is to develop production processes while meeting environmental and economic efficiency.
The management and monitoring of a development activity for a product or for a service must be carried out through an overall assessment of the resource flows used. The "fundamentals" of the circular economy imply that the resources used for an activity must be made available again to be reused. To achieve this goal it is necessary to develop an appropriate monitoring that, along with the economic quantification, is able to assess the quality, quantity, and types of resources used throughout the production chain and for the life

cycle of the product or service. The assessment must take in account the phases of purchase, production, packaging, and transport, as well as the method of use and reuse, maintenance, durability, and frequency of use. The recovery and recycling phase must be efficient, in order to avoid the dispersion of resources or the depreciation and degradation of the materials used with respect to their original value and characteristics.
During the design phase it is extremely necessary to apply eco-design strategies to evaluate the life cycle of the resources used and to identify the most environmentally and economically efficient solutions.

The choice of the best solution (or solutions) to pursue can be identified only through the evaluation of market scenarios and monitoring the system to identify possible implications and criticalities.
The economic component, together with the environmental component, makes it possible to obtain an overall picture in terms of "circular efficiency" and therefore to evaluate concretely, for example, if the choice to use certain resources can guarantee economic sustainability with respect to durability, reparability, and recyclability of a product. Two main indicators must characterize the possibility of making strategic choices based on reliable market scenarios: economic indicator and physical indicator (relative to the resources used). Resorting for long periods of time to forms of compulsory contributions for the management of resources does not allow the system to generate innovative models of "economic circularity", since the lack of a free market and direct responsibility for the choices made does not push sufficiently companies to find alternative solutions.

The industrial evolution from the post-war time to today has brought us to the current situation, characterized by a consumption of resources greater than those at our disposal. It is necessary to go beyond fake circular models to pursue improvement actions and the creation of new materials: this must be done by assessing in advance the possible consequences.
To achieve this goal, it is necessary to activate a national action with the direct involvement of regions and companies in order to create "Resource Flow Maps" measuring the input and output of different flows of resources (waste and materials), subdividing them by quantity, origin from renewable/non-renewable source, recycling, and permanent recycling.

Even the efficient use of water resources is an element of significant importance in a circular economy context. It is necessary to pursue actions, especially in the context of production processes, aiming at optimizing water consumption and reducing discharges in water bodies, in particular through the reuse of treated wastewater, in conditions that are safe and cost-effective. We need to pursue as well actions aiming to increase available water supplies through unconventional resources alleviating the pressure on over-exploited natural resources. Furthermore, even the recovery of energy and substances through an efficient increase of wastewater treatment allows to exploit resources that could be otherwise dispersed or could have negative environmental impact. To facilitate this process, it is advisable to prepare a regulatory framework facilitating

and supporting companies to apply different recovery and reuse strategies, as well as to introduce economic incentives encouraging the implementation of appropriate treatments for the use and reuse of water in the logic of circular economy, while guaranteeing adequate and consistent levels according to the current regulations on the protection of human health and the environment.

5.5. Indicators

5.5.1. Measuring the Circular Economy

Every economic activity is measurable in order to assess precisely the results obtained through a budget (its efficiency or inefficiency). Therefore all circular "economy" actions must necessarily be measurable.
It is necessary to define precise measurability references for the circular economy, otherwise it would be very difficult (if not impossible) to obtain evidences in terms of results from the actions pursued or to be pursued and consequently difficult to evaluate the benefits in terms of economy and protection of resources.
"Economy" determines the functioning of market and therefore it is essential referring the same rules to "circular economy". Whether it is a country, a region, a city, a product or a service, a material, water or energy resource, economy is able to quantify its value through the use of international units of measurement.
Measuring circularity is essential to give concrete and univocal references to the actions pursued or to be pursued: it is essential to obtain a feedback clearly demonstrating the results achieved in the management of resources in terms of economic and environmental sustainability.
It is necessary to identify a set of parameters allowing us to quantify the "circularity" of products, services, organizations, based on the benefits they generate both in terms of reducing the use of non-renewable resources, and in terms of use of renewable resources.

This approach is relatively simple when we consider the quantity of materials used or the energy consumption, while it is more complex when we have to assess the circularity of requirements such as the extension of the useful life of a product or the sharing activities.
There are examples of more or less articulated methods for measuring circularity at national and international level[15] and the common element common of all these methods is the drafting of an input-output budget.
There are mainly five key elements of the circular economy, which can be declined through some indicators (Chart 15).

[15] Enel, Alla scoperta dell'Economia circolare. Indicatori di performances – 2017 (https://www.enel.it/it/economia-circolare-futuro-sostenibile.html).

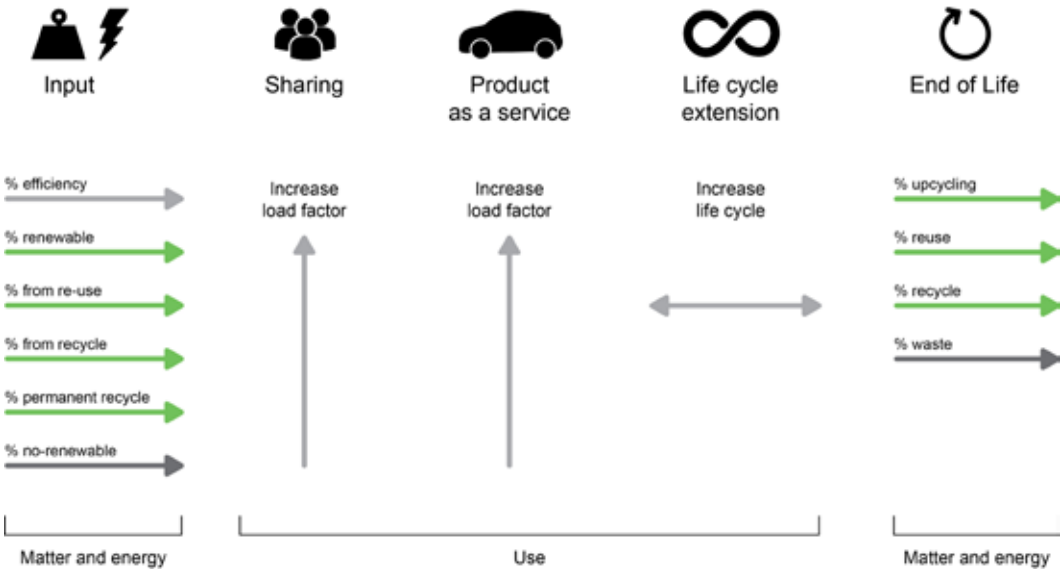


Chart 15 – The flows for measuring the circularity of a product and/or service

For an easy applicability, especially for small and medium enterprises, it is appropriate that the final result is identified with a single circularity index that in this way can be easily compared to the economic aspects. This index should take in account:
– the circularity of the flow of resources used, which in its turn must take into account all the components in terms of materials and energy compared to the budget,
– input (materials and energy if from renewable sources; recycled materials, permanent recycling16, reuse, etc.)
– output (materials intended for recycling, reuse or landfill).
– the circularity of the use of a product or product-service, in a context of extension of its useful life, number of users of the same product, sharing models. In addition to considering the flows of resources used (input - output), it is appropriate to evaluate functional aspects such as, energy efficiency, water consumption, and environmental impact.

In this way it is possible to obtain a circular balance related to a product, a service, an organization or territory clearly showing costs and benefits for the management of resources. The results are useful to achieve more transparency for the market and to avoid misleading information that does not clearly express what has really been done: the goal is rewarding the most virtuous actions unmasking those of mere "green washing".

The topic of "measuring circularity" must however be tackled mainly on two levels:

[16] "Resolution of the European Parliament 21 May 2012 on a resource-efficient Europe" overcomes the distinction between "renewable" and "non-renewable" resources, taking also into account "durable" or "permanent" materials. More specifically, point G of the resolution states: "... considering that a future global resource policy should no longer distinguish between "renewable" and "non-renewable" resources, but also to consider durable materials ..."

– **macro**: as an instrument applied to the country system,
– **micro**: as an instrument applied to the system of companies and other public and private activities.

With regard to macro indicators, the European Commission, in particular DG Environment, is developing a system that analyzes:

The Production and Consumption Phase
– resource productivity/domestic material consumption/consumption of raw materials,
– GPP share (focus on CAM for circularity) compared to public tenders,
– waste production (per capita and per unit of GDP),
– food waste.

The Waste Management Phase
– recycling rate for municipal waste,
– recycling rate for specific waste flows.

The Secondary Raw Materials
– contribution of recycled materials to the demand for raw materials,
– share of trade in secondary raw materials.

Competitiveness, Innovation, Economy
– private investment, employment, and added value in the recycling, repair, and reuse sectors,
– number of patents and circulation of recycled products and SRM on the market.

The results of this initiative are likely to be made public within the first few months of 2018.

The measurement of circularity at the "micro" level must be a useful tool for companies, Public Administration and other private subjects in order to assess, through a budget, the quantities of natural resources used in relation to the aspects of economic and environmental sustainability. In this way companies have the possibility, even independently, to draw up their own circularity balance and possibly involve their suppliers and customers throughout the supply chain.

It is essential that the two levels, macro and micro, find a convergence point on the metrics adopted in order to promote a mutual exchange of results also in terms of comparison and possible improvements to be achieved for product chains..

5.5.2. Measuring the Circularity of a Product

Measuring the circularity of a product or service must be the goal of all companies in order to understand the quality and quantity of natural resources used, as well as the ways in which they are used.

In order to measure the circularity of a product or service, and therefore to evaluate the efficient use of resources, it is necessary to consider mainly three aspects:
– the amount of resources used and put back into the system,
– the environmental impact of the resources used and put back into the system,
– the economic value of the resources used and the value at the time they are reintroduced into the system.
The three aspects are closely related to each other and the exclusion of one of these in the measurement may preclude the evaluation of the final result.

In order to evaluate the types of resources used and the ways in which they are reintroduced into the system it is essential to divide them into:
– renewable and non-renewable resources,
– recycled, recycled, permanent, and recyclable resources,
– biodegradable and compostable resources.

To evaluate their environmental impact, various international reference tools such as the Life Cycle Assessment or the Carbon Footprint are available.

To quantify the economic value of the resources it is possible to carry out a Life Cycle Costing (considering therefore also the environmental externalities), or to follow an approach considering the costs/revenues of the resource market.
Overall, it is a matter of creating an "input-output" budget considering the entire life cycle of the product. The approach can be gradual both considering the types of resources inventoried (materials, energy, water), and the degree of depth (involvement or non-involvement of suppliers or other subjects in the supply chain).
The inventory phase must be very accurate in order to avoid approximations that can create high margins of error in the calculation methodology. The inventory data useful for the production phase are already held by the companies as they represent the specifications of each individual product. In addition to the production data we need to take into consideration those related to packaging, the use phase (maintenance and replacement of components), and finally those related to disposal and recycling (by competence in possession of public companies, consortia or national bodies).
Durability, repairability, frequency of use or reuse, and sharing of the product, are requirements that must necessarily be considered in the assessment of circularity, as they allow to obtain indications on the effectiveness of the product use.
The requirements and methods of application must be different in terms of product sectors in order to identify the best sector strategy to be pursued: for example, the repairability requirements applied to an electrical and electronic product can not be the same applied to clothing or food. On this aspect, the involvement of companies will be important in order to identify the most appropriate reference indicators by sector, also in relation to their applicability to micro and small businesses.

There could be difficulties in comparing physical indicators (such as used materials and produced waste), with indicators of use (eg load factor) and in the context of physical indicators it could be difficult having to include both material and energy resources.
A solution to this problem is adopting KPI (Key Performance Indicators), which allow to relate all the five key elements of the circular economy and therefore both physical and use factors achieving a single univocal result.
For each phase of the product life cycle, alongside the data of the resources used and the methods of use, we must take in account the economic data allowing to evaluate the process economy. In this way it is possible for companies to define market scenarios by intervening, for example, on the choice of materials or on how the goods are sold, as a product or as a service.

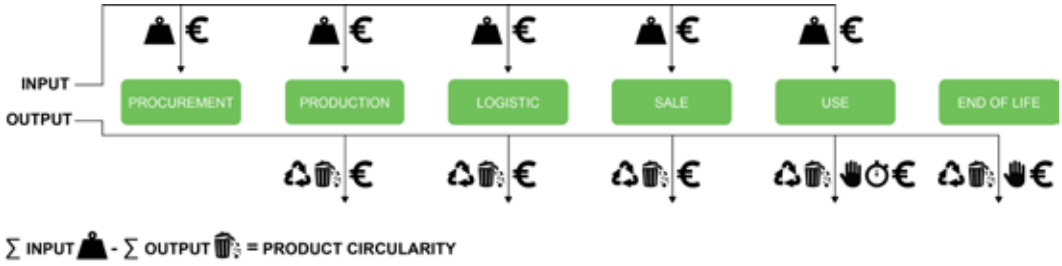


Chart 16 – Flow scheme for measuring the circularity of a product and/or service

The choice of the best solution (or solutions) to pursue can be identified only defining market scenarios where, through environmental and economic assessments and resource use flows, it is possible to identify possible implications and criticalities of the system, obtaining in this way useful indications for the changes to be made. The economic component, together with the physical one, helps us to obtain an overall picture in terms of circularity and therefore to evaluate concretely, for example, if the choice to use certain resources guarantees greater durability, reparability, and recyclability to the product.

The measurement of circularity is an essential requisite to give substance to the actions to be pursued in the field of circular economy, towards greater transparency for the market and for the consumers. From this it follows that:
– **actions of taxation and public incentives** can refer to the results obtained with this measurement. If for the legislator taxation and incentives must be instruments of "reward", then this must be a flywheel that on hand recognizes the achievement of a result and on the other push towards a sustainable market demand. To do all this, it is essential that the legislator establishes precise and recognizable criteria on the method of assigning merit and therefore, measuring the circularity of a product or service can be the solution to be pursued. In this way it is easier for the legislator to have

an overview of the system and to set priorities on which to act also through forms of incentives aimed at the consumer during the purchase phase.
– active involvement of **consumers**, as key players in the entire economy of the country, in pursuing responsible and sustainable actions during the purchase of a product. To do this it is necessary to enable the same consumers to understand and evaluate the "circularity" of a product. Communication must be simple, recognizable, and transversal for different product categories, in order to allow the consumers to understand and compare information.

5.5.3. Indicators of Circularity for the Italian System

In order to deepen the topic of the "indicators", the Ministry for the Environment and for the Protection of the Territory and the Sea set up a "Technical Table", aimed at identifying suitable indicators to measure and monitor the circularity of the economy and the efficient use of resources at macro, meso and micro level.

In this regard, the following activities are underway in collaboration with the competent offices of the Ministry of Economic Development and with the technical-scientific support of ENEA:
- Identification of indicators already defined and monitored (eg recycling percentages for different types of waste in A7, or domestic autonomy of materials in A1);
- Identification of available data sets (at EUROSTAT, ISTAT, regional, associative or other levels) for defining new indicators for the circular economy (eg eco-innovation indicators at various levels);
- Identification of missing data sets (eg resource accounting at company, territorial, and national level in A1, A7, B1, B7, C1, C7) and related indicators. When it is possible, reference will be made to already established indicators and models (eg LCA and LCT in general, existing certification models, standards, MIPS, MFA, etc.), as well as to the results of experimentation on the topic of measurement launched in 2016 by the Presidency of the Council in collaboration with some pilot companies. The Technical Table will use the public bodies competent in the subject and will have variable geometry, involving other subjects in relation to the topics dealt with.

Box 10

Review of the main databases showing "macro" indicators of the Circular Economy

The United Nations Inter-Agency and Expert Group (UN-IAEG) has the task of proposing the most suitable indicators to monitor the achievement of the 169 targets included in the 2030 Agenda. With reference to the circular economy, the 8.4 and 12.2 targets are those most immediately attributable to the upstream phase, while 12.5 and 11.6 concern waste management respectively from the management point of view and from the environmental and health point of view. Many other targets, however, have close ties to the circular economy and can be interesting.

The OECD manages a system of Green Growth Indicators. The system articulates into 5 areas (Environment and Productivity of Resources, Natural Components, Environmental Dimension and Quality of Life, Economic Opportunities and Political Instruments, Socio-Economic Context) and 75 indicators for Member States and about 70 non-Member States. The first two areas are of particular, but not exclusive, interest in the Circular Economy. They are in turn divided into 4 sub-groups (CO2 productivity, energy productivity, material productivity and production and management of waste, multi-factor productivity; in general all measures regarding the use of resources necessary to produce a unit of GDP) and 3 sub-groups (consumption of water resources, land resources, and impact on biodiversity).

EUROSTAT develops a dashboard of resource efficiency indicators (Resource Efficiency Scoreboard) consisting of 1 main topic (productivity of resources), 4 general topics on the pressure of resources (materials, land, water, carbon/energy) and 3 sectoral topic (transformation of the economy, including waste management, nature, and ecosystem; key areas such as food, construction, and sustainable mobility), 13 sub-themes, and 32 indicators also developed by other institutions including the European Environment Agency..

https://unstats.un.org/sdgs/iaeg-sdgs/
http://www.oecd.org/greengrowth/green-growth-indicators/
http://ec.europa.eu/eurostat/web/europe-2020-indicators/resource-efficient-europe

Notes

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