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Formazione e mindset imprenditoriale per l'internazionalizzazione delle imprese della green economy

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Entrepreneurial mindset, social competences and internationalization of green economy firms.
How to boost the circular economy model

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ABSTRACT OF THE THESIS

This PhD thesis investigates the concept of circular economy in European framework and how this new approach could be accepted, adopted and adapted among citizens and SMEs.

The concept is considered as a suitable alternative to linear model of economic growth, and above all, as a way of connecting economic and environmental gains.

Circular economy means maintaining the value of products and materials for as long as possible, minimizing waste and pollution and using resources in a smarter and sustainable way, as European Commission stated in its presentation of the 2015 Circular Economy package.

This dissertation is structured in four chapters. The chapters are presented in an autonomous though interrelated way, following different approaches but all with a common ground: they aim is to define the relationship between circular economy and business development in terms of the social factors - law, economics, educations, politics, etc. - that influence firms' behavior.

The study begins with the analyzes of the drivers of the circular economy (i.e. population trends; loss of biodiversity, pollution and environmental degradation; consumers' preferences and other cultural aspects) taking into account quantitative and qualitative aspects to measure their impact on growth. European and Italian set of measures aimed at introducing provisions on CE are also taken into consideration, as well as the role of public contracts and other market-harnessing controls. The study extends the analyzes to the regional level and focuses on opportunities generated by local specialities. The intention is to explore the concept in a multi-perspective approach - considering principles, actors and tools – and to analyze the changing role of local institutions in order to improve public awareness and participation.

The second paper is a systematic literature review of circular economy as a strategy of sustainable development and to what extent it covers the three areas of sustainability - economic, environmental and social - with particular reference to water management. In doing so, this chapter analyzes the relationship between CE and the 2030 Agenda for Sustainable Development, specifically its Goal number 6: *Ensure availability and sustainable management of water and sanitation for all*.

Consequently, challenges related to wastewater have emerged posing specific issues primarily concerning quantitative aspects and quality requirements, mostly due to the increasing demand for freshwater, against the backdrop of limited resources stressed by over-abstraction, pollution and climate change.

Since water is the largest untapped resource, the third chapter focuses on EU *Regulation on minimum requirements for water reuse in irrigation COM(2018) 337*, the latest proposal introduced within the framework of Circular Economy. The study, conducted within the EU Marie S. Curie project on

AcceLerate Innovation in urban wastewater management for Climate changE (ALICE)[1], pointed out the case of Italy that, as other regions in Southern Europe, has to face some challenges related to water scarcity and quality. On the other hand, there are best-practices as well: early adopters facilitated by more favorable regional parameters (e.g. the Mancasale WWTP in Emilia Romagna and Capitanata district in Puglia).

Considering that it is in the economic interest of SMEs to optimize the use of their resources, as well as explore new business opportunities, the last chapter analyzes the role of education and managerial skills for human resources in the adoption of Circular Economy. The purpose is twofold: analyzing main business models of reference and stressing the necessary qualifications or skills for operating under those conditions. By conducting a map of European-funded projects, the chapter shows relevant findings related to business needs concerning value creation in Adriatic-Ionian Macro-Region, an area where water is the main connecting element both of resources, goods, and even knowledge and competences. Main findings show that education plays a crucial role to raise the right skills at all levels and other measures to support value creation for jobs in the new framework of circular economy.

[1] The EU funded project is ALICE – AcceLerate Innovation in urban wastewater management for Climate changE - H2020-MSCA-RISE-2016/ under REA grant agreement n° 734560. The project is coordinated by University of Ulster, United Kingdom.

INTRODUCTION

The four chapters that form this thesis are presented in an autonomous, though interrelated way. Various motivations are at the basis of this dissertation and it is useful to mention them in this introduction, in order to clarify the sense and key objectives.

Firstly, the work focuses on circular economy because this approach offers a viable alternative development strategy to bridge the gap between desired economic development and environmental concerns (EC, 2018), enabling green SMEs to improve their competitiveness in particular in terms of international trade relations. Alongside the great importance given by worldwide institutions, a growing body of literature has emerged during the last years on various theoretical, methodological and empirical aspects of circular economy and its implementation. This interested several lines of research, covering not only technological and economic aspects, but also legal and sociological ones. An overall review of literature on the circular economy are examined on the first two chapters, respectively relate to legal and international business issues.

Secondly, the emphasis has mainly been on water. This is for two reasons. First of all, it is the most important shared resource across the entire supply chain and the largest "untapped resource" (UN, 2017), hereby a pillar of the Circular Economy (EC, 2014). The bond between circular economy and water is strengthened by an intersection of initiatives, including local dimensions. In this respect, water also play a pivotal role in some project I have been involved during my work, namely the EU Marie Curie project on AcceLerate Innovation in urban wastewater management for Climate changE (ALICE)[2] and Smart Farming: Innovare con i Droni l'Ambiente (SFIDA)[3].

Some of the results that address water resources problems are shown in the third chapter, which specifically analyzes the new EU *Regulation on minimum requirements for water reuse in irrigation* COM(2018) 337. The aim is to investigate whether and to what extent European measures, as well as technologies solutions, could overcome the psychological barrier of water reuse. Could EU regulation of quality requirements lead to optimizing reuse potential and effectiveness? In this scenario, are institutions, decision-makers and citizens differently affected? What are the measures which promote the water reuse access among institutions, companies and citizens?

[2] The EU funded project is ALICE – AcceLerate Innovation in urban wastewater management for Climate changE - H2020-MSCA-RISE-2016/ under REA grant agreement n° 734560. The project is coordinated by University of Ulster, United Kingdom.

[3] More specifically, SFIDA - Smart Farming: Innovare con i Droni l'Ambiente is a project within the measures 16.1 of RDP of Marche Region, which supports EIP operational groups to ensure agricultural productivity and sustainability. Project reference: n° 29073 - 0601185|31/05/2018|R_MARCHE|GRM|AEA|A|300.20.110/2016/AEA/15.

Furthermore, water is also an essential element of the link between nations: the place of circulation both of resources and goods, and also knowledge and competences. As analyzed in the last chapter, an example is given by the Adriatic-Ionian Macro-Region, where circular economy is one of the priorities pointed out by Member States and regions in their Smart Specialisation Strategies.

As well as, the 2015 circular economy package highlights the key role of research and innovation and of a growing number of funding opportunities available under the European Cohesion Policy, including support for reuse and repair, improved production processes, product design and SMEs. Beyond the funded projects, several initiatives have complemented the circular economy (e.g. the Circular Economy Finance Support Platform; Open Innovation and innovative business models included in many topics; networking of projects and stakeholders; and even international cooperation in specific areas, as in industrial biotechnology with China and in agriculture with Africa).

Current policy development (e.g. on waste or on design), are moving tentatively towards circular economy and not necessarily in a systematic or coordinated way (EEA, 2016). Thus, education plays an essential role to support this transition, which requires more information and collaboration in order to involve all stakeholders, from authorities to civil society and citizens (Cialdini, 2007).

Based on a mapping of European-funded projects in the Adriatic-Ionian Macro-Region, the fourth chapter identifies the underlying problems and challenges to CE in an entrepreneurial perspective. Results are consistent with the new training demands, with a strong focus on managerial skills, local education and research capacity. This area shows relevant findings related to business needs concerning value creation, where education plays a crucial role to support circular value creation.

This research opens several lines of further research, which will be illustrated and discussed in the Summary conclusions section.

References

Accenture (2014). *Circular advantage — Innovative business models and technologies to create value in a world without limits to growth*, Dublin

Andersen, M. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science, 2*(1), 133-140

ASFOR (2015). *Ricerca VIII - Trend evolutivi della Formazione Manageriale*

ASFOR (2015). *Ricerca X - Domanda di Formazione Manageriale*

Cialdini, R. (2007). *Influence: The psychology of persuasion*. New York: Harper Business

EC (2018). *Horizon 2020. Work Programme 2018 - 2020*

EEA (2016). *Circular economy in Europe. Developing the knowledge base*

Ellen MacArthur Foundation (2015). *Growth Within: a circular economy vision for a competitive Europe*

Gregson, N., Crang, M., Fuller, S., et Holmes, H. (2015). Interrogating the circular economy: The moral economy of resource recovery in the EU. *Economy and Society,* 1-26

Gubitta, P. (2015). *La formazione manageriale e imprenditoriale nelle PMI*, Franco Angeli

Stahel, W. R. (2016). Circular economy: A new relationship with our goods and materials would save resources and energy and create local jobs. *Nature, 531*(7595), 435

UN (2017). *World Water Development Report - Wastewater: The Untapped Resource*

Chapter I
DEVELOPING A CIRCULAR APPROACH IN ITALY

ABSTRACT

Building on recent studies on sociological drivers of the circular economy (CE), the purpose of this paper is to investigate the relevance of CE in European and Italian contexts by focusing on opportunities generated by local specialities. As first, the aim is to map attention for CE which has risen sharply in the last five years and how dynamic linkages have been gradually established over time at the national level. Competitiveness Decree, Environmental Annex and Green Public Procurement code represent the first step towards putting CE concept into daily practice. Moreover, only 7 (Emilia Romagna, Campania, Puglia, Friuli Venezia Giulia, Marche, Toscana, Piemonte) of 20 Italian regions are setting up CE principles within their jurisdiction. Secondly, on the basis of our results which show the relevance of CE as a way for EU to tackle climate change and source scarcity, this paper aims at analyzing the role of public contracts and other market-harnessing controls, as environmental levies.

This paper focuses on measures which are aimed at introducing provisions on CE. In doing so, they could be cross-cutting or highly specialized in a particular area. After analyzing entities and tools involved in the transition (i.e. command and control instruments, market-harnessing controls, self-regulation), it will also be discussed the changing role of local institutions in order to improve public awareness and participation.

This study is a holistic review of the rapidly growing literature on CE of recent years, aiming to cover the concept and assess its national and regional implementation. The European Commission states its full commitment to implementing CE Action Plan operating across several policy areas and meantime it requires efforts of many different actors. Thus, on the basis of the findings, this paper identifies issues and challenges related to CE from a local perspective.

Keywords: circular economy, environmental policy, national development strategy.

1. INTRODUCTION

In Europe, the past decades have seen widespread use of the concept of the circular economy (CE) - among both institutions, decision-makers and customers - as a viable, practical alternative to the predominantly linear economic model.

The linear approach of economic growth to 'take - make – dispose', had prevailed from the 1850s until 2000. During the Industrial Revolution (IR), it was easier to obtain primary resources and cheaper to dispose of them at the end of their use. At the same time, the greatest economic gains of this period came from using resources on a massive scale to reduce labor costs, generating unprecedented prosperity, wealth, competitiveness and renewal over the last century. Therefore, the resources were extracted on a one-way track with no plans for reuse or active regeneration of their natural systems. In this way, the linear take-make-dispose resource model generates significant waste. Nowadays, the power of the linear model is reaching a limit because this high level of resource use is no more sustainable, especially for Europe, the world's largest net importer of fossil fuels and metal resources.

The linear model approach of growth is problematic not only for economical and ecological, but also for social and cultural changes. Creating conditions for prosperity and stability requires a new industrial model which is less dependent on primary energy and emphasizes the full use of resources. After analyzing the main drivers of the transition, this paper covers the "CE" topic in the Italian legislative framework, focusing on its overall response and implementation strategy: how could the Italian legal system carry out CE principles? And how does CE affect the relationship between public and private operators? And finally, how CE is being implemented and enforced in the different industries or regions, becoming pilot cases to follow from individual situations related to CE actions. In order to provide a comprehensive overview of the CE advancements, all impacts of legislation should be addressed to the extent possible.

2. THE MAIN DRIVERS OF CIRCULAR ECONOMY

2.1 Population trends and their implications in economics

In the last decades, the economic gains of the Industrial Revolution (IR) have changed because resource prices are rising[4] and becoming more volatile[5].

[4] Key commodity prices overall increased by 156% from 2002 to 2017. In February 2017, the FAO Food Price Index (FFPI) is as much as 17.2 % higher than its level in the corresponding month last year.

[5] Volatility in resource prices is also due to the future mining reserves' areas, where there is high political risk. This effect is visible in the increase of exploration and mining costs of new resources, despite recent improvements in unconventional fossil fuels.

Considering its high dependence on imported resources are around 60%, the EU is exposed to price volatility and geopolitical uncertainties that create competitive problems, especially for manufacturing firms, where materials and imported components account for 40–60% of the total cost base.

Resource price inflation and volatility have negative consequences not only for economic growth, but also for public finances, citizens' welfare and the environmental health, by increasing uncertainty, discouraging businesses from investing and increasing the cost of hedging against resource-related risks. At worst, these trends could fuel protectionism and political ferment.

Scholars (Dobbs et al., 2011; 2012) suggest that inflation and volatility are likely to continue in the future, because the drivers of these effects reside in the demographic development.

Firstly, population growth[6] is the main cause that led to talk about responsible management of natural resources and it is unlikely to stop growing this century[7].

In all likelihood, up to 3 billion people will be added to the global middle class by 2025, with almost 90% of the growth coming from the Asia-Pacific region (OECD, 2010). This represents the highest propensity to buy manufactured goods and the fastest rise in spending power ever, which continues the acceleration in demand for products and services that have taken place since 2000 (Kharas, 2010; Dobbs et al., 2012; Yueh, 2013).

Analyzing the current recycling levels of world population and the pressure on finite resources in a traditional approach of growth, Professor James Clark and other experts have calculated that some elements vital for industry - such as gold, silver, indium, iridium, tungsten and many others - may be depleted within five to fifty years (Hunt, 2013)[8].

Moreover, the deterioration in the environment contributes to increasing the vulnerability of resource supply systems. As consequences, the prices have increased not just for metals and mining products, but also for food categories such as maize, wheat and rice as well as beef.

[6] Even another population index, the density increase, has affected the development of CE, promoting the adoption of its practices (see the following paragraph).

[7] Data reveals that that world population has been increased from 6.5 billion people in 2005 to the current 7.2 billion people and the UN estimated that it will increase to 8.2 in 2025 (United Nations - Population Division, 2015). Other analyzes shows that world population can be expected to reach 9.6 billion in 2050 and 10.9 billion in 2100 (Gerland et al., 2014).

[8] This coming upsurge in consumer demand has been considered as a "potential time bomb" by the World Bank (Dobbs et al., 2012), particularly OECD estimates that consumers' resource footprint is a triple of that generated by the new middle classes (OECD, 2010). Considering the natural scarcity of resources (energy, food, materials, water), among scholars, has arisen the question if that rapid population growth would produce widespread poverty and famine, increasing economic, social, and geopolitical risk (EEA, 2014; Cavanna, 2014).

In the past, similar concerns on the limits to growth have appeared (Malthus, 1789; Meadows and Club of Rome, 1972) but, the perceived risks have proved unfounded, according to the market's self-regulation thesis, predominant in the 20th century. Nowadays, researchers (Lacy et al., 2016) underline as the debate has shifted from problems to solutions (Von Weizsäcker et al., 1998).

In this respect, the green economy has given the first good results. The current system to reduce, reuse, and recycle is simply a delaying strategy and it shows major costs and inefficiencies if placed within the 'take-make-dispose' model. In fact, at the end of the linear process, the resources' waste is around 60-80% and less than half has been recycled (Dobbs et al., 2012). Instead, CE system allows to achieve savings of 700 billion dollars/year in the consumer goods sector (Lucia et al., 2015). In this context, an EU legislative proposal requires that 70% of municipal waste is reused and recycled by 2030 (see Chapter III).

Certainly, the CE implementation requires some remarkable starting investments, that lead institutions and firms to a crossroads: to suffer the resource prices rising or create new circular patterns that allow treating organic and industrial waste as raw materials for use in other sectors (see Chapter IV).

2.2 Loss of biodiversity, pollution and environmental degradation

Using 2.5 times more natural resources and ecological services than their ecosystems can provide creates a situation of an ecological deficit, whose effect - loss of biodiversity, pollution and environmental degradation - have several remarkable consequences both ecologically and economically.

The most severe aspect of the environmental crisis is the loss of biodiversity, that has contributed to numerous collapses of civilizations in the past, affecting human well-being by interfering with valuable ecosystem services such as climate disruption, crop pollination and water purification (Ehrlich et al., 2013; Galli et al., 2015).

In the last several decades, corresponding to the rise of industrial society, modern extinction rates have increased sharply and are considerably higher than background rates. Although biologists cannot say precisely how many species have become extinct from IR to date[9], they agree that exceptionally high modern extinction rates suggest a mass extinction underway, the sixth of its kind in Earth's 4.5 billion years of history (Ceballos et al., 2015).

According to the Living Planet Index, species population abundance declined by 58% between 1970 and 2012 due to unsustainable agriculture, fisheries, mining and other human activities that contribute to habitat loss and degradation, overexploitation, climate change and pollution (WWF, 2016).

Reestablishing biodiversity is a priority to continue to perform essential services, such as breathable air and drinkable water. An effective and urgent action was also required by the Convention on

[9] This period coincides with the geological epoch called "Anthropocene" by Nobel Prize winner Paul Crutzen (2002), because human activities are exerting increasing impacts on the environment at all scales and have grown to become significant geological forces, for instance through land use changes, deforestation and fossil fuel burning. For these reasons, scholars agreed that current environmental challenges - habitat loss, introduction of alien species, overexploitation, unsustainable use of natural resources, and also pollution - are as the result of globalization and of the intensification of international trade.

Biological Diversity's (2010), whereby 196 signatory countries agreed to 20 ambitious biodiversity targets to be achieved by 2020. However, if current trends continue by then, vertebrate populations may have declined on average by 67 per cent over the last half-century (CBD, 2014).

Even if it is not possible to monetize all of the changes in ecosystem services, the demonstration of economic value is useful for decision-makers, in adopting decisions considering the full costs and benefits of a proposed use of an ecosystem.

The economic value of biodiversity includes several edges, for instance, halving deforestation rates by 2030 would reduce global greenhouse gas emissions worth USD 3.7 trillion; or coral reef provides resources for over 30 million people, as the primary means of food production, income and livelihood; green products and services represent a new market opportunity; insect pollination worldwide turnover amounts at USD 165 billion/year, of which USD 213 million is annually generated by bee keeping in Switzerland; moreover, 400,000 trees planted in Canberra (Australia) reduce energy costs for air conditioning and enhance urban life quality, regulating microclimate, reducing pollution (Sukhdev et al., 2010).

In the economic approach, capturing value can be an important aid in achieving more efficient use of natural resources, through mechanisms that incorporate the values of ecosystems into decision-making, e.g. incentives and price signals.

On the other hand, polluted water, air, and soil, make workers' life quality worse by making firms unwelcoming and unhealthy places. This kind of economic development that does not consider nature, loses value itself because, producing minimal lifespan items contributes to environmental degradation and to diseases widespread, from allergies to cancer (Musu, 2008).

2.3 Consumers' preferences and other cultural aspects

Other important circular economy drivers, which belong to consumers' preferences, can accelerate adoption and scale-up of circular economy principles from the side of products and services requests. The last economic trend is noted for its long recession and youth under or unemployment and so due to the drastic decrease in spending power, led families to shift their preferences.

Today's people prefer access to products and services on demand rather than ownership of lower quality products. Although habits are hard to change, new collaborative use models of consumption seem emergent. Its gains concern on the widespread interaction between users, retailers and manufacturers, that positively affects the economy, reducing the cost of components and increasing asset productivity, availability and quality. Among the social changes, that are part of this new lifestyle, we count the sharing economy, the internet of things and consequently, the smart cities (Berra et Nuciari, 2013; Testoni, 2013; Ferrero, 2015).

For instance, since 2012 Seoul's Metropolitan Government has adopted the "Sharing City Seoul" initiative, an alternative for social reform, to provide more services to citizens with a smaller budget, due to 20 sharing programs and policies for generating or diffusing sharing city infrastructure.

A leading European case could be Barcelona, that in 2012 has been starting to implement IoT technologies across whole urban systems, from public transport to parking, from lighting to waste and water management. Analyzing the latter, thanks to sensors to monitor rain and humidity control, operators can determine how much irrigation is needed in each park. In this way, the city has cut water usage by about one-quarter, saving approximately USD 555.000 per year. In 2054, at the end of the project, this system would save 600,000 liters of water each year, as estimated by the City Council.

Data records show over 12.5 billion devices connected around the world in 2010 and the amount is expected to multiply, to 25–50 billion by 2020 (Evans, 2011).

In this scenario, greater opportunities to accelerate the CE transition are strictly related to two other social aspects: the higher population density in urban areas and what is known as the Fourth Industrial Revolution. In fact, according to the World Urbanization Prospects (2014), over half of the world's population has been residing in urban areas since 2000. Besides, Industry 4.0 has been reaching progress that allows better tracking of materials, e.g. RFID technology; to end world dependence on fossil fuels, e.g. electric cars, and to minimize pollution and wastage of resources, e.g. 3D printing. Both these factors, not only optimize waste collection and reduce the cost of components and logistics, but also promote trust-based collaboration, knowledge and best practices sharing, due to online learning and instant communication, all in order to obtain more gains with fewer resources[10].

3. EUROPEAN AND NATIONAL BACKGROUND

For the reasons previously quoted, several initiatives have been recently adopted among different levels of institutions in order to achieve a circular model of growth: from EU directives to the internal legislation of the countries, from regional planning to the firm associations.

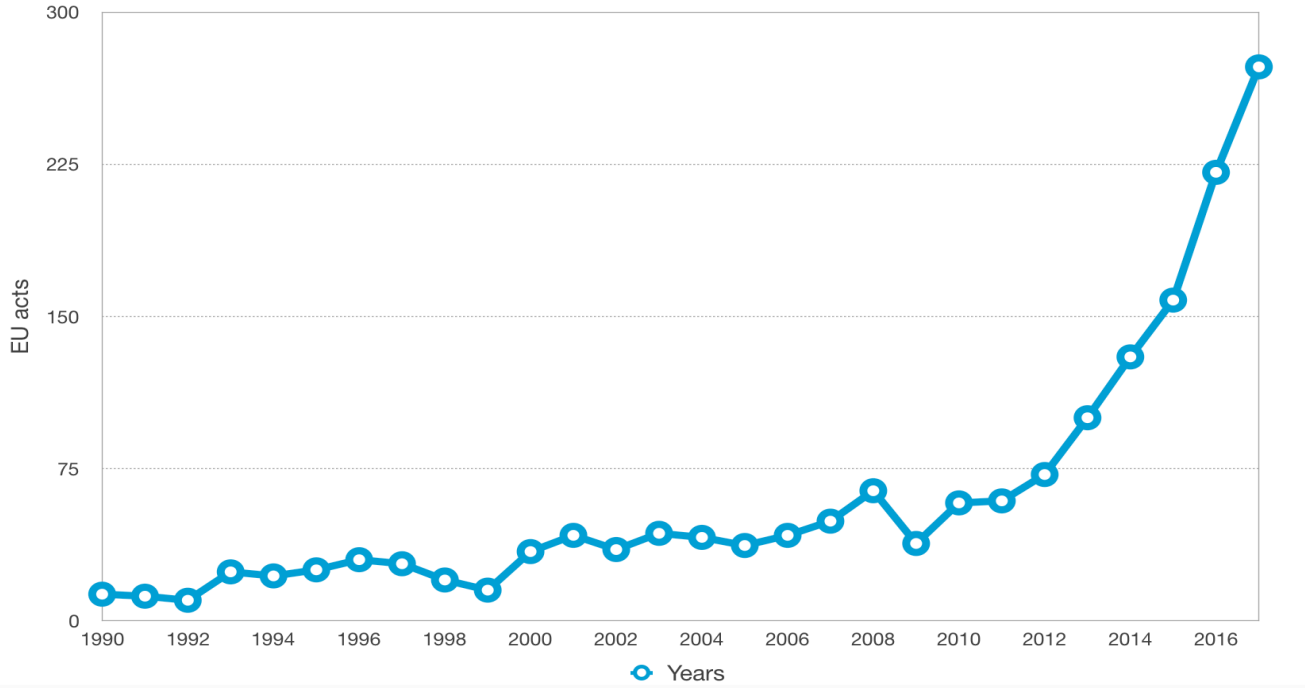
The graph below shows how European attention to CE has risen sharply in the last five years[11]. Figure 1 addresses the interest in CE of both EU institutions and Member States, considering overall documents: international agreements, preparatory acts, consolidated acts, case law, parliamentary

[10] The utopic consequences were illustrated by Ida Auken, Danish Ministry for the Environment, in her last essay, *"Welcome to 2030: I Own Nothing, Have No Privacy and Life Has Never Been Better"* (WEF, 2016).

[11] http://eur-lex.europa.eu/search.html?qid=1516791766497&text=circular%20economy&scope=EURLEX&type=quick&lang=en (accessed January 2018).

questions and others. Notwithstanding a part of these is at the draft stage, their amount indicates how significant the matter in question is.

Figure 1. Interest of European Union in CE from 1990 to 2017



3.1 EU action plan for CE

In the face of growing European integration in the area of environmental protection, the policy of Energy Union has to ensure the safety and energy efficiency, developing infrastructures and completing the internal market in energy (Gnes et Chiti, 2016).

EEA synthesizes as EU has provided *"global environmental leadership"* for over 40 years (EEA, 2015, p. 6), due to a broad range of directives, regulations and decisions which are known as the *environmental acquis*. Likewise, the level of protection has improved measurably in most European countries, reducing emissions of specific pollutants to the air, water and soil.

For the first time, in the Manifesto for a resource-efficient Europe 2012, the European Commission (EC) underlined that *"the EU has no choice but to go for the transition to a resource-efficient and ultimately regenerative circular economy"*.

The 7th Environment Action Programme (EU, 2013) regarded CE as instrumental to our prosperity and healthy environment, *"where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience"*.

A few years later, again in December, the Commission introduced its long-term action plan for the CE, adopting an *"ambitious"* and *"concrete"* set of actions, COM/2015/614.

It should be seen against the background of the EU's Environmental Strategy aimed at reducing waste and stimulating economic growth and employment. In fact, in the 2014 proposal itself, COM/2014/398, the Commission, withdrawing its legislative initiative on waste reduction targets, postponed it with a view to putting the whole matter into law by the end of 2015.

Thanks to the measures that are being delivered in the 2015 communication (COM/2015/614), *Closing the loop - An EU action plan for the Circular Economy,* the Commission want to cut resource use, reduce waste and boost recycling.

According to the COM/2015/614 introduction, Europe's transition towards a circular economy *is an essential contribution* to several aspects. Firstly, in terms of economy, CE *will boost the EU's competitiveness by protecting businesses against scarcity of resources and volatile prices*. Secondly, in terms of ecology, saving energy due to the CE, this *will help avoid the irreversible damages caused by using up resources at a rate that exceeds the Earth's capacity to renew them in terms of climate and biodiversity, air, soil and water pollution.* Lastly, in terms of equity, creating new business activities and generating new jobs, CE *will create local jobs at all skills levels and opportunities for social integration and cohesion.* In this way, European businesses, industries, and citizens, that *are key in driving this process,* would be able to benefit alike[12].

The CE Package acts on different levels, covering the whole economic cycle: from production and consumption to waste management and the market for secondary raw materials and water reuse[13].

In this scenario, the EU has a *fundamental role* to play in supporting local, regional and national authorities, driving investments and creating a level playing field. The Commission itself outlines the actions and other key legislative proposals that should be followed by 2020 (see Appendix n. 1).

3.2 CE in Italy: an overview

The interest of the CE and its promotion in Italy lies in the fact that it has moved beyond an "environmental" concept (Lombardi, 2016), following on from the 17 SDGs of 2030 Agenda and the Paris Climate Agreement, both adopted in 2015 (Eurostat, 2016). More recently, the same principles were enshrined in the "5-year Bologna roadmap", adopted during the G7 Environment Ministerial Meeting (Bologna, June 2017), which prioritizes resource efficiency actions with a view to achieving

[12] In 1976, well before the report by the Ellen MacArthur Foundation, the whole impact of a CE was first demonstrated in a paper to the Commission of the European Communities by Stahel and Reday-Mulvey.

[13] Even if, the 2014 EC intention was to present a new package which would cover the full economic cycle, the practical relevance goal has not been achieved in every aspect. In fact, the 2015 CE Package is mainly focused on the waste management, which is the second half of the cycle. Instead, very little has been said about the first part, consisting of eco-design. Moreover, regarding the waste management, European Environmental Bureau (2015) stresses a further lack of specific targets for re-use, just dealing food waste ones. There is no way to build a CE only by recycling without binding waste prevention targets that change our current production and consumption patterns, cutting down on the waste we generate (McDonough and Braungart, 2010; EEB, 2015; EEA, 2016).

the objectives of their Communiqué for the protection of the planet. As pointed out, "there is strong evidence that Resource Efficiency, 3Rs, Circular Economy and Sustainable Material Management can be a major driver to attain economic growth and employment, and can bring about environmental and social benefits together with long-term economic competitiveness and prosperity" (G7, 2017).
Sharing the same values, in addition, the Minister of the Environment Galletti and the Minister of Economic Development Calenda have promoted a National Strategy for Sustainable Development, whose draft was opened to comments and additions until last September. Italian government gives priority to integrated measures aimed at sustainability and innovation, as the so-called Industry 4.0 (EC, 2017). Indeed, notwithstanding Italy lacks raw materials, its many small and medium-sized enterprises have a great tradition of creativity and design, which are essential for the development of CE. The government-backed paper (Towards a Model of Circular Economy for Italy - Overview and Strategic Framework, 2017) deals with pre-existing measures (e.g. Industrial Symbiosis, Extended Producer Responsibility, Green Public Procurement and Minimum Environmental Criteria) and stresses the need for a substantial increase in financial incentives for businesses and consumers.
Even so, a gap can be observed in legislative terms. Overall, there is some slight progress on the CE promotion without achieving a comprehensive approach, but a distinction should be made between national and regional planning. Despite European integration in environmental protection, a standard form for CE does not set out under national legislation and significant disparities between Italian regions may be observed. Those differences can be a result of several factors, as political decisions and financial resources.
At present[14], the Italian legislator has referred to the CE notion on three occasions – in 2014, 2015 and 2016, respectively (see tab. 2. below) – which can be considered drivers to support the transition towards CE at the national level.

Table 2. Italian laws related to CE

Number and year	**Content**
Law No 116 of 11 August 2014, that converted the Law Decree No 91 of 24 June 2014	*Competitiveness Decree - Relevant measures in favor investments in Italy*
Law No 221 of 28 December 2015, called Financial-Stability Law 2016 in force since 4 February 2016	*Environmental Annex (Collegato Ambientale) – Measures for green economy and resource efficiency*
Law No 50 of 18 April 2016, last amended by Law No 205 of 27 December 2017,	*Green Public Procurement (GPP) code*

[14] Italian laws in force at February 2018.

so-called Financial-Stability Law 2018

In the Competitiveness Decree, CE and efficient use of resources are essential drivers for creating strong employment growth at a time of economic downturn. The Environmental Annex is likewise at the forefront in creating a strategic tool to establish the framework for all CE-related initiatives in Italy, as bioenergy and environmental footprint, GPP, sustainable production and consumption, circular waste management and the market for recycled products. In this respect, the new Article 206-ter of legislative decree No 152/2016 requires enforceable agreements and program contracts to promote the purchase of circular products, which are rebuilt from salvaged parts. Whereas new tools and instruments to enhance this follow-up have been set up as a matter of business policy, e.g. incentives to support their commercialization or their use in calls for tenders. Concerning in particular the field of GPP, the use of the "minimum environmental criteria" has become mandatory for some product, as lighting, electronic devices, cleaning products and construction materials. To identify the most economically advantageous tender, the GPP code requires that the contract award decision should be based on objective criteria, including qualitative, environmental and social aspects.

However, CE is not the key subject, in the absence of a comprehensive set of regulation for all stages of the cycle. Current shortcomings may be overcome through a broad interpretation, for instance scholars (Ciarniello, 2017; Pierobon, 2017; Spoto, 2017) consider the law encouraging the donation and distribution of food products and reducing waste (Law No 166 of 16 August 2016) as part of national CE strategy even if this concept is not mentioned. As well as this, Galletti notes that the 2017 Budget Law - so-called Financial-Stability Law 2017 - has been bolstered CE through Industry 4.0.

From a regional point of view, the framework is extremely varied. Although each region has demonstrated great sensitivity and a sense of urgency in adopting measures to conserve natural resources, only seven of them have hitherto issued legislative acts in order to bolster CE[15]. Chart 3 illustrates the disparities in the regional laws fostering CE, as explained below (tab. 4.).

[15] For a comprehensive analyzes on the soil protection at regional level, reference is made to Lombardi P. (2016).

Figure 3. Enactment of regional laws to bolster CE

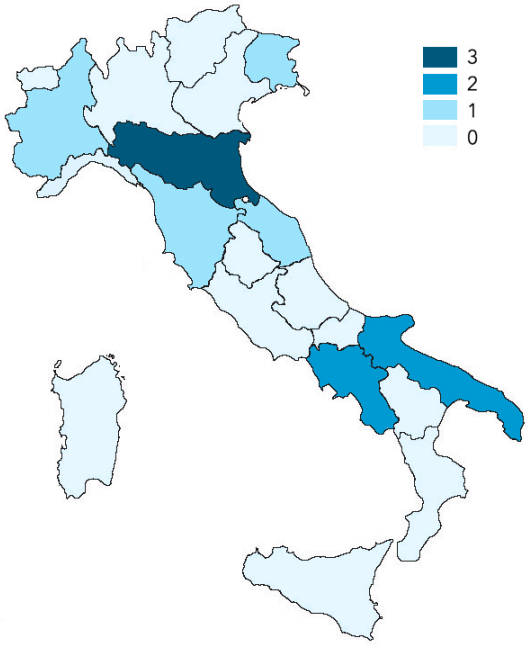


Table 4. Regional laws on CE

Region	Laws
Emilia Romagna	Regional Law No 16 of 05 October 2015 - *Measures for circular economy, reduction of municipal waste, reuse and recycling* Regional Law No 25 of 23 December 2016 – *Related to Regional Financial-Stability Law 2017* Regional Law No 16 of 18 July 2017 – *Additional support in earthquake-stricken areas*
Campania	Regional Law No 14 of 26 May 2016 – *Provisions for the implementation of European and national waste framework* Regional Law No 23 of 28 July 2017 – *Campania region as a glass house. Annual law for administrative simplification*
Puglia	Regional Law No 4 of 29 March 2017 - *Measures to manage ring rot caused by Xylella fastidiosa in the Puglia region territory* Regional Law No 13 of 18 May 2017 – *Recovery and reuse of food and pharmaceutical products*
Friuli Venezia Giulia	Regional Law No 34 of 20 October 2017 – *Guidelines for waste management and circular economy*
Marche	Regional Law No 32 of 13 November 2017 - *Measures for solidarity-based economy, end of waste and preventive actions against waste production*
Toscana	Regional Law No 71 of 12 December 2017 - *Regional business support services*
Piemonte	Regional Law No 1 of 10 January 2018 – *Waste management and integrated urban waste management*

Most of these regional laws take CE principles as a statement of intent or a starting point for the sustainable use of resources, goods and services. It is not for nothing that CE must be pursued as a priority by region in accordance with EU objectives. Circular and solidarity aims are also to be found

in several laws - as they each point out in their opening articles – and which are mainly related to other crucial issues. For instance, to the recovery of unused and unexpired drugs or other pharmaceutical products (Law No 32/2017 of the Region of Marche; Law No 13/2017 of the Region of Puglia); to the improvement of the agri-food chain (Law No 4/2017 of the Region of Puglia); or to the economic recovery thanks to innovation, digitalization and CE and even by engaging institution and civil society as a whole (Law No 71/2017 of the Region of Toscana). As well as this, Piemonte Region underlines the CE principles in its Waste Management Law and its political willingness is also reflected in participation in various joint initiatives and research projects (see Piemonte Region website). Moreover, the laws of Friuli Venezia Giulia, Emilia Romagna and Campania deserve particular mention since they aim at comprehensive approaches and further instruments.

Friuli Venezia Giulia Regional Law No 34 of 20 October 2017 provides not only pharma and food waste limits (Article 5) but also guidelines on the waste management and CE by introducing a new regional system, so that it will be able to carry out sustainable activities and be capable of producing substantial savings. The Region recognizes the need for a participatory process and grassroots opinion, which will set up two authorities - a Regional Forum and a Permanent Round Table for CE – and will promote a greater involvement of stakeholders and better cooperation between members, as consumers and their organizations, committees, professional and union associations, research institutes and schools at all levels. This acts through wide-ranging information and prevention campaigns related to sustainable waste management, targeting both young people, entrepreneurs and civil society organizations. In addition, all actions under the regional waste management plan referred to in Article 13[16] shall be subject to three-year evaluation reports.

As far as the laws of Emilia Romagna Region are concerned, they all refer to the overall aims and objectives of CE, in accordance with EU direction.

Both Regional Law No 25 of 23 December 2016 (Related to Regional Financial-Stability Law 2017) and Regional Law No 16 of 18 July 2017 (Additional support in earthquake-stricken areas) follow the prescriptions of Regional Law No 16 of 05 October 2015 (Measures for circular economy, reduction of municipal waste, reuse and recycling), which implements CE principles as a strategy for resources savings by specific means, such as financial instruments and new authorities, one of them is the CE-related Forum. It is composed by bodies at different levels of local government, representatives of civil society, economic and social partners, and other environmental associations.

[16] In this respect it is critically important that, at the end of 2017, the Italian Government lodged an appeal with the Constitutional Court against this regional law, objecting to the infringement of national legislative competence on the subject of waste management planning (Article 117, paragraph 2, point s of the Italian Constitution). This is especially the case with the aforementioned Article 13, which establish the procedure for regional planning in a manner inconsistent with the Legislative Decree No 152/2006, failing to fulfil the Strategic Environmental Assessment, this being a vital prerequisite provided for by European and national legislations.

A typical situation as concerns the experience of Campania Region. Over the last two decades it faced great difficulties in implementing the European legal framework on waste disposal and this has, in fact, repeatedly earned it the condemnation of the European Court of Justice (C-365/97; C-135/05; C-196/13), particularly as a national "emergency" (De Leonardis, 2011; Baroni, 2016; Losengo et Martone, 2016). It is only in recent years that Campania Region has been adopted CE principles, particularly since the Regional Law No 14 of 26 May 2016, so-called Provisions for the implementation of European and national waste framework. According to EU directives, this law should move the Region closer to a recycling society, seeking to avoid waste generation and to use waste as a resource (Article 2). And that is possible only if the Region sets up reward schemes (Article 3) and a policy of information and education related to socio-environmental sustainability (Article 4). The latest Campania Region act (No 23/2017) confirms and reinforces the principles previously championed in relation to CE, namely CE and bioeconomy are some of the administrative simplification measures (Article 6).

As pointed out, adopting adequate legislation to support the transition towards CE is mandatory, both at European, national and regional level. The following section will deal with various Italian approaches that can be found in the literature. Most of the scholars relate CE implementation to specific circumstances: from geographical standpoint, as the guidelines of the European legislation and jurisprudence with particular regard to the management of waste in the Campania Region (Baroni, 2016; Losengo et Martone, 2016); or from a sectorial perspective, specifically about agri-food (Lattanzi, 2014; Bianchi, 2015; Cerini et Lamarque, 2016; Stile, 2016; Bianchi, 2017; Damiano, 2017; Pierobon, 2017; Spoto, 2017) or fashion industry (Bianchi, 2016). Other scholars regard CE as a tool of European integration - namely of Energy Union (Gnes et Chiti, 2016) – and even of a faith-based legal order (Ruozzi, 2016).

4. EXPLORING CE: A MULTI-PERSPECTIVE APPROACH

Although the challenge of transition towards the CE has been essential for our pattern of consumption, it is only in recent years that CE has gained its valuable space in scientific publications and the political debates as a means of achieving sustainable and inclusive growth (Bovino, 2014; Cavanna, 2014; Federico, 2015; Stile, 2015; Porcellana, 2016; Meli, 2017).

Actually, it is clear that the ultimate aim of CE is human well being, including future generations, in accordance with Article 3, paragraph 2 of the Italian Constitution (Pennasilico, 2016: 1317). Hence, efforts are made in different directions for a shift from a linear economy to a CE (Stile, 2015). The EC commitment towards this direction has involved CE proposals and individual directives, as far as air, water and soil are concerned. Alongside this, popular initiatives have been promoted, e.g. the so-

called Zero Waste Law, which provides guidelines for a proper waste management in order to support ambitious measures in three key areas: a 70% recycling target; a 50% reduction target for marine litter; and a 50% reduction target for food waste across the whole production and consumption chain (so-called from farm to fork).

First and foremost, it should be clarified that measures aimed at introducing provisions on CE could be cross-cutting or highly specialized in a particular area. Among the latter, there have been sector-specific interventions on standards, technical regulation and conformity assessment procedures, e.g. the "building license departing from general planning instruments" referred to in Article 14 T.U.Ed. last amended by D.L. n. 133/2014, so-called "decreto Sblocca-Italia" (Lombardi, 2016); or the changes in the productive system and then in the working world due to CE and sharing economy (Tiraboschi, 2016). Clearly, it is desirable that all those actions shall be implemented in an integrated manner.

Even though a holistic approach to the CE issue has not yet been reached, most of the latest legislative measures are drifting in that direction and flowing into the national action plan (Towards a Model of Circular Economy for Italy - Overview and Strategic Framework, 2017), where regulatory amendment, economic instruments, communication and awareness-raising and promotion of research are strongly interlinked. Scholars, companies and institutions are aware that Europe's transition towards a CE *is an essential contribution* in term of economy, ecology and equity, as the COM/2015/614 introduction make clear (see 2.1). Indeed, the CE is considered as a framework, for instance D'Addezio (2017) talks about a "cornice interpretativa", which will form the basis for further legislative action since it is the major element in pursuing the European priority objective of sustainable development.

According to De Leonardis (2017), the EU willing to adopt a systematic approach is emphasized with the term "package", which collects the sets of guidelines related to CE in various respects: production, consumption, waste management, market for secondary raw materials, sectorial action, innovation and investments, monitoring. More than just changes in objectives, priorities, benchmarks and procedures, it requires a real cultural change and a greater involvement both of Public Administration and civil society (citizens, consumers and firms). Not only the *red economy* (characterized by a linear approach) but also the *green economy* (that considers the environment and its protection as negative externalities) seem to be largely exceeded by the *blue economy* (Pauli, 2015), so-called CE. However, in this latter the environment is the main driver of economic and institutional development through the capability of regenerating. Therefore, CE represents a model of economic growth involving three

different meanings: the environmental protection and waste management[17]; the economic issue related to at the end of waste and a more *efficient use of raw materials; and then, the most innovative one, which refers to bioeconomy, namely a model of economic development based on renewable raw materials, eco-design and symbiosis between agriculture and industry*. Such a model of socio-economic growth entails on the tasks of legislative power and of Public Administration the need for measures to move towards a new model of State, precisely the *Circular State*, which is environment-friendly and progress-oriented, with scientific research, eco-innovation and public involvement as its main tools.

4.1 The polluter-pays principle in the CE scenario

For a long time, we have known about the impact of private economic activity on environment (Caffè, 1958) which has resulted in the polluter-pays principle. Putting it under the CE scenario means that all stakeholders at every level are responsible for environment, from national governments to citizens, from associations to entrepreneurs, both private and public. Visible progress has been made and the trend is towards a "collaborative economy", mentioning Georgescu-Roegen ideas (Georgescu-Roegen, 2003; Meli, 2017, 76) as a more open attitude which will lead to people making better use of resources, products and services.

According to Uricchio, "environmental levies" or other forms of eco-taxes are designed to ensure compliance with the EU legislation on CE (COM/2015/614) by favoring process and product innovation in existing economic activities, thus setting up a "circular taxation system" which is also environmentally and socially responsible. And consequently, two aspects of Green taxation become apparent: I) the negative side, that is a penalty tax to compensate for the damage that the environment has suffered as a result of waste and pollution; II) the positive one, a sort of incentives and attractive measures to support action to modernize enterprises and to innovate products, process and services in terms of environmental sustainable development (Uricchio, 2017, 1861).

The polluter-pays principle is also the underlying logic of the "circular taxation system", where the taxable amount shall not be determined only by the economic value of production or consumption (as with common excise duties) but on the basis of the pollutant effect generated by the related activities (Uricchio, 2017, 1856). Accordingly, it is considered that should be applied a Pigovian tax in which the amount of tax levied might exactly coincide with the overall negative environmental

[17] According to Lombardi (2015), the concept of waste must be looked at from several angles, including the issue of civil liability and the "relational" perspective. Following on from the judgments of the Court of Cassation (No 1188/2012, concerning dump and waste; No 25207/2012, for the connection between waste and asset), the Author clearly analyzes the qualification of waste as an asset, with specific attention to its role inside the new environmental policy, that favors different solutions to the garbage disposal in a dump, like the salvage, reuse, recycling of materials, in harmony with the precautionary principle and the sustainable development. Then, it considers the techniques of waste sorting and it focus on tortuous civil liability that result from its not observance.

externalities (Andersen, 2007). Other scholars, however, argue that these eco-taxes should be based on forward-looking criteria, as the estimated quantity of pollution caused by economic process (Dorigo et Mastellone, 2013, 31).

Considering that environmental levies are twofold: firstly, they are used to provide tax revenue gains and, secondly, to stimulate market transformation towards more efficient production and eco-friendly process, as well as to trigger behavioral changes in consumption by enterprises and even citizens.

Form this point of view, the main outcomes of the "circular taxation system" are:

I) imposing taxes on production discards (i.e. the residue left behind) to foster Rs actions;
II) relaunching a kind of process that will improve utilization of resources while respecting the environment;
III) restricting unproductive and unsustainable public spending;
IV) ensuring economic, social and territorial balance due to contributions in line with the polluter's ability to pay.

According to Cecchetti (2006), flexible environmental levies are to be preferred to standard duties since they have the potential to trigger more effective actions and hence they would make it possible to realize tangible achievements in the social and economic fields at the same time.

As a result, tax expenditures as described above give the CE model its fulfilment (Uricchio, Aulenta et Selicato, 2015, 33 ss.; Cavanna, 2014) and furthermore a circular taxation system has to become a fully integrated part towards a *Circular State* (De Leonardis, 2017).

4.2 Main actors and instruments

The complexity of the problems facing the CE development requires a series of players, both public and private, acting together and that must therefore close the loop. Entities and tools are identified depending on the stage of the whole process (see Appendix n.1) to which reference is made in Annex to CE Action Plan.

As concerns the entities, the consequent effects on the legal world of the concept of CE involves legislative policies and administrative decisions. While most of the institutional documents of this area have no legal value but an informational one only (Gnes et Chiti, 2016), the legislative authorities are consequently called upon to collaborate at all levels: international, European, national and even regional.

There are a variety of methods and instruments that can be used to build a Circular State, such as:

I) Regulatory instruments of a command and control system. In the early of the 1960s, it became popular within the environmental policy (see Biondi, 2013; Nespor, 2016) by the adoption of a three-pronged approach. The legislator identifies values and standards by setting up restrictions or prohibitions (see Tab. 2 and Tab. 4); other administrative

authorities have a monitoring and supervisory role; and lastly, it will be imposed penalties for not respecting the predefined criteria. Mandatory targets for GPP can be mentioned as a cornerstone at EU and national level (Tukker et al., 2008; Testa et al., 2012).

II) Market-harnessing controls. This covers the wide range of economic instruments which seek to protect environment and human health through the principles of the market economy. For instance, these include green taxes, modulated taxation with reward-penalty schemes, financial incentives, Extended Producer Responsibility[18], regulated tariffs, deposit-refund system, insurance tools and other forms of public support.

III) Self-regulations. They belong to the corporate culture and could be classified in: certification and labeling rules, environmental management systems, environmental economic account modules, traceability and communication tools, voluntary agreements (see Frey, 2014). These instruments aim to standardize, oversee and verify the whole economic process, as well as enhance company image and consumer awareness.

A command and control system ensures *environmental effectiveness but not necessarily economic efficiency* (OECD, 2016). Indeed, it is a particularly distorting tool, because it provides no incentive to improve efficiency and delivers no benefit (support or reward) in terms of competitiveness of the most environment-friendly companies. Furthermore, market-harnessing controls guarantee economic efficiency, even at the cost of environmental effectiveness. Self-regulations often are not able to ensure high level of environmental protection, since their implementation and enforcement require active and responsible participation by various entities: private sector, civil society, local players, and even national authorities. It is precisely these authorities entrusted with governance which should be capable to deal directly with the production system and local actors in order to take into account their diversity, thereby leading to greater flexibility and efficiency, while maintaining certain minimum standards. It is evident that environmental policy is about business, involving competitiveness between countries and enterprises (Ferrara, 2009, 147). And that therefore, new policy tools should be accompanied by an impact assessment (Biondi, 2013; EEB, 2017), as has been happening in the latest EU environmental measures.

New public contracts are just one example highlighting the fact that the European institutions are pointing out the need to adopt a more sustainable economic model, the *blue* economy (Feliziani, 2017). Even though public contracts were initially designed to be a fundamental tool in the development of the single market, they have been increasingly instrumentalized in order to act as an

[18] An extension of the manufacturer responsibility to take charge of the end of life of his products, with the mandatory to achieve specific percentages of recovery and recycling of its materials.

effective means of protecting environment and public health, albeit indirectly. To this end, the legislative decree n. 50/2016 (GPP code) was adopted by the Italian legislator in order to comply with the new European directives on public procurements, namely 2014/23/EU, 2014/24/EU and 2014/25/EU. The main novelty of this regulation lies in the introduction of the award criterion as the "lowest cost" as a replacement for the "lowest price". The term "cost" in this context shall, to the extent relevant, take account of purchase price, as well as life-cycle costs, namely the costs relating the end of life of products (Articles 95 and 96 of GPP code) and imputed to environmental externalities, e.g. collection and recycling costs (Andersen, 2007; Gili, 2017). It is therefore glaringly obvious that this is a reference to CE within the public procurement law (Valaguzza, 2016).

In the new 2016 procurement code, as well as its 2017 Corrective, typical environmental protection concepts are first consistently introduced, e.g. "short supply chain", "life cycle assessment", "green economy" and "circular economy", as Villamena (2017) emphasized. Using a common technical language in the EU environment demonstrates how the Italian legislative authorities have engaged a wide range of expertise both in economics, political, biological, physical, and engineering sciences. Nevertheless, there are still a few critical issues, which should be considered by the Author, especially with regards to competitive public tender procedure. First and foremost, there is a great risk of discriminations between various economic operators due to non-objective assessment criteria and difficulties in managing ecological profiles. As long as the legal award criterion of the "lowest price" is to the detriment of good environment saving practice, which may involve the largest expenditure items.

As well as this, environmental interests are taken as an "internal limit" to the activities of private and public stakeholders. In particular, "ecological contract" (Pennasilico, 2016) is a leading instrument for the rescheduling of products and consumption models, with a view to boosting sustainability, inclusion and CE.

4.3 Public involvement and local institutions in a holistic view

Impact assessment studies and other informal documents are providing adequate knowledge and experience to the public in order to encourage confidence in CE practices. Their purpose is twofold and aims to summarize relevant information under the following issues:

I) Gather details and lay down the basis for the so-called "fit-for-purpose" approach: a flexible and incremental method to set up implementation mechanism, both at local and sectorial level;

II) Provide data and analyzes for making entrepreneurs and citizens more aware of the cost-benefit tradeoff from the transition towards a CE.

Furthermore, since the 1988 Aarhus Convention[19] and the following Access to Environmental Information Directive and INSPIRE Directive, the EU has clearly been creating a legal framework for sharing environmental information, including on how EU environmental law is being implemented.

In recent years, CE has been occasionally reinforced throughout local initiatives, albeit isolated and not integrated with each other. Reference is made to the regional forums and other permanent round tables for CE (e.g. in Emilia Romagna, Friuli Venezia Giulia, Basilicata and Abruzzo) and also to business associations (e.g. FISE UNICIRCULAR).

Embracing the cultural change, Valaguzza (2016) deals with "strategic regulation" as a *new way to look at the principles that govern the administrative action* where clashes demand – e.g. protection of competitive markets, respect of the environment, use of clean energy, social inclusion - could be brought into line with each other. As noticed above, public contract system is the main instrument for environmental policy (Villamena, 2015; Valaguzza, 2016; Feliziani, 2017), as well as to ensure more inclusive[20] and sustainable growth (De Leonardis, 2016; Vivani, 2016; Pierobon, 2017).

However, apart from these regulatory tools, it should not be forgotten that the same CE package shall associate all stakeholders - whether public or private, producers and consumers alike - at every stage of a value chain. Indeed, this holistic approach characterizes the CE concept distinguishing it from previous efforts to improve resource efficiency (Bonciu, 2014). It becomes clear that the holistic approach affects both entities and sectors. Firstly, the regulatory action needs to be prompt in order to seize the technological development and carry out investment related, while respecting the rules of competition and market principles. European, national and regional legislative work have to be even more closely coordinated through forums, specific meetings and reports. Secondly, standards and other requirements shall be consistent with infrastructures and plants available or provide for a new one. And lastly, "holistic" means interconnections of different technologies, sectors and disciplines, for instance in the design of products and services the whole life cycle shall be considered, not only from production to destruction but also how they could be replaced in their production cycle or of other industries. From this point of view, De Leonardis (2017) suggests to move *from sectors to systems* and has entrusted local institutions with the power of establishing a network between all entities involved and supervising CE activities carried out in their territory by preventing fragmented interventions.

[19] Reference is made to the Convention on Access to Information, Public Participation in Decision- making and Access to Justice in Environmental Matters, where citizens can more effectively protect the environment through mandatory public participation in the administrative decision-making process.

[20] For more on the definition of CE as a "moral economy" see Gregson et al. (2015).

5. CONCLUSION

The present study shows how CE is increasingly becoming a factor of sustainability for Europe's long-term growth. However, scholars have worked on CE concept under different perspectives by considering a variety of features and initiatives: cross-cutting or highly specialized in a particular area. Even though a holistic approach is essential and desirable in terms of the effectiveness, it might tend to be a restraining force. The reasons may lie in the need for policy makers to keep abreast of economic changes and new variables by taking measures to ensure proper and full execution of CE principles in compliance with the implementation of global commitments taken by the EU and its States, i.e. the G7 Alliance on Resource Efficiency and the 2030 Agenda, especially Goal 12 on sustainable consumption and production patterns. Hence, it is very clear the importance of moving ahead on this issue, albeit one step at a time. In this regard, the European level is generally preferred as the cornerstone *to reform product policy and adopt single market policy measures* (EEB, 2017).

Although the CE Action Plan sets up 53 measures to move towards a more coherent and effective approach, it is difficult to gauge where Italy as a whole stand in the adoption process due to the lack of clear quantitative and qualitative indicators and measurement and verification standards of environmental performances for products and services.

Within the Italian context, several barriers have been identified, both physical and socio-psychological.

Further to the lack of specific infrastructures and technological applications, companies have not advanced their implementation programs enough because of the lack of awareness, competences, resources and forces to put into practice the various economic and social top-down advancements proposed by the institutions. As well as this, from the demand side, all levers must be detected in order to change the behavior of consumers.

Two future lines of research can follow up this study. Firstly, the elaboration of a new theoretical framework with the purpose to investigate whether and to what extent a causal link exists between the regional legislation and development. Secondly, entrepreneurial and individual levers could also be examined. In this case, the strengths and weaknesses of a top-down and bottom-up approach to pursue common goals might arise. The analyzes could be conducted at firm or industry level by taking into account every type of policy instrument (e.g. public tenders, financial incentives and other subsides) and their efficacy to introduce new and sustainable products and services and then to change the behavior of consumers with the main aim of preserving the integrity of the environment.

APPENDIX n. 1

The following appendix shows the Commission timetable with the actions to deliver/delivered and how they have been declined at European level.

Data shall be presented according to the classification given in *Annex to the Closing the loop - An EU action plan for the Circular Economy*, COM/2015/614.

Actions	**Timetable**	
Production		Implementation at EU level
Emphasis on circular economy aspects in future product requirements under the Ecodesign directive.	2016 onwards	Adopted on 30 November 2016
Ecodesign work plan 2015-2017 and request to European standardization organizations to develop standards on material efficiency for setting future Ecodesign requirements on durability, reparability and recyclability of products.	December 2015	17 December 2015
Proposal for an implementing regulation on televisions and displays	End 2015 or beginning 2016	Transmitted to WTO on 21 December 2016
Examine options and actions for a more coherent policy framework of the different strands of work of EU product policy in their contribution to the circular economy	2018	
Include guidance on circular economy into Best Available Techniques reference documents (BREFs) for several industrial sectors	2016 onwards	Adopted: _Common waste water and waste gas treatment/management systems in the chemical sector – 3 December 2015 _Non-ferrous metals industries – 3 December 2015 _Intensive rearing of poultry and pigs – 3 October 2016 and 15 February 2017
Guidance and promotion of best practices in the mining waste management plans	2018	
Establishing an open, pan-European network of technological infrastructures for SMEs to integrate advanced manufacturing technologies into their production processes	2016	Call opened on 8 November 2016
Examine how to improve the efficiency and uptake of the EU Eco-Management and Audit Scheme (EMAS) and the pilot program on environmental technology verification (ETV)	2017	
Develop an improved knowledge base and support to SMEs for the substitution of hazardous substances of very high concern	2018	

Consumption		
Better enforcement of existing guarantees on tangible products, accompanied by a reflection on improvements (upcoming Commission proposal for online sales of goods, and Fitness Check of consumer legislation)	2015-2017	Proposal adopted on 9 December 2015, Fitness check ongoing

Action on false green claims, including updated guidance on unfair commercial practices	2016	Guidance document adopted on 25 May 2016
Analyzes of the possibility to propose horizontal requirements on repair information provision in the context of Ecodesign	2018	
REFIT of Ecolabel, to be followed by actions to enhance its effectiveness	2016	
Assessment of the possibility of an independent testing program on planned obsolescence	2018	
Subject to evaluation of the current ongoing pilots, explore the possible uses of the Product Environmental Footprint to measure and communicate environmental information	2016 onwards	
Action on Green Public Procurement: enhanced integration of circular economy requirements, support to higher uptake including through training schemes, reinforcing its use in Commission procurement and EU funds	2016 onwards	Criteria adopted as follows: _Buildings: 20 May 2016 _Roads: 10 June 2016 _Computers and Monitors: 21 October 2016

Waste management[21]		
Revised legislative proposal on waste	Dec 2015	Adopted on 2 December 2015
Improved cooperation with Member States for better implementation of EU waste legislation, and combat illicit shipment of end of life vehicles	2015 onwards	Throughout 2016
Stepping up enforcement of revised Waste Shipment regulation	2016 onwards	Adopted 28 July 2016
Promotion of industry-led voluntary certification of treatment facilities for key waste/recyclate streams	2018 onwards	
Initiative on waste to energy in the framework of the Energy Union	2016	Adopted 25 January 2017
Identification and dissemination of good practices in waste collection systems	2016 onwards	Throughout 2016 (Conference on 29 January 2016)

Market for secondary raw materials		
Development of quality standards for secondary raw materials (in particular for plastics)	2016 onwards	
Proposal for a revised fertilizers regulation	Early 2016	Adopted on 17 March 2016
Proposed legislation setting minimum requirements for reused water for irrigation and groundwater recharge	2017	Adopted on 28 May 2018 [22]

[21] The following legislative proposals on waste have been adopted:
- Proposed Directive on Waste
- Annex to proposed Directive on Waste
- Proposed Directive on Packaging Waste
- Annex to proposed Directive on Packaging Waste
- Proposed Directive on Landfill
- Proposed Directive on electrical and electronic waste, on end-of-life vehicles, and batteries and accumulators and waste batteries and accumulators
- Analytical note on waste management targets
- Staff Working Document - Implementation Plan

[22] Last extensive public and stakeholder consultations confirmed the need for actions at European level. Nevertheless, EU regulatory

Promotion of safe and cost-effective water reuse, including guidance on the integration of water reuse in water planning and management, inclusion of best practices in relevant BREFs, and support to innovation (through the European Innovation Partnership and Horizon 2020) and investments	2016-2017	Guidance published on 10 June 2016
Analyzes and policy options to address the interface between chemicals, products and waste legislation, including how to reduce the presence and improve the tracking of chemicals of concern in products	2017	16.1.2018 - COM(2018) 32 - Communication on the implementation of the circular economy package: options to address the interface between chemical, product and waste legislation
Measures to facilitate waste shipment across the EU, including electronic data exchange (and possibly other measures)	2016 onwards	
Further development of the EU raw materials information system	2016 onwards	

Sectorial action		
Plastics		
Strategy on plastics in the circular economy	2017	16.1.2018 - COM(2018) 28 final - A European Strategy for Plastics in a Circular Economy
Specific action to reduce marine litter implementing the 2030 Sustainable Development Goals	2015 onwards	

Food waste		
Development of a common methodology and indicators to measure food waste	2016	Elements of the methodology discussed with the platform on 29 November 2016
Stakeholders platform to examine how to achieve SDGs goals on food waste, share best practice and evaluate progress	2016	Platform established on 1 August 2016; first meeting on 29 November 2016
Clarify relevant EU legislation related to waste, food and feed in order to facilitate food donation and utilization of former foodstuffs for animal feed	2016	Drafts discussed with the platform on 29 November 2016
Explore options for more effective use and understanding of date marking on food	2017	

Critical raw materials		
Report on critical raw materials and the circular economy	2017	16/01/2018 – SDW(2018) 36 - Report on Critical Raw Materials and the Circular Economy
Improve exchange of information between manufacturers and recyclers on electronic products	2016 onwards	
European standards for material-efficient recycling of electronic waste, waste batteries and other relevant complex end-of-life products	2016 onwards	
Sharing of best practice for the recovery of critical raw materials from mining waste and landfills	2017	

Construction and demolition	

action is not found proportionate as far as aquifer recharge because of its strong local dimension.

Pre-demolition assessment guidelines for the construction sector	2017	
Voluntary industry-wide recycling protocol for construction and demolition waste	2016	9 November 2016
Core indicators for the assessment of the lifecycle environmental performance of a building, and incentives for their use	2017 onwards	

Biomass and bio-based materials		
Guidance and dissemination of best practice on the cascading use of biomass and support to innovation in this domain through Horizon 2020	2018- 2019	
Ensuring coherence and synergies with the circular economy when examining the sustainability of bioenergy under the Energy Union	2016	As part of recast of Renewable Energy Directive adopted on 30 November 2016
Assessment of the contribution of the 2012 Bioeconomy Strategy to the circular economy and possible review	2016	

Innovation and investments		
Initiative "Industry 2020 and the circular economy" under Horizon 2020	October 2015	Investment of € 650 million in the Focus Area - Second round of calls: 20 September and 8 November 2016
Pilot project for "innovation deals" to address possible regulatory obstacles for innovators	2016	Call open between 26 May and 15 September 2016
Targeted outreach to encourage applications for funding under EFSI, and support the development of projects and investment platforms relevant to the circular economy	2016 onwards	Throughout 2016
Targeted outreach and communication activities to assist Member States and regions for the uptake of Cohesion Policy funds for the circular economy	2016 onwards	Throughout 2016
Support to Member States and regions to strengthen innovation for the circular economy through smart specialization	2016 onwards	Throughout 2016
Assessment of the possibility of launching a platform together with the EIB and national banks to support the financing of the circular economy	2016	Launched on 25 January 2017
Engagement with stakeholders in the implementation of this action plan through existing fora in key sectors	2016 onwards	
Support to a range of stakeholders through actions on public-private partnerships, cooperation platforms, support to voluntary business approaches, and exchanges of best practices	2015 onwards	Throughout 2016

Monitoring		
Development of a monitoring framework for the circular economy	2017	16.1.2018 - COM(2018)29 - Monitoring framework for the circular economy

6. REFERENCES

Ajuntament de Barcelona (2014). *Barcelona 5.0: Smart City*. http://www.socinfo.es/contenido/seminarios/0508smartcities7/JuliaLopez.pdf, accessed on February 2017

Andersen, M. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science,* 2(1), 133-140

Baroni, L. (2016). La gestione dei rifiuti in Campania alla luce della recente condanna, dello Stato italiano al pagamento di « sanzioni », pronunciata dalla Corte di Giustizia UE nel giudizio di «doppia condanna» (ex art. 260 Tfue) relativamente alla causa c-653/13. *Rivista italiana di diritto pubblico comunitario*, 5, 1196

Berra, M. et Nuciari, M. (2013). Smart cities: infrastrutture ICT per la partecipazione sociale? *Quaderni di sociologia*, 57:63 (set), 127-153

Bianchi, R. (2015). Bucce d'arancia, fondi di caffè e recupero di energia nel programma «Europa rifiuti 0». *Ambiente e sviluppo*, 7, 441

Bianchi, R. (2016). L'economia circolare nel "mondo" della moda. *Ambiente e sviluppo*, 11, 737

Bianchi, R. (2017). La bioeconomia lungo la filiera alimentare. *Ambiente e sviluppo*, 4, 272

Biondi, V. (2013). Dallo sviluppo sostenibile alla green economy: il caso del Green Economy Network. *Impresa Progetto-Electronic Journal of Management*, 3

Bonciu, F. (2014). The European Economy: From a Linear to a Circular Economy. *Romanian Journal of European Affairs (RJEA), 14*(4), 78-91

Bovino, C. (2014). Verso un'economia circolare: la revisione delle direttive sui rifiuti. *Ambiente e sviluppo*, 10, 682

Brown, D.A. et Taylor, P. (a cura di), (2015). Ethics and Climate Change: A Study of National Commitments. *IUCN Environmental Policy and Law Paper*, 86, Gland

Brown, L.R. (2002). *Eco-economy: una nuova economia per la terra*. Editori Riuniti

Brown, L.R. (2011). *Un mondo al bivio: come prevenire il collasso ambientale ed economico*. Edizioni Ambiente

Brown, L.R., Flavin, C. et Postel, S. (1992). *Un pianeta da salvare: per un'economia globale compatibile con l'ambiente*. Franco Angeli

Caffè, F. (1958). Considerazioni intorno al settore pubblico dell'economia. *Rivista trimestrale di diritto e procedura civile*, ristampato in Caffè, F. (1958). *Saggi critici di economia*. De Luca, 77 ss.

Calabrò, M. (2009). Le certificazioni di qualità ambientale di prodotto quali fattori di competitività per il made in Italy. *Foro amministrativo* T.A.R., 2640 ss.

Cavanna, V. (2014). Economia verde, efficienza delle risorse ed economia circolare: il rapporto" Signals 2014" dell'Agenzia europea dell'Ambiente. *Rivista giuridica dell'ambiente*, 29(6), 821-829

CBD (2014). *Global Biodiversity Outlook 4*. Canada

Ceballos, G., Ehrlich, P.R., Barnosky, A.D., García, A., Pringle, R.M. et Palmer, T. M. (2015). Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Science Advances*, 1. Doi: 10.1126/sciadv.1400253

Cecchetti, M. (2006). La disciplina giuridica della tutela ambientale come "diritto dell'ambiente", in *www.federalismi.it*, 25, accessed on May 2018

Cerini, D. et Lamarque, E. (2016). Cibo e farmaci non consumati diventino doni, quando possibile, non rifiuti. Commento a prima lettura della l. 19 agosto 2016, n. 166. *Corriere Giur*., 2016, 11, 1376

Ciarniello, D. (2017). I rifiuti alimentari nell'economia circolare, in *GiustAmm.it*, 7, 6

Connett, P., Ercolini, R. et Lo Sciuto, P. (2012). *Rifiuti zero. Una rivoluzione in corso*. Viareggio, 13-14

Crutzen, P. J. (2006). The "anthropocene", *Earth system science in the anthropocene*, Springer Berlin Heidelberg, 13-18

D'Addezio, M. (2017). Transizione verso un'economia circolare: diritto per l'agricoltura e coordinate costituzionali. Prime riflessioni. *Rivista di Diritto Agrario*, 1, 1, 85 - 116

De Leonardis, F. (2011). The Legal Provisions Governing Waste in the Italian Legal System. *Ius Publicum Annual Report* – ITALY, 1/2011 Special

De Leonardis, F. (2016). Il futuro del diritto ambientale: il sogno dell'economia circolare, in *www.aidambiente.it*, accessed on February 2018

De Leonardis, F. (2017). Economia circolare: saggio sui suoi tre diversi aspetti giuridici. Verso uno Stato Circolare? *Diritto Amministrativo,* 163, 1

Dipace, R. (2014). La rigenerazione urbana tra programmazione e pianificazione. *Rivista giuridica dell'edilizia*, II, 237 - 239

Dobbs, R., Oppenheim, J. et Thompson, F. (2012). *Mobilizing for a resource revolution*. McKinsey Quarterly, 1

Dobbs, R., Oppenheim, J., Thompson, F., Brinkman, M. et Zornes, M. (2011). *Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs*. McKinsey Global Institute

Dorigo, S. et Mastellone, P. (2013). La fiscalità per l'ambiente. Attualità e prospettive della tassazione ambientale, in *Saggi di diritto tributaria*, 5 (collana diretta da F. Amatucci, P. Boria e A.F. Uricchio), Aracne, Roma, 2013, 1–367, ISBN 978-88-548-6461-0

EC (2010). *Europe 2020 – A strategy for smart, sustainable and inclusive growth*

EC (2012). *Innovating for Sustainable Growth: A Bioeconomy for Europe*

EC (2012). *Manifesto for a resource-efficient Europe*, in *http://europa.eu/rapid/press-release_MEMO-12-989_en.htm*, accessed on March 2017

EC (2017). *Digital Transformation Monitor - Key lessons from national industry 4.0 policy initiatives in Europe*

EC (2017). *The EU Environmental Implementation Review Country Report - ITALY Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions The EU Environmental Implementation Review: Common Challenges and how to combine efforts to deliver better results*. Staff Working Document

EC (2017). *The European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan.* Report from the Commission to the European Parliament, the Council. COM(2017) 33 final

EEA (2011). *Green Economy. Europe's Environment, an assessment of assessments.* Copenhagen: Rosendahl-Schultz Grafisk

EEA (2012). *Ecosystem resilience and resource efficiency in a green economy in Europe.* Copenhagen.

EEA (2014). *Signals 2014.* Copenhagen.

EEA (2016). *Circular economy in Europe. Developing the knowledge base.* Copenhagen.

EEA (2015). *The European Environment: State And Outlook 2015*. Copenhagen.

EEB (2015). *Not bad, but can do better: leaked EU Proposal on Circular Economy*, in *http://www.eeb.org/EEB/index.cfm/news-events/news/not-bad-but-can-do-better-leaked-eu-proposal-on-circular-economy/*, accessed on January 2017

EEB (2017). *Policy options for a Circular Economy*. An EEB report and recommendations for the Italian Ministry for the Environment, Land & Sea. Voluntary National Review Italy National Sustainable Development Strategy. Italian Ministry for the Environment Land and Sea, Directorate-General for Sustainable Development, Environmental Damage and International Affairs - Division I *www.minambiente.it*

Ehrlich, P. R., et Ehrlich, A. H. (2013). Can a collapse of global civilization be avoided? *Proc. R. Soc. B*, 280, 1754, The Royal Society

Ellen MacArthur Foundation (2013). Towards the circular economy. *Journal of Industrial Ecology*

Ellen MacArthur Foundation (2014). *Analysis of an EU target for Resource Productivity. Growth within: a circular economy vision for a competitive Europe*. Report to the European Commission, Brussels

Ellen MacArthur Foundation (2016). *Intelligence Assets: Unlocking the Circular Economy Potential*

EU (2013). *7th Environment Action Programme*

EU, Directive 2003/4/EC on public access to environmental information

EU, INSPIRE Directive 2007/2/EC

Eurostat, (2016). *Sustainable development in the European Union: a *statistical glance from the viewpoint of the UN Sustainable Develompent Goals*. Publications office of the European Union, Luxembourg

Evans, D. (2011). The Internet of Things. How the next evolution of the internet is changing everything. *Cisco White Paper*

FAO (2017). *Food Price edged higher in February*, Press Release date: 02/03/2017, *http://www.fao.org/worldfoodsituation/foodpricesindex/en/*, accessed on March 2017

Federico, T. (2015). *I fondamenti dell'economia circolare*. Fondazione per lo sviluppo sostenibile

Feliziani, C. (2017). I" nuovi" appalti verdi: un primo passo verso un'economia circolare? *Diritto dell'economia*, 2, 349-378

Ferrara, R. (2009). Modelli e tecniche della tutela dell'ambiente: il valore dei principi e la forza della prassi. *Foro amministrativo, Tar,* 2009, 6, 1945

Ferrero, E. (2015). Le 'smart cities' nell'ordinamento giuridico. *Foro amministrativo*, 2: 4 (2015:apr), 1267-1286

Frey, M. (2014). *Strumenti volontari e ruolo delle imprese nello sviluppo sostenibile dei territori*, in Augusto Ninni (a cura di), Politica Industriale e Sviluppo Sostenibile

G. Pauli (2015), *Blue economy 2.0.* Ed. Ambiente, 30

Galli, A., Halle, M. et Grunewald, N. (2015). Physical limits to resource access and utilisation and their economic implications in Mediterranean economies. *Environmental Science & Policy,* 51, 125-136. 10.1016/j.envsci.2015.04.002

Georgescu-Roegen, N. (2003). *Bioeconomia. Verso un'altra economia ecologicamente e socialmente sostenibile,* Torino, Bollati Boringhieri

Gerland, P. Raftery, A. E., Ševčíková, H., Li, N., Gu, D., Spoorenberg, T., Alkema, L., Fosdick, B.K., Chunn, J., Lalic, N., Bay, G., Buettner, T., Heilig, G.K. et Wilmoth, J. (2014). World population stabilization unlikely this century. *Science*, 346, 6206

Gili, L. (2017). La nuova offerta economicamente più vantaggiosa e la discrezionalità amministrativa a più fasi. *Urb. e app.*, 24 ss.

Gnes, M., et Chiti, E. (2016). Cronache europee 2015. *Rivista Trimestrale di Diritto Pubblico*, 4, 1113

Gregson, N., Crang, M., Fuller, S., et. Holmes, H. (2015). Interrogating the circular economy: The moral economy of resource recovery in the EU. *Economy and Society,* 1-26

Heshmati, A. (2015). A Review of the Circular Economy and its Implementation

Hunt, A. J. (2013). *Element Recovery and Sustainability*. RSC Green Chemistry Series, Cambridge

Iacovelli, D. (2016). La politica europea sui rifiuti. *Il diritto dell'economia*, 90(2), 447-471

IFEL, ANCI (2016). La Legge 26 Maggio 2016, n. 14 della Regione Campania, recante "Norme di attuazione della disciplina europea e nazionale in materia di rifiuti". Un primo commento 4 giugno 2016

Lacy, P., Rutqvist, J. et Lamonica, B. (2016). *Circular economy. Dallo spreco al valore*. Egea

Lattanzi, P. (2014). Gli ostacoli di ordine giuridico alla riduzione dello spreco alimentare. *Rivista di diritto agrario*, *93*(3), 273-312

Laursen L. (2014). *Barcelona's Smart City Ecosystem - A big investment in data-driven city management starts to pay off,* https://www.technologyreview.com/s/532511/barcelonas-smart-city-ecosystem/, accessed on February 2017.

Lolli, A. et Bercelli, J. (2011). Public Environmental Services (Water and Municipal Waste) in Italy. New Regulatory Measures. *Ius Publicum Annual Report* – ITALY, 1/2011 Special

Lombardi, P. (2016). Il permesso di costruire in deroga tra interessi, uso e riuso del territorio. *Rivista Giuridica dell'Edilizia*, 249, 3

Lombardi, R. (2016). Il bene "rifiuto" tra concezione "relazionale" e responsabilità civile. *Rassegna Diritto civile*, 841

Losengo, R. et Martone, A. (2016). Verso un'"economia circolare": le linee direttrici della legislazione e giurisprudenza europea con particolare riferimento alla gestione dei rifiuti nella Regione Campania. *Rivista giuridica dell'ambiente*, 2, 227 – 261

Lucia, M. G. et Lazzarini, P. (2015). *La terra che calpesto. Per una nuova alleanza con la nostra sfera esistenziale e materiale*. Franco Angeli

Malthus, T. (1970). *An essay on the principle of population*. New York

MATTM (2017). *Manovra: Galletti, grande spinta Economia Circolare*. Press Release; http://www.minambiente.it/comunicati/manovra-galletti-grande-spinta-economia-circolare, accessed on March 2018

MATTM et SVE (2017). *Towards a Model of Circular Economy for Italy Overview and Strategic Framework*

McDonough, W. et Braungart, M. (2010). *Cradle to cradle: Remaking the way we make things*. MacMillan

Meadows, D. H., Randers, J., et Behrens III, W. W. (1972). *The limits to growth: a report to the club of Rome*. Universe Books, New York

Meli, M. (2017). Oltre il principio chi inquina paga: verso un'economia circolare. *Rivista critica del diritto privato*, 1, 63 – 80

Monterossi, M. F. (2017). Oltre la sostenibilità. Il pacchetto europeo sulla "Circular Economy" in tema di rifiuti e il ruolo sempre più determinante di imprese e consumatori. *GiustAmm.it*, 9, 9

Musu, I. (2008). *L'economia e la natura*, in Cadelo E. (a cura di), *Idea di Natura*, 69-88, ed. Marsilio

N.A. (2016). *Dalla "green" alla "circular" economy.* Marketing Journal, March 3rd, http://www.marketingjournal.it/green-circular-economy-2/, accessed on December 2017

N.A. (2016), *Sharing City Seoul: 4 years' achievements*, in http://english.sharehub.kr/infographic-sharing-city-seoul-4-years-achievements/, accessed on February 2017

N.A. (2017). *G7 Bologna Environment Ministers' Meeting Bologna*, Italy 11-12 June 2017 Communiqué

Nespor, S. (2016). La lunga marcia per un accordo globale sul clima: dal protocollo di Kyoto all'accordo di Parigi. *Rivista trimestrale di diritto pubblico*, 1, 81-121

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

OECD Development Center, Kharas, H. (2010). *The Emerging Middle Class in Developing Countries.* Working Paper No. 285, www.oecd.org, accessed on November 2016

Pennasilico, M. (2016). Sviluppo sostenibile e "contratto ecologico": un altro modo di soddisfare i bisogni. *Rassegna di diritto civile*, (4), 1291-1323

Pierobon, A. (2017). Legge sugli sprechi/eccedenze alimentari, farmaci e indumenti. *Azienditalia*, 1, 14

Porcellana, F. (2016). La virtuosità dell'economia circolare: economia a zero rifiuti. *Aperta Contrada*
Renna, M. (2011). EIA, SEA and IPPC – Ita Ius Publicum Annual Report - ITALY Issue n. 1/2011 Special

Röttgen, D. (2016). È arrivata la conferma per l'end of waste tramite provvedimenti autorizzativi. *Ambiente e sviluppo*, 10, 632

Ruozzi, E. (2016). La lettera enciclica Laudato Si': dal diritto dell'individuo ad un ambiente sano al dovere di protezione del bene comune. *Ordine internazionale e diritti umani*, 145-160

Russo, P. (2016). Il nuovo pacchetto sull'economia circolare. *Economia pubblica*, 2, 169 - 176

Spoto, G. (2017). La cessione a titolo gratuito delle eccedenze alimentari contro gli sprechi. *Europa e diritto privato*, (3), 1111-1127

Stahel, W. et Reday-Mulvey, G. (1976). *Jobs for Tomorrow: The Potential for Substituting Manpower for Energy.* Report to the Commission of the European Communities (now European Commission), Brussels

Stahel, Walter R. (2016). Circular economy: A new relationship with our goods and materials would save resources and energy and create local jobs. *Nature, 531*(7595), 435

Stile, M.T. (2015). Da economia lineare ad economia circolare: un percorso in salita - From Linear Economy to Circular Economy: an Uphill Struggle. *Diritto comunitario e degli scambi internazionali*, 1, 263-266

Stile, M.T. (2015). Da economia lineare a economia circolare: la strategia dell'Unione europea e l'anello mancante. *Rivista giuridica dell'ambiente*, 4, 647 - 654

Stile, M.T. (2016). Piano d'azione per l'economia circolare: l'UE e i «patti per l'innovazione». *Diritto comunitario e degli scambi internazionali*, 1, 151

Stile, M.T. (2016). Economia circolare: lo smaltimento dei rifiuti alimentari tra legalità ed eticità - Circular Economy: the Disposal of Food Waste Between Legality and Ethics. *Diritto comunitario e degli scambi internazionali*, 1, 155-163

Sukhdev, P., Wittmer, H., Schröter-Schlaack, C., Nesshöver, C., Bishop, J., ten Brink, P., et Simmons, B. (2010). *The economics of ecosystems and biodiversity: mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB*. European Communities.

Tarantino, L. (2010). Il tempo della responsabilità: La pianificazione in tema di rifiuti. *Rivista della Scuola superiore dell'economia e delle finanze*

Testa, F., Iraldo, F., Frey, M. et Daddi, T. (2012). What Factors Influence the Uptake of GPP (Green Public Procurement) Practices? New Evidence from an Italian Survey. *Ecological Economics*, 82, 88-96

Testoni, C. (2013). Smart cities: la riqualificazione come concreto strumento per uno sviluppo urbano sostenibile. *L'ufficio tecnico: rivista mensile di tecnica, edilizia ed urbanistica per amministrazioni pubbliche, professionisti e costruttori*, 35:n. 1/2 (gen-feb), 8-14

Tiezzi, E. (2001). *Tempi storici, tempi biologici. Vent'anni dopo*. Edizioni Donzelli

Tiraboschi, M. (2016). L'inquadramento giuridico del lavoro di ricerca in azienda e nel settore privato: problematiche attuali e prospettive future. *Diritto delle relazioni industriali*, 26, 933-994

Tueh, L. (2013). *The rise of the global middle class*. BBC News, 19th June 2013

Tukker, A., Emmert, S., Charter, M., Vezzoli, C., Sto, E., Andersen, M.M., Geerken, T., Tischner, U. et Lahlou, S. (2008). Fostering change to sustainable consumption and production: an evidence based view. *Journal of Cleaner Production,* 16, 1218–1225

UN, Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision*, CD-ROM Edition

UN, Department of Economic and Social Affairs, Population Division (2015). *World Population Prospects: The 2015 Revision*, custom data acquired via website accessed on February 2017

UNECE (1998). *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters*

UNEP (2012). *Responsible Resource Managemenet for a Sustainable World: Findings from International Resource Panel*. www.unep.org, accessed on November 2016

Uricchio, A. (2017). I tributi ambientali e la fiscalità circolare. *Diritto e Pratica Tributaria*, 5, 1849

Uricchio, A., Aulenta, M. et Selicato G. (2015), *La dimensione promozionale del fisco*, Bari, 33 ss.

Valaguzza, S. (2016). *Sustainable development in public contracts: an example of strategic regulation*. Vol. 106, Editoriale scientifica

Villamena, S. (2015). Appalti pubblici e clausole ecologiche: nuove conquiste per la competitività non di prezzo anche alla luce della recente disciplina europea. *Il diritto dell'economia*, 87(2), 355-387

Villamena, S. (2017). Codice dei contratti pubblici 2016. Nuovo lessico ambientale, clausole ecologiche, sostenibilità, economicità. *Rivista Giuridica dell'Edilizia*, 3, 101-112
Vivani, C. (2016). Appalti sostenibili, green public procurement e socially responsible public procurement. *Urb. e app*., 993 e ss.

Von Weizsäcker, E. U., Lovins, A. B. et Lovins, L. H. (1998). *Factor four: doubling wealth-halving resource use: the new report to the Club of Rome.* Earthscan

WEF (2014). *Annual Meeting Report, Towards a Circular Economy – Accelerating the scale-up across global supply chains*

WEF (2016). *Annual Meeting of the Global Future Councils*. Dubai

WWF (2016). *Living Planet Report: Risk and resilience in a new era*

Chapter II
CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT: THE CASE OF WATER MANAGEMENT

ABSTRACT

The purpose of this paper, which is an international business literature review, is to investigate whether and to what extent circular economy (CE) is considered by scholars as a strategy of sustainable development (SD). CE is a model which places sustainability at the center of economic and social growth, in which waste is efficiently turned into valuable resource or at least largely restricted. Thus, not only great benefit to the environment is achieved, but also competitiveness and resilience to social changes are supported. Despite the increasingly widespread emphasis in the terms CE and SD, appropriate actions have not been adopted equally. First of all, their implementation can vary depending on conditions associated with the type of resource. In the case of water management (WM), it poses specific issues primarily related to quantitative concerns and quality requirements. Mostly due to the increasing demand for freshwater, against the backdrop of limited resources stressed by over-abstraction, pollution and climate change. For these reasons, water availability is as limited as its quality.

Main findings show that CE, of great importance to worldwide institutions, seems to be not entirely applied to WM. One of the main reasons might be the difficulty in monitoring, both water quality and the effectiveness of the Rs actions, namely not only reduce, reuse, recycle, but also remove and recover.

Nevertheless, the literature widely considers CE as beneficial for municipal and rural WM since it is a vehicle for generating new business opportunities and recovering research and development costs of environmentally sustainable, economically equitable and socially responsible solutions. More specifically, this paper aims to analyze the relationship between CE and the 2030 Agenda for Sustainable Development, specifically its Goal number 6 - Ensure availability and sustainable management of water and sanitation for all - and contributes in raising awareness on the concept of CE. The results point out that, while 6 SDG sets up circular-related benchmarks, the CE is recognized as the method to meet those objectives. Eco-industrial park and industrial symbiosis can be the business settings to deeper investigate quantitative and qualitative issues on a specific level of analyzes, as well as in terms of enhancing the quality monitoring instruments, which require greater investment.

This study provides useful insights and practical implications for the following interest groups: international scholars (a more comprehensive review and systematization of the concept of CE by reference to WM), managers (awareness-raising on CE, opportunities and challenges in the WM scenario, setting up actions and strengthening sustainable wastewater approach). Finally, policy makers (investment in infrastructure system, key barriers which affect citizens and other stakeholders and require action politically and institutionally to ensure that opportunities are fully exploited by companies).

Keywords: circular economy, sustainable development, water resources management.

1. INTRODUCTION

There is considerable literature on circular economy (CE) for a sustainable development (SD), however, the issue of ecological water management (WM) as a determinant of economic growth has been poorly addressed (e.g. Shi and Zhang, 2005; Zhu and Qiu, 2008).

This study proposes a systematic review of the IB literature about whether and to what extent circular economy affects sustainable development, with respect to water management policies and practices. Key questions to be answered are the following: is circular economy a sustainable development strategy, especially for the water resources management? Are there specific studies in the international business (IB) literature which investigate circular economy, sustainable development and water management?

1.1 Sustainable development: environmental protection, development of economy and society

It is well established that economics and environment are closely inter-related (Schumpeter, 1977; Brown, 2002), to the point that deal with "Green economics" (Hawken, et al, 2007) as an opportune and necessary scenario (Nacken, 2012).

The literature supports the importance of the environmental and the social dimensions along with the economic one since economy is sustainable only if it complies with the limits of the adaptability of ecosystems and biodiversity. According to Brown (2002), all economic activities refer to the terrestrial ecosystem and its development. To this end, Brown promotes the eco-economy, which affects on all aspects of life, as a mammoth task similar to the Copernican Revolution. The concept of a global economy consistent with land ecosystems reveals the SD core since it has its origin in the problem of the scarcity of resources (Brown, 1981; Costanza et Daly, 1992). Even the first definition of SD, agreed on the spirit of the Stockholm Conference (1972), combines *the needs of the present* with *the ability of future generations to meet their own needs* (WCED,1987: 43).

SD, *one of the key challenges of the 21st century* (Sachs, 2005; Clark, 2007), is a collective long-term goal, by involving the exploitation of resources, the direction of investments and the orientation of technological development. To this end, it brings both firms and institutions (e.g. Earth Summit, 1992).

In 2002, Johannesburg World Summit (WSSD) marked a further expansion of the standard definition with the three pillars, namely, those of economy, ecology and equity (3Es), as well as, the 2030 Agenda for Sustainable Development (2015) outlines 17 SD Goals (SDGs), that either openly or subtly reflect these three basic principles. Similarly, contributions in the literature focusing on SD demonstrate a multidimensional concept, which could be divided into three main components: economic development, social welfare and environmental conservation (Pearce, 1988; Pearce et Turner, 1990; Chu et al., 2007; Ji et Yuan, 2008; Dempsey et al., 2011).

Owing to the importance of the matter in its entirety, Gladwin et al. (1995) proposed a more fruitful integrative paradigm so-called *sustaincentrism* in the modern management approach. Accordingly, sustainability-related subjects have been increasingly included in the curricula of business programs over the years (Walck, 2009). With respect to this, Kuckertz et Wagner (2010) argue two crucial issues: their analyzes suggests that the awareness of the sustainability orientation of managers could give an insight into entrepreneurial intentions, but on the other hand, they highlight that the positive impact of sustainability orientation fades with the influence of business experience.

For these reasons, researchers have constantly promoted to establish sustainability as a framework for strategic management education (Audebrand, 2010; Stephens and Graham, 2010; Kopnina, 2017).

1.2 Circular economy as a sustainable development strategy

Among the firms, SD can be pursued in many different ways, e.g. through corporate social responsibility (Moon, 2007) or stakeholder relations management (Steurer et al., 2005).

Over the last decade, scholars increasingly believe that SD can be achieved through CE, as a new pattern of growth (evolution illustrated in detail by Heshmati, 2016). In support of this, CE is even promoted at institutional level, sometimes with means of soft legislation, e.g. in EU, sometimes with command-and-control ones or *green barriers*, e.g. in China (see Chapter I).

Much of the early literature in CE focuses on SD (see tab. 1) shown positive effects, which spill over firms benefit and impact global well-being.

Table 1. Empirical studies on CE and SD

Authors	Year of publication	Academic journal
Li, W. et Zhang, T.	2005	*Science of Science and Management*
Yuan, Z., Bi, J., et Moriguichi, Y.	2006	*Journal of Industrial Ecology*
Andersen, M. S.	2007	*Sustainability Science*

Zhang, B., Bi, J., Fan, Z., Yuan, W. et Ge, J.	2008	*Ecological Economics*
Qiao, F., et Qiao, N	2013	*Prakseologia*
Wu, H. Q., Shi, Y., Xia, Q., et Zhu, W. D.	2014	*Resources, conservation and recycling*
George, D. A., Lin, B. C. A., et Chen, Y.	2015	*Environmental Modelling et Software*
Geissdoerfer, M., Savaget, P., Bocken, N.M.P. et Hultink, E.J.	2017	*Journal of Cleaner Production*

First of all, scholars demonstrate how attention has shifted from the traditional production model of take-make-dispose with a view to ensuring greater awareness and adoption of circular development model.

The CE implementation – pursued through the 3Rs actions, namely reduce, reuse, recycle - presupposes to develop deep and harmonious relationships between economy, environment and society in order to achieve mutually supporting development and national competitiveness (Li et Zhang, 2005). In this regard, Yuan et al. (2006) predicted the promising future of CE in China, whether some issues will be suitably addressed, as a regulation, policy system and social awareness. According to Zhang et al. (2008), different developing strategies should be adopted on the basis of regional features, as economic and environmental function areas and the structure and function of government system. In particular, regarding this last point, Wu et al. (2014) stress the differences in regional resource productivity and eco-efficiency, which are largely due to the difficulty of carrying out a cohesive and coordinate CE policy at the national and local level for realizing SD.

In view of the global nature of CE as SD strategy, its multi-level operational framework is emphasized, for instance some researchers focus on the corporate, inter-firm and social level (Qiao et al., 2013).

As far as the European side, Andersen (2007) reiterates the basic welfare economic four functions of the environment – namely, the amenity values, a resource base for the economy, a sink for residual flows and a life-support system - and their ties within the concept of the CE (Pearce et Turner, 1990). In support of this, the Author argues that, in Europe, significant advances have been achieved in the pricing of externalities by means of interdisciplinary analyzes which involves environmental consequences. Accordingly, Andersen (2007: 133) suggests a CE *for individual resources as well as for sustainability as a future trajectory*.

George et al. (2015) present a new theoretical model composed of two types of economic resources: a polluting input and a recyclable input. Their analyzes indicates a *new perspective* on achieving SD, amply demonstrating that the improvement in environmental quality, as evaluated by a mitigation of pollution, can only be attained by an increase in the environmental self-renewal rate or the recycling ratio. In this regard, George et al. (2015) promote not only CE as a new SD strategy but also introduce an *open* – or *international* - *CE* model, in which countries exchange resource with technological innovation and not forgetting that a waste for country A could be a resource for country B.

Recently, Geissdoerfer et al. (2017) summarize, first of all, the main similarities and differences between SD and CE, and therefore demonstrate that literature regards CE as a condition for sustainability, a beneficial relation, a trade-off, or a regenerative system.

For these reasons, a widespread interest in CE strategies - as long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling - has been reported from companies and policymakers in Europe and China.

1.3 Relevance of the topic and gaps in the extant literature

CE is a model which places sustainability at the center of economic and social growth, in which waste is efficiently turned into valuable resource or at least largely restricted. Thus, not only great benefit to the environment is achieved, but also competitiveness and resilience to social changes are supported.

Despite the increasingly widespread emphasis in the terms CE and SD, appropriate actions have not been adopted equally. First of all, their implementation can vary depending on conditions associated with the type of resource. In the case of WM, it poses specific issues primarily related to quantitative concerns and quality requirements. Mostly due to the increasing demand for freshwater, against the backdrop of limited resources stressed by over-abstraction, pollution and climate change. For these reasons, water availability is as limited as its quality. Data shows that two thirds of the world's population have been experiencing water scarcity at least one month over the year and about 500 million people live in areas where consumption exceeds the locally renewable resources by a factor of two (WWAP, 2017). In addition, global trend is characterized by low-quality water, due to agricultural runoff, discharges of untreated sewage and inadequately treated wastewater from cities and industries. If nothing is done on both aspects, adverse effects will intensify not only on the environment, but also on the economy and society[23].

[23] The main concerns regard threats to human health and ecosystems (see Chapter III).

To prevent this, institutions and other organizations agree that it would be of great value and desirable to try to apply a sustainable model to (waste)WM[24]. The United Nations (UN) share the same view, as demonstrated by the content of 6 SDG and by the further established indicators (see tab. 2).

Table 2. Revised list of 6 SDG indicators*

Goal 6. Ensure availability and sustainable management of water and sanitation for all

Targets (from the 2030 Agenda)	*Indicators*
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.1 Change in water-use efficiency over time
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management implementation (0-100)
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time

[24] References is made to European institution and international organizations, e.g. WHO, UNEP; UNW-DPC, ISO, FAO, UNICEF.

6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan
6.b Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

* As contained in Annex III of the Report of the Inter-Agency and Expert Group on SDG Indicators (E/CN.3/2017/2) and agreed upon, including refinements on several indicators, at the 48th session of the UN Statistical Commission held in March 2017.

The conceptual work of the UN must be recognized since SDGs are *more aspirational, extensive* and *ambitious* (GLAAS, 2017) than the 2000 Millennium Development Goals (MDGs), which dealt only with *environmental sustainability* generally. Meanwhile, SDGs and MDGs share the same key features, namely they are *clear, concise, time-bound* and *measurable* (UN, 2013). Particularly, Targets of 6 SDG across the whole WM spectrum: from universal and equitable access to water standards and efficiency, from drinking-water to ecosystems, from sanitation and hygiene to integrated water resources management, as well as, from local communities' participation to international cooperation. Hence, the implementation requires numerous means, involving financial resources, technology development and cooperation between municipalities and regions. Meanwhile, these coincide with the financing, policy and governance gaps, which have been identified as the main barriers to achieving SDGs. Furthermore, research and innovation trends will focus on resource recovery (WWAP, 2017), which accounts a new CE action specific for the field of WM.

First of all, this work aims at filling the gap in the IB literature by investigating if CE is considered by international scholars as a SD strategy. Secondly, this paper investigates how many studies on CE are related to WM. As first, an approach based on the interaction between indicators and targets within SDG 6 and CE actions are a matter of concern to policy makers in their decisions to a better use of existing sources, to allocate financial assistance or to mobilize further support. As second, CE is widely viewed as beneficial for municipal and rural WM since it is a vehicle for generating new

business opportunities and recovering research and development costs of environmentally sustainable, economically equitable and socially responsible solutions. Finally, the ultimate aim of this paper is to get the evidence to determine if CE model enables to meet 6 SDG targets (see tab.2).

1.4 Water resources management: urban and rural wastewater

Nowadays, the management of water resources includes two wide aspects: urban and rural wastewater. Urban wastewater may consist of domestic effluent of blackwater (excreta, urine and associated sludge), grey water (kitchen and bathroom wastewater), water from commercial establishments and institutions, including hospitals, industrial effluent storm water and other urban runoff. Instead, rural wastewater covers agricultural, horticultural and aquaculture runoff (Raschid-Sally and Jayakody, 2008: 1).

Untreated or not properly treated water have negative impacts on human health, the environment and productive activities. For these reasons, global institutions, as well as local governments, are responsible for ensuring compliance with clean water and sanitation standards. More specifically, their governance may vary hugely between urban and rural areas at sub-national level.

In accordance with the classification by Raschid-Sally and Jayakody (2008), untreated urban wastewater may be subject to direct or indirect use. In the former case, wastewater is directly disposed on farmland from a sewage outlet. In the latter, water from a river receiving urban wastewater is abstracted by farmers downstream for agricultural purpose, specifically when cities do not have any comprehensive sewage collection network and drainage systems discharge collected wastewater into rivers. Instead, treated wastewater complies with the rules of direct use, since it is used for agriculture, irrigation or other recycling purposes. As a result, these definitions reveal a close relationship between the agri sector and the municipal one with regard to the water resource reuse.

Wastewater, after having undergone one or more treatments, becomes *new water* (WWAP, 2017), or as called in the literature: reclaimed or recycled water. This paper will be focused on that one, which can be reused in compliance with the rules for beneficial purposes, the prime example being irrigation.

This paper is structured as follows. Section 2 sets up the basic model and analyzes the dynamic behavior of a sustainable WM including the “Rs” actions applied in the agricultural sector and the municipal one. In section 3, the articles selection and classification methodologies are explained. Section 4 provides the analyzes of the main findings. Section 5 discusses the evidence from the literature analyzes and section 6 concludes the work with future lines of research, implications and limitations.

2. THEORETICAL BACKGROUND

As aforementioned, proponents of CE argue that its purpose is to achieve eco-effectiveness and long-term sustainability together through the Rs actions.

2.1 4Rs in the WM cycle (reduce, remove, reuse, recover)

Although, CE implementation is pursued through the typical 3Rs actions (reduce, reuse, recycle) for the greatest proportion of the resources, it is interesting to note how it differ significantly as regards water. Considering WM, its cycle consists of four actions, not only reduce pollution at the source and reuse reclaimed water or, so-called treated wastewater, for various applications, but also remove contaminants from wastewater streams (i.e. treatment) and recover useful by-products[25], as nutrients or energy (WWAP, 2017). Hereby, circular WM operates by 4Rs interconnected actions, namely reduce, reuse, remove and recover, which make all production more secure and sustainable. Although all of them contribute to the WM, the interplay between the actions vary with the climate system, the degree of resources availability, the level of economic development, the types of economic activity, the infrastructure conditions and the settlement patterns (UNEP, 2015). Above all, in all fields, the most effective action is reducing use of water, that means minimization both wastewater and pollution at the source. This step not only reduces the volumes of them, but also increases water use efficiency, for instance in the leather processing especially after increased treatment costs (Rao et al., 2003). As regards the industry, scholars have emphasized two main features: WM are closely integrated and connected with the specific sector (Ping et al. 2011; Yu, 2007; Niu et al. 2010) and there are considerable synergies between waste streams and water resource recovery, mainly consisting in internal reuse (Rao et al., 2003; EcoWater, 2015). As far as the agricultural and municipal sectors are concerned, development patterns can be identified and they point to the need to adopt a systematic and synergic approach among themselves.

2.2 Circular utilization of water resource in the agricultural sector

Over the past few years, there has been an increase of economic activities in response to population growth and agriculture has had a key role in order to meet the global demand for food. Nevertheless, the sector has been under peculiar pressure arising from increases in costs of production, enhanced quality standards, fierce competition from foreign markets and this took place at low and decreasing sales. In this scenario, an optimal WM is claiming to be a factor for resource efficiency, quality of

[25] It is evident how the actions of remove and recover are closely linked with technical innovations and the concept of 'fit-for-purpose'. This latter aspect means that it is economically feasible and also recommended treating wastewater to a standard acceptable by the different users.

products, and at the same time, to reduce business cost and to minimize negative impacts for human health and the environment. These objectives reveal economic and social principles, which the vast majority of current European policy adhere. The following paragraphs relate primarily to quantitative and qualitative aspects that have a direct impact on rural WM, and then to the use of Rs actions, in order to investigate their impact in the agricultural sector.

2.2.1 Quantitative and qualitative issues

The increase in agriculture activities usually involves challenges relating to the availability and quality of water. Firstly, in this sector the use of water resource represents around 70% of its abstractions worldwide and irrigation is the main use (EEA, 2009; WWAP, 2017). Although there are differences between developing - developed countries and also within Member States and across the whole of the EU, the area intended for irrigation has risen from around 1.4 million km^2 in 1961 to around 3.2 million km^2 in 2012 (Aquastat, 2014). The considerable differences of irrigation volume vary depending on the area, the climate, the specific crops and the methods applied (Lallana et al., 1999). Secondly, the increase in agricultural production has caused environmental impact. Water pollution from agriculture occurs when the use of pesticides and fertilizers exceeds the assimilation capacity of systems, including minerals and organic matter that deplete oxygen and increase the associated risk. The conjunction of these factors points to the salinization of water bodies, soil erosion, sediments in groundwater, misuse of irrigation water and abuse of agricultural measures giving rise to several types of pollutants (Lallana et al., 1999; Scheidleder et al, 1999; Mateo-Sagasta et Burke, 2010). These components not only are dangerous for human health and toxic for environment, but impact also on ecosystems. In fact, Lorenz (2014) observed that the decline in biodiversity is directly proportional to the salinity concentration, side to side, the extinction of weeds and insects have negative long-term consequences in the food chain.

2.2.2 Responses to water scarcity and agricultural pollution: 4Rs in WM

Some actions can be adopted in short and long-term in order to address the challenges. As aforementioned, saving water is the more effective and immediate action, especially during irrigation, in order to reduce consumption, soil salination and pollution (Mateo-Sagasta and Burke, 2010; Gündüz, 2015).

As noted by institutions and scholars (WWAP, 2017), it is common ground that the reuse of treated wastewater does not have widespread acceptability. Notwithstanding this, water reuse could increase food security if it is properly treated and this action has a great potential in agriculture. Used water may undergo different treatment levels, depending on the inputs - as type and concentration of contaminants - and the purpose of reuse. Although secondary treatment is often sufficient in agriculture (Lallana et al., 1999), Drechsel and Evans (2010) demonstrate how the area irrigated with unhealthy wastewater is likely to be ten times larger than the safe area.

Some national policies of Mediterranean countries encourage new advanced methods, namely Cyprus, Malta and the south of Spain represent main best practices in reuse treated wastewater, especially for irrigation (Lallana et al., 1999; 2001). In these cases, traditional systems of irrigation, consisting of gravity, are replaced by pressure ones and, most of all, are financed through European subsidies (e.g. Murcia).

Farther, IT developments contribute to additional gains. Indeed, IT enables precision farming, and consequently, more resource-efficient and profitable techniques. According to EU Parliament (2014), precision agriculture could improve irrigation efficiency by about 20–30%, reduce pesticide use by 10–20% and save machinery and input costs by 75%.

2.3 Circular utilization of water resource in the municipal sector

According to the World Urbanization Prospects (2014), over half of the world's population has been residing in urban areas since 2000. This shift has led to a sharp increase in water demand and thus the need to manage resources properly. The main considerations in this context, therefore, are new hygiene and sanitary habits on one side, and poor inadequate infrastructures on the other (Gawlik et al., 2017). It reflects the overarching priorities, namely the need to ensure safe drinking water and an effective wastewater collection system for all (Koop and Van Leeuwen, 2017).

2.3.1 Quantitative and qualitative issues

Urbanization has been offered new opportunities for business and the labor market, in fact more than 80 % of the gross world product comes from cities (Dobbs et al. 2011; 2012; Koop et Van Leeuwen, 2017). Although cities play a key role in economic growth, it is not a managed and sustainable development in many cases. That is the cause of climate change, water scarcity and pollution. Municipal wastewater consists of domestic, industrial, commercial and institutional sources. It varies considerably reflecting not only the different contaminants released, but also the forms and dimensions of urban systems (WWAP, 2017). Gawlik et al. (2017) estimate that most of the water will be chemically destroy in about 100 million years.

In this context, the major barriers to keeping up with the new urban demand are the large costs of wastewater infrastructure and the complexity of its governance (Scheidleder et al, 1999; Gawlik et al., 2017; Koop et Van Leeuwen, 2017). These are also the reasoning behind the trends in consumption patterns. New living standards have been impacted on the WM approach since the trends of consumers are affected by several socio-economic factors, as tariff and prices, water availability, immigration, healthy and hygienic conditions, new production techniques and others.

2.3.2 Responses to water stress and consumption trends: 4Rs in WM

Preserving the environment and ensuring managed development are inextricably linked goals that must be pursued by institutional and economic instruments. First of all, each state and municipalities

contribute to determine water bills, especially 55–60 % of mayors control water supply and wastewater treatment in Europe (Dobbs et al., 2011).

Moreover, EU has influenced them with its policies since Urban Waste Water Treatment Directive (91/271/EEC) (Lallana et al., 1999), which Article 12 reads: "treated water shall be reused whenever appropriate". Nonetheless, there are no more specifications and regulations on water reuse addressed. The practice distinguishes potable from other purposes of reuse (Gawlik et al. 2017; WWAP, 2017). It is also noteworthy that drinking water is obtained from recycled water only in few innovative cases (Gawlik et al. 2017).

As EU legislation has determined the content of water bills, saving money fosters 4Rs actions, especially reduction and reuse. In fact, as several studies have shown, increase the water price for domestic consumers is a way of discouraging water use. On the other side, Lallana et al. (2001) have posed the issue of equitable access in order to ensure affordable prices of domestic use at minimum essential level for all.

Next to this, urban planning has been developing over the ways and possibility of allowing a more sustainable WM through projects which reduce consumption and promote water reuse and recirculation (e.g. Potsdamer Platz in Berlin). Some practices and techniques that are worth recalling are: green roofs that filter and capture rainwater; use shower water to flush the toilet; to apply natural filters or flow limiting devices, which manages a reduction of water consumption of 50 % (EEA, 2003). A sustainable WM works also through the enhancement of lower-quality water. It allows to save natural and financial resources. Some actions could be: the unbundling of unloading grids of black and grey water, their treatment and reuse for not drinking purposes, as for irrigation of public parks and recreation centers, toilet flushing system, washing machines, dishwashers and other commercial uses or industrial processes (US EPA, 2004). In this way, wastewater treatment follows the fit-for-purpose concept in order to meet the water standards required for a planned reuse. The abovementioned techniques allow to preserve, save and recover water, energy and other materials. In Europe, they are more common than the use of treated municipal wastewater for drinking (GLAAS, 2017). Industrial, commercial, recreational and peri-urban agriculture reuses are exactly more economically feasible in urban agglomerations developed, where the points of reuse and production are especially close.

As pointed out, incentives for new methods and techniques in the WM are sparse, both in agricultural sector and municipal one. Adopting CE strategies to WM, it primarily means to put the water resource efficiency at the center of concerns.

3. METHODOLOGY

The criteria used to find relevant journal articles is based on the search cues "circular economy", "develop*", "water" in the "Abstract" and in the following databases: *Business Source Premier*, *Regional Business News, GreenFILE, Chinese Insight* accessed through *EBSCOhost*. This searching procedure delivered 52 results.

As about the criteria of inclusion and exclusion, among the 52 journal articles only documents focused on circular economy and water resources management were considered relevant. 7 articles were "partly relevant" since they explore new production techniques to SD thanks to an efficient water use in several sectors: the wine and alcohol production (Ping et al. 2011; Yu, 2007; Niu et al. 2010), the eco-industrial network construction (Zhao et al. 2006), the agricultural industry (Zhou, 2008; Luo et al. 2010). Moreover, one of these articles is about practical technologies of low-carbon use (Zhou et al. 2010). Other four articles were "not relevant" to this research since they deal with eco-efficiency indicators to evaluate circular economy development: the Material Flow Analysis (MFA) (Huang et al. 2006; 2008) or attempt to construct a set of eco-efficiency indicators to measure circular economy development, including water productivity (Shi et Zhang, 2005; Zhu et Qiu, 2008). These studies resulted from the searching procedure because they include the above mentioned keywords searched in the abstract but are not purposeful for the research questions of this systematic literature review: is CE a sustainable development strategy for water resources management? And how does it affect the decision-making of the firms and of the other political actors? The above mentioned papers are not relevant to the water case but they are useful to analyze whether circular strategies are considered distinctive factors for the economic growth, regardless of the involvement of the water resources system.

Next to the documents obtained from the afore-mentioned databases, the snowballing technique (Jalali et Wohlin, 2012) was adopted on the basis of the relevant citations appearing in the 52 results. This additionally searching procedure produced 71 documents resulted in a total of 123. The following sections analyze and discuss the key findings.

4. THE ANALYSIS

Evidence shows the recent academic interest in the CE for a sustainable growth and in the WW management. Specifically, 34 papers out of 123 cover the "CE" topic. However, only 7 out of 34 papers focus on policies and/or practices of water management (see tab. 3 below).

Table 3. Studies on CE, SD strategies and water management

Authors	Year of publication	Academic journal
Liu, C., Zhang, K., et Zhang, J.	2010	*Journal of Cleaner Production*

Su, B., Heshmati, A., Geng, Y., et Yu, X.	2013	*Journal of Cleaner Production*
Li, Y., et Ma, C.	2015	*Journal of cleaner production*
Angelis-Dimakis, A., Arampatzis, G., et Assimacopoulos, D.	2016	*Journal of Cleaner Production*
Arampatzis, G., Angelis-Dimakis, A., Blind, M., et Assimacopoulos, D.	2016	*Journal of Cleaner Production*
Grace, M.A., Clifford, E., et Healy, M.G.	2016	*Journal of Cleaner Production*
Winans, K., Kendall, A., et Deng, H.	2017	*Renewable and Sustainable Energy Reviews*

The study by Liu et al. (2010) refers to water resource as one of the main factors hindering SD of the world economy and society. In this paper the industrial ecology, which offers a new method for the sustainable utilization of water resources, are examined, by analyzing the successful example of the Hai Hua Ecological Industry Pilot Zone (HHEIPZ) project. As first, the authors describe the method for sustainable utilization of water resources as a part of the HHEIPZ project, which mainly involved a three-level water cycle: small one, at individual firm level; medium one, at inter-firm level; and large one, which involves industry, agriculture and tertiary industry and residential systems. The results show that the three-level water cycle provides benefits to the whole region, it saves water resources and increases water resource utilization rate; it reduces the environmental pollution resulting from wastewater discharge and beautify the local environment; it establishes a positive image of developing a circular economy, economizing resources and protecting the environment; as well as, it enhances the popularity of the HHEIPZ zone. As a result, sustainable utilization of limited water resource has been achieved. Secondly, the local government has also attached great importance to the project to improve the local sustainability and plays a significant role in organization, consultation, coordination and concrete implementation, providing economic incentives, building infrastructure, educating the participants and collecting information, notably through the water resource monitoring system and the CE office affiliated.

The study by Su et al. (2013) reviews the concept of CE in China, stressing the importance of three different levels (micro, meso and macro-level) for a successful implementation. After consideration of the CE development in four pilot cities (Dalian, Beijing, Shanghai and Tianjin), the Authors observed whether the stated goals have been achieved thanks to ten indicators classified into four aspects: energy and water efficiency, waste discharge, waste treatment and waste reclamation.

Between the above mentioned cities, Dalian municipality represents the best practice in WM since it raised plans in order to improve the efficiency of water use. The government not only supports and encourages enterprises and citizens, but also attempts to pursue both the supply and demand-driven approaches to WM including finding new water sources, minimizing water loss, and encouraging water saving behavior among residents through price incentives and quota management. On the other hand, the Authors also suggest that appropriate performance indicators can help identify the CE key issues and the government should seek standardized methods for data collection, calculation and submission procedures.

In the third study, Li et Ma (2015) analyze the Guangdong Silver Island Lake (GSIL) Papermaking Park project, which realizes cleaner production and SD by developing CE, through recycling energy, water, and materials. Referring to WM, the above water circulation mode fully reflects the CE concept and recycle is an important part of the CE planning. Water-resource recycling includes small-scale, medium-scale and large-scale recycling, likewise for the study by Liu et al. (see tab. 3). Li et Ma mainly introduce the latter two forms constructed through centralized water drawing and supply, stepwise use, centralized wastewater treatment, and centralized discharge.

The authors of the fourth paper (Angelis-Dimakis et al., 2016) consider the "eco-efficiency" issue being part of environmental decision-making, serving as a policy objective and a measure of SD. Their interests extend to a methodological framework for a WM at the meso level, which has been applied to eight alternative water use systems. The study not only reveals the environmental weaknesses and potential eco-efficiency opportunities, but also emphasizes cooperation of stakeholders to propose innovative technological solutions and to plan further political steps for the overall eco-efficiency of the system. Scholars confirm the clear direct correlation between this "meso-level closed resource loops" and the CE development. Under this perspective, the methodological framework identifies vary potential synergies in water use system. Therefore, regarding urban and agricultural systems, there are less available waste streams that could be used as an input to another system than in the industrial ones, however it consists mainly in internal reuse of the recovered waste (EcoWater, 2015).

The fifth work also fits in the systemic eco-efficiency assessment of a water use system at the meso level through a web-integrated suite of tools and resources (EcoWater Toolbox) (Arampatzis et al., 2016). The topical importance lies in the request to quantify and compare the performance of water use systems towards SD. The instrument evaluates both the environmental performance and the economic component of the eco-efficiency. Meanwhile, it different ranking sets are based on the classification of technologies according to the objective of their implementation, such as pollution prevention, resource efficiency and CE.

The review of Grace et al. (2016) examines, inter alia, the utilization of waste products for the removal of contaminants from water in the agricultural sector. It is clear from the review that there is a large scope for encourage symbiosis, for instance the contamination between research, industry and public authorities could would develop a sustainable method of removing contaminants from water. In this way, the creation of waste will be avoided and European CE legislation will be supported, according to the notion of 'CE', which requires products, materials, and services to be maintained within the economy for as long as possible (EC, 2015).

After considering the history of the CE concept, the latter study (Winans et al., 2017) provides an overview of its current applications, including policy instruments and approaches (e.g., eco-industrial park, eco-industrial network, and industrial symbiosis), value chains, material flows, and product-specific applications (e.g., wood and paper, plastics, metals, agricultural products and waste, phosphorus and other chemicals) and technological, organizational, and social innovation, which can be stimulated by government and industry actors, by economic geography and value chains or by feedbacks between ecological and economic systems. According to the literature, employing the strengths, weakness, opportunities and threats (SWOT) analyzes and the strategic environmental assessment for new CE-related initiatives are essential to guide policy and decision-makers when it is believed that recycling and reusing wastes are an economical option for businesses. As well as, an economic input-output (EIO) analyzes can be used to quantify potential economic benefits or to be aware of potential barriers to the success of a new CE-related initiative, e.g., in the case of UE quality requirements for water reuse.

Although the issue of WM does not appear consistently among the main CE-related initiatives, the quantity and quality of water reuse is of critical importance to improve CE actions and further WM development according to the principles of sustainability. Scholars, companies and institutions are aware of the importance of WM in several different resource cycles in order to achieve SD towards CE.

5. DISCUSSION

The results analyzed in this systematic literature review show how CE has its valuable space in the IB literature, but has not been taken into WM account as much as other strategies. First and foremost, the previous sections confirm the gap between China and Europe. In China, some districts (e.g. HHEIPZ, GSIL) and cities (e.g. Dalian, Beijing, Shanghai, Tianjin) are considered to be pilot zones of CE, where innovation, environmental standards, financial incentives and partnership all meet with success in practice. As is evident from papers, all of them have two basic features: water resources are managed on three levels based on their size; and the influence of Chinese policy, that plays an

essential role in terms of promotion and implementation. In fact, the government has affected decision-making process of firms through new infrastructures and other incentives.

The situation is less designed in Europe, where CE is a relatively recent phenomenon, that emerged in the latter half of the past decade. As a matter of fact, European scholars have tried to study and measure CE related initiatives in order to assess whether it is worth joining this SD strategy. According to EC (2015), CE involves a series of actions, which vary depending on the kind of resource engaged and on the new purpose, notably with regard to water. The interaction between CE measures and SD targets, and their cost-benefit assessment have affected EU policy and, hence, the decision-making of the firms.

5.1 CE and water: the influence of 3Es on EU policy

Quantitative and qualitative issues of WM have been defined as a priority of EU (EC, 2012). Likewise, several studies (Steen, 1998; Hutton and Haller, 2004; Corcoran et al., 2010; Van Vuuren et al., 2010; Meda et al., 2012; Drechsel et al., 2015a; Steffen et al., 2015; Abu-Ghunmi et al., 2016; Andersson et al., 2016) have demonstrated the advantages of a circular management of water, both in economic, ecologic and social terms. Generally speaking, institutions have regarded CE as a viable alternative to unsustainable linear model.

Whereas water may be regarded both as a resource, product and service, CE applied to the WM may preserve and recover vital resource – water, energy, other nutrients - and prevent pollution and contamination.

Recently Gawlik et al. (2017) demonstrate how SD of water use is affected by different features, as WM and waste management choices, climate change and even food preferences, especially in European cities. Accordingly, sustainable WM requires supportive policies in order to reduce pollution and enable fit-for-purpose treatment due to new technologies and financial mechanisms (Foster et al., 2016).

In last years, several innovations in technology and design have emerged that allow for Europe's competitiveness in the global marketplace. Next to this, European institutions are rethinking their approach to WM in order to ensure the effectiveness of their policies, since monitoring and reporting water standards are *absolutely vital in the context of the economic incentives* (EEA, 2012) and necessary to achieve SD (e.g., economic incentives given by the Common Agricultural Policy).

Some studies (UN-Water, 2015) reveal as an effective regulatory framework may be addressed by decision-makers and managers due to transparency and access to information (EEA, 2012). As well as, EU (2001) has promoted an adequate coordination, both national and international, which enhances the effectiveness of limited financial resources (e.g., the case of Danube and the Black Sea).

5.2 The interplay between CE and 6 SDG

As previously shown, achieving SD in WM has required a flexible and incremental approach, since regulatory and financial instruments need to be implemented locally. In accordance with that, scholars suggest CE to balance economic development with environmental protection, including as regards water resource. While 6 SDG sets up circular-related benchmarks, the CE is recognized as the method to meet those objectives.

Goals and targets of 2030 Agenda will be monitored with a set of global indicators in order to track progress for them. According to UN-Water (2016) the proportion of wastewater safely treated and the proportion of water bodies with good ambient quality, namely ecosystem-friendly, are the most closely related to WM.

Likewise, the state of CE is the result of an overall assessment of them. An enhanced level of wastewater treatment and water reuse have supported the transition to a CE, since 6 SDG addresses both quantitative and qualitative issues, specifically related to drinking water, sanitation and hygiene, and also to the sustainability of water resources (UN, 2016; WWAP, 2017).

UN (2016) have prospected an integrated system[26] of WM as a follow-up action to the Johannesburg Plan of Implementation, since 6 SDG can be fully achieved only by incorporating each target. This requires substantial investments in new infrastructure and technologies. Therefore, current financing level can provide basic water access, sanitation, and hygiene (WASH) services, but is unable to achieve safely managed services (Hutton et Varughese, 2016). The study by Hutton (2012) pointed out that additional investments are well worth their cost whether appropriate evaluation of actions is performed.

To this end, some scholars (Levidow, 2015; Angelis- Dimakis, 2016) consider that meso-level could be a valuable tool with greater possibilities to growth in water use system in EU. It has been seen as social and economic *interactions* – or *tensions - among heterogeneous actors across the entire value chain* which help them to develop *mutual interests* and *shared responsibility (*Levidow, 2015: 2, 4, 11).

The meso-level takes into account the interdependencies and acts between the legal, economic and environmental parameters established at the national or international level (the macro-level) and the single actions or specific technologies (the micro-level) (Dopfer et al., 2004). It not only combines techniques and purposes in order to render water qualitatively and quantitatively suitable, but also provides an overview of the profit distribution (Angelis- Dimakis, 2016). It has been an important

[26] Although Integrated Water Resource Management (IWRM) is a widely discussed approach and a controversial issue (e.g., Grigg (2014) considers IWRM as a *big tent to cover many situations and purposes*; while, Biswas (2008) is of the opinion that IWRM is *highly unlikely to work in the future*).

concept of decision-making, involving the sharing of resources and the symbiosis between the actors. Thus, the process support policy initiatives through a comprehensive cost-benefit examination (Humphrey et Schmitz, 2001).

6. CONCLUSION

The present work investigates if CE is considered by international scholars as a SD strategy in the management of water and how many times CE concept is related to WM.

The study shows how CE as an approach of sustainable WM is under-investigated in the literature. However, scholars and institution have increased attention on "SD" topics over the years. Recently, the CE concept appears as a strategy to reach sustainable growth. CE is analyzed from various perspectives and features, involving several kinds of resources, actors and initiatives. It is clear that CE is a SD-related strategy and, meanwhile, SDGs are instrumental in developing and implementing better CE methods and technologies. This concept may also be applied to WM, as emphasized by the 6 SDG.

As about the models used to isolate the CE concept, no consistent material appeared in the methodology parts of the analyzed works. The main findings illustrated in this research can be considered as a premise to confirm the need for further research on CE and SD related to the WM. Eco-industrial park and industrial symbiosis can be the business settings to deeper investigate quantitative and qualitative issues on a specific level of analyzes, as well as in terms of enhancing the quality monitoring instruments, which require greater investment.

There is a wide range of opportunities for future lines of research can follow up this study, especially some of them are particularly critical to the advancement of literature.

Firstly, since EU will play a central part in the entire development process, it is necessary to provide an overview of the European framework, on the basis of the new measures on water quality standards. For this purpose, a specific legal literature review will follow. Secondly, it is critical to investigate the influence of regulatory framework and appropriate financing mechanisms over the behavioral change and social acceptance, especially to overcome the multi-barrier attitude in wastewater use and resource recovery. And lastly, the identification of potential symbiosis, namely those practices in which wastewater from sector A can become a resource for sector B. In this regard, education, managerial skills and active participation of stakeholders are essential to understand how to adopt a more sustainable approach for managing resources.

7. REFERENCES

Abu-Ghunmi, D., Abu-Ghunmi, L., Kayal, B., et Bino, A. (2016). Circular economy and the opportunity cost of not 'closing the loop' of water industry: the case of Jordan. *Journal of Cleaner Production*, 131, 228-236

Aivazidou, E., Tsolakis, N., Iakovou, E., et Vlachos, D. (2016). The emerging role of water footprint in supply chain management: A critical literature synthesis and a hierarchical decision-making framework. *Journal of Cleaner Production*, 137, 1018-1037

Amec Foster Wheeler Environment et Infrastructure UK Ltd, IEEP, ACTeon, IMDEA and NTUA, (2016). *EU-level instruments on water reuse*. Final report to support the Commission's Impact Assessment

An-Zhao, J., Jing-Hua, Y. (2008). Study on Legislation of Sustainable Development. *Journal of Zhejiang University*

Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science*, 2(1), 133-140

Andersson, K., Rosemarin, A., Lamizana, B., Kvarnström, E., McConville, J., Seidu, R., Dickin, S. et Trimmer, C. (2016). *Sanitation, Wastewater Management and Sustainability: From Waste Disposal to Resource Recovery*, Nairobi/Stockholm, UNEP

Angelis-Dimakis, A., Arampatzis, G., Assimacopoulos, D. (2016). Systemic eco-efficiency assessment of meso-level water use systems. *Journal of Cleaner Production,* doi: 10.1016/ j.jclepro.2016.02.136

Aquastat (2014). Area Equipped for Irrigation. *Infographic*. Rome, FAO www.fao.org/nr/water/aquastat/infographics/Irrigation_eng.pdf, accessed March 2017

Arampatzis, G., Angelis-Dimakis, A., Blind, M., et Assimacopoulos, D. (2016). A web-based Toolbox to support the systemic eco-efficiency assessment in water use systems. *Journal of Cleaner Production,* 138, 181-194

Audebrand, L. K. (2010). Sustainability in strategic management education: The quest for new root metaphors. *Academy of Management Learning et Education*, 9(3), 413-428

Bao, X. Y., et Shi, H. (2010). Analysis of Municipal Sewage Treatment under the Concept of Circular Economy. *Pollution Control Technology*

Biswas, A. K. (2008). Integrated water resources management: Is it working?. *International Journal of Water Resources Development*, *24*(1), 5-22 http://dx.doi.org/10.1080/07900620701871718

Brown, L. (1981). *Building a Sustainable Society*, Norton, New York

Brown, L. (2002). *Eco-economy: building an economy for the earth*, Orient Blackswan

Chu, J., Chen, J., Wang, C., et Fu, P. (2004). Wastewater reuse potential analysis: implications for China's water resources management. *Water Research*, *38*(11), 2746-2756

Clark, W. C. (2007). Sustainability science: a room of its own. *Proceedings of the National Academy of Sciences*, 104(6), 1737

Communication from the Commission to the European Parliament and the Council (2001). Environmental co-operation in the Danube - Black Sea Region /* COM/2001/0615 final */

Communication from the Commission to the European Parliament and the Council (2007). *Addressing the challenge of water scarcity and droughts in the European Union*, 0414

Corcoran, E., Nellemann, C., Baker, E., Bos, R., Osborn, D. et Savelli, H. (eds) (2010). *Sick Water? The Central Role of Wastewater Management in Sustainable Development*. United Nations Environment Programme/United Nations Human Settlements Programme/GRID-Arendal (UNEP/UN- Habitat). www.unep.org/pdf/SickWater_screen.pdf, accessed June 2017

Costanza, R., et Daly, H. E. (1992). Natural capital and sustainable development. *Conservation biology*, 6(1), 37-46

Dempsey, N., Bramley, G., Power, S., et Brown, C. (2011). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable development*, 19(5), 289-300

Dobbs, R., Remes, J., Manyika, J., Roxburgh, C., Smit, S., et Schaer, F. (2012). *Urban world: Cities and the Rise of the Consuming Class*. McKinsey Global Institute, New York

Dobbs, R., Smit, S., Remes, J., Manyika, J., Roxburgh, C., et Restrepo, A. (2011). U*rban world: Mapping the Economic Power of Cities*. McKinsey Global Institute, New York

Dong, L.P., Zhang, H., Wan, Q.L., He, N.Y. et Fan, X.P. (2011), Study on Brewing Chinese Rice Wine with the New Process of Rapid Rice Sleeping. *Liquor-making Science Technology,* Vol. 2011, 2, 89-92

Dopfer, K., Foster, J., Potts, J., 2004. Micro-meso-macro. *J. Evol. Econ*, 14, 263-279 http://dx.doi.org/10.1007/s00191-004-0193-0

Dou, X. (2016). A critical review of groundwater utilization and management in China's inland water shortage areas. *Water Policy*, 18(6), 1367-1383

Drechsel, P. et Evans, A. E. V. (2010). Wastewater use in irrigated agriculture. *Irrigated and Drainage Systems*, Vol. 24, No. 1, 1–3, http://dx.doi.org/10.1007/s10795-010-9095-5

Drechsel, P., Qadir, M. and Wichelns, D. (eds) (2015). *Wastewater: Economic Asset in an Urbanizing World*, Springer, Netherlands

EcoWater (2015), *Cross-comparison of Case-study Outcomes*, Public Deliverable 6.2 of the EcoWater Project

European Commission, COM (2000)60, *EU Water Framework Directive.* Brussels

European Commission, COM (2007)414, *Addressing the challenge of water scarcity and droughts in the European Union.* Brussels

European Commission, COM (2012)673, *Blueprint for Safeguarding European Waters (EU Water Blueprint).* Brussels

European Commission, COM (2015)614, *Closing the loop – An EU action plan for the Circular Economy.* Brussels

European Environment Agency - EEA (2003). *Europe's Water: An Indicator- based Assessment.* Report Number 1/2003. Copenhagen

European Environment Agency - EEA (2006). *Urban Sprawl in Europe: The ignored challenge.* Report Number 10/2006. Copenhagen

European Environment Agency - EEA (2009). *Water resources across Europe - confronting water scarcity and drought*, Report Number 2/2009. Copenhagen

European Environment Agency - EEA (2012). *Towards efficient use of water resources in Europe*, Report Number 1/2012. Copenhagen

European Parliament, Directorate-General for internal policies, *Precision agriculture: an opportunity for EU farmers – potential support with the CAP 2014-2020*, 2014.

Fawell, J., Le Corre, K., et Jeffrey, P. (2016). Common or independent? The debate over regulations and standards for water reuse in Europe. *International Journal of Water Resources Development*, doi: 10.1080/07900627.2016.1138399

Gawlik, B.M., Easton, P., Koop, S., Van Leeuwen, K., Elelman, R., (eds.) (2017). *Urban Water Atlas for Europe*. European Commission, Publications Office of the European Union, Luxembourg. doi: 10.2788/003176

Geissdoerfer M., Savaget P., Bocken N.M.P. et Hultink E.J. (2017). The Circular Economy – A new sustainability paradigm?. *Journal of Cleaner Production*, 143, 757-768

George, D. A., Lin, B. C. A., et Chen, Y. (2015). A circular economy model of economic growth. *Environmental Modelling et Software*, 73, 60-63

Gladwin, T. N., Kennelly, J. J., et Krause, T. S. (1995). Shifting paradigms for sustainable development: Implications for management theory and research. *Academy of management Review*, 20(4), 874-907

Grace, M.A., Clifford, E., et Healy, M.G. (2016), The potential for the use of waste products from a variety of sectors in water treatment processes. *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2016.07.113

Grigg, N. (2014). Integrated water resources management: Unified process or debate forum? *International Journal of Water Resources Development,* 1-14. dx.doi.org/10.1080/07900627.2013.877338

Gündüz, O. (2015). Water Qual Expo Health, 7: 1. doi.org/10.1007/s12403-015-0161-y

Hawken P., Lovins A. et Lovins L. H. (2001). *Capitalismo naturale. La prossima rivoluzione industriale*, Ed. Ambiente, Milano

Heshmati, A. (2016). A Review of the Circular Economy and its Implementation (No. 431). *Royal Institute of Technology*, CESIS-Centre of Excellence for Science and Innovation Studies

Huamao, X., et Fengqi, W. (2007). Circular economy development mode based on system theory. *Chinese Journal of Population Resources and Environment*, 5(4), 92-96

Huang, H.P. et Bi, J. (2006), Evaluating Regional Circular Economy Based on MFA: A Case Study in Wujin District of Changzhou City. *Resources Science*, Vol. 28, No. 6, 20-27

Huang, H.P., Bi, J., Li, X.M., Zhang, B. et Yang, J. (2008). Material Flow Analysis (MFA) of an eco-economic System: A Case Study of Wujin District, Changzhou. *Acta Ecologica Sinica*, Vol. 26, No. 8, 2578-2586

Humphrey, J., Schmitz, H. (2001). *Governance in Global Value Chains*. IDS Bulletin, 32(3), Institute of Development Studies

Hutton, G. (2012). *Global Costs and Benefits of Drinking- Water Supply and Sanitation Interventions to Reach the MDG Target and Universal Coverage.* Report No. WHO/HSE/WSH/12.01. Geneva, WHO

Hutton, G., et Haller, L. (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level*. Geneva, WHO, www.who.int/water_ sanitation_health/wsh0404.pdf, accessed November 2016

Hutton, G., et Varughese, M. (2016). The Costs of Meeting the 2030 sustainable Development Goal Targets on Drinking Water, Sanitation and Hygiene

Jalali, S., et Wohlin, C. (2012). *Systematic Literature Studies: Database Searches vs. Backward Snowballing*. International Conference on Empirical Software Engineering and Measurement, ESEM'12, September 19-20, 2012, Lund, Sweden, http://www.wohlin.eu/esem12a.pdf, accessed February 2017

Koop, S. H., et van Leeuwen, C. J. (2017). The challenges of water, waste and climate change in cities. *Environment, development and sustainability*, 19(2), 385-418

Kopnina, H. (2017). Sustainability: New strategic thinking for business. *Environment, Development and Sustainability*, 19(1), 27-43

Kuckertz, A., et Wagner, M. (2010). The influence of sustainability orientation on entrepreneurial intentions—Investigating the role of business experience. *Journal of Business Venturing,* 25(5), 524-539

Lallana, C., Estrela, T., Nixon, S., Zabel, T., Laffon, L., Rees, G., et Cole, G. (1999). *Sustainable water use in Europe*. W. Krinner (Ed.). Office for Official Publ. of the European Communities

Lallana, C., Krinner, W., Estrela, T., Nixon, C. S., Leonard, J., et Berland, J. M. (2001). *Sustainable water use in Europe*. Office for official publications of the European Communities

Leeuwen, C., Frijns, J., Wezel, J., et Ven, A. (2012). City Blueprints: 24 Indicators to Assess the Sustainability of the Urban Water Cycle. *Water Resources Management, 26*(8), 2177-2197

Levidow, L., Lindgaard-Jørgensen, P., Nilsson, Å., Skenhall, S. A., et Assimacopoulos, D. (2015). Process eco-innovation: assessing meso-level eco-efficiency in industrial water-service systems. *Journal of Cleaner Production*, 110, 54-65

Li, W., et Zhang, T. (2005). Research on the Circular Economy Evaluation Index System in Resource Based City [J]. *Science of Science and Management of S. et T*, 8, 18

Li, Y., et Ma, C. (2015). Circular economy of a papermaking park in China: a case study. *Journal of cleaner production*, 92, 65-74

Liu, C., Zhang, K., et Zhang, J. (2010). Sustainable utilization of regional water resources: experiences from the Hai Hua ecological industry pilot zone (HHEIPZ) project in China. *Journal of Cleaner Production*, 18(5), 447-453

Liu, Q., Li, H. M., Zuo, X. L., Zhang, F. F., et Wang, L. (2009). A survey and analysis on public awareness and performance for promoting circular economy in China: A case study from Tianjin. *Journal of Cleaner Production*, 17(2), 265-270

Lorenz, J. J. (2014). A review of the effects of altered hydrology and salinity on vertebrate fauna and their habitats in northeastern Florida Bay. *Wetlands*, Vol. 34, Supplement 1, 189-200

Luo, X.F., Xiong, W, Yang, C.F., Xie, J. et Lei, S.M. (2010). Characteristics of Agricultural Circular Economy in the Three Gorges Reservoir Region of Chongqing-A Case Study of the Ecological Agriculture Pattern of 'pig-biogas-orange'. *Chinese Journal of Eco-Agriculture*, Vol. 18, No. 2, 405-409

Ma, K. (2005). CE development is an important approach to Scientific Viewpoint of Development. *Macroeconomics*, 4(3)

Manoli, E., Katsiardi, P., Arampatzis, G., et Assimacopoulos, D. (2005). Comprehensive water management scenarios for strategic planning. *Global NEST Journal*, 7(3), 369-378

Maria, T. A. (2015). Sustainable Development, A Multidimensional Concept. *Annals-Economy Series*, 82-86

Mateo-Sagasta, J. and Burke, J. (2010). *Agriculture and Water Quality Interactions: A Global Overview*. SOLAW Background Thematic Report-TR08. Rome, FAO

Meda, A., Lensch, D., Schaum, C., et Cornel, P. (2012). Energy and water: Relations and recovery potential. V. Lazarova, K. Choo and P. Cornel (eds), *Water–Energy Interactions in Water Reuse*. London, IWA Publishing

Moon, J. (2007). The contribution of corporate social responsibility to sustainable development. *Sustainable development*, 15(5), 296-306

Nacken, D. (2012). *Il Kondratieff verde, ovvero perché le crisi possono essere positive*, Allianz Global Investors

Niu, J.T., Tao, M. and Jin, B.D. (2010). Investigation on Circular Economy in Alcohol Production. *Liquor-making Science Technology*, Vol. 2010, No. 6, 108-112

Nixon, S. C., Lack, T. J., Hunt, D. T. E., Lallana, C., Boschet, A. F., de l'Eau, A., et Leader, E. T. C. I. W. (2000). *Sustainable use of Europe's water. State, prospects and issues*, European Environmental Agency, Environmental Assessment Series, (7)

Pearce, D. (1988). Economics, equity and sustainable development. *Futures*, 20(6), 598-605

Pearce, D. W., et Turner, R. K. (1990). *Economics of natural resources and the environment*. JHU Press

Qiao, F., et Qiao, N. (2013). Circular economy: An ethical and sustainable economic development model. *Prakseologia*, 154, 253

Rao, J. R., Chandrababu, N. K., Muralidharan, C., Nair, B. U., Rao, P. G., et Ramasami, T. (2003). Recouping the wastewater: a way forward for cleaner leather processing. *Journal of Cleaner Production*, 11(5), 591-599

Raschid-Sally, L. and Jayakody, P. (2008). *Drivers and Characteristics of Wastewater Agriculture in Developing Countries: Results from a Global Assessment*. IWMI Research Report No. 127. Colombo, International Water Management Institute (IWMI)

Sachs, J.D. (2005). Challenges of sustainable development under globalisation. *International Journal of Development*, 4(2):1–20

Scheidleder A., J. Grath, G. Winkler, U. Stärk, C. Koreimann, C. Gmeiner, et al., (1999). *Groundwater quality and quantity in Europe*, S. Nixon , EEA

Schumpeter J.A., (1977). *Il processo capitalistico. Cicli economici*, ed. orig.1964, Torino, Boringhieri

Shi, L. et Zhang, T.Z. (2005). Circular Economy Indicators to Evaluate Regional Development-Take Guiyang as an Example. *China Population, Resources and Environment*, Vol. 15, No. 5, 63-66

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B. and Sorlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, Vol. 347, No. 6223. Doi: 10.1126/science.1259855

Stephens, J. C., et Graham, A. C. (2010). Toward an empirical research agenda for sustainability in higher education: exploring the transition management framework. *Journal of Cleaner Production*, 18(7), 611-618

Steurer, R., Langer, M. E., Konrad, A., et Martinuzzi, A. (2005). Corporations, stakeholders and sustainable development: a theoretical exploration of business–society relations. *Journal of Business Ethics*, 61(3), 263-281

Su, B., Heshmati, A., Geng, Y., et Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production*, 42, 215-227

SUN, MAF (2014). *Growth within: a circular economy vision for a competitive Europe*

UN (1987). *Our Common Future*, World Commission on Environment and Development, New York

UN (2016). *Progress towards the Sustainable Development Goals*. Report of the Secretary-General, E/2016/75, New York

UN (2013). *A new global partnership: eradicate poverty and transform economies through sustainable development*. New York

UN Department of Economic and Social Affairs, Population Division (2014). *World Urbanization Prospects: The 2014 Revision*, CD-ROM Edition

UN General Assembly (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. Resolution adopted by the General Assembly on 25 September 2015. A/RES/70/1. New York, United Nations

UN-Water (2016). *Metadata on Suggested Indicators for Global Monitoring of the Sustainable Development Goal 6 on Water and Sanitation*. www.unwater.org/fileadmin/user_upload/unwater_new/ docs/Goal%206_Metadata%20Compilation%20for%20Suggested%20Indicators_UN-Water_v2016- 04-01_2.pdf, accessed July 2017

UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) (2015). *TrackFin Initiative: Tracking Financing to Sanitation, Hygiene and Drinking-water at the National Level*. Guidance document summary for decision-makers. Geneva, WHO www.who.int/water_sanitation_health/monitoring/investments/trackfin- summary.pdf, accessed July 2017

UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) (2017). *Report Financing universal water, sanitation and hygiene under the sustainable development goals*. Geneva, WHO

UN-World Water Assessment Programme (WWAP) (2017). *Wastewater: The Untapped Resource.* The United Nations World Water Development Report, Paris, UNESCO

UNEP (2015). *Economic Valuation of Wastewater - The cost of action and the cost of no action.* Division of Environmental Policy Implementation

UNESCO (2014). *The United Nations World Water Development Report 2014: Water and Energy*. Paris, UNESCO

US EPA (2004). *Guidelines for water reuse*. U.S. Environmental Protection Agency and U.S. Agency for International Development, Washington, DC

Van Vuuren, D. P., Bouwman, A. F., Beusen, A. H. W. (2010). Phosphorus demand for the 1970–2100 period: A scenario analysis of resource depletion. *Global Environmental Change*, Vol. 20, No. 3, 428–439. doi.org/10.1016/j.gloenvcha.2010.04.004

Walck, C. (2009). Integrating sustainability into management education. *Journal of Management Education*, 33(3): 384–390

Wang, K.Y., Ju, H.Y., Liu, S., et al., 2006. Saving water and sustainable development of leather industry. *China Leather,* 35 (1), 20-23

Winans, K., Kendall, A., et Deng, H. (2017). The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews*, 68, 825-833

Wu, H. Q., Shi, Y., Xia, Q., et Zhu, W. D. (2014). Effectiveness of the policy of circular economy in China: A DEA-based analysis for the period of 11th five-year-plan. *Resources, conservation and recycling,* 83, 163-175

Xu, L., Wang, Jun, Li, K.K., et al., 1999. The direct recycle technology of leather waste water. *Ind. Water Treat*, 19 (6), 45-46

Xue-song, L. I. (2008). Statement on Legal Adjustment of Water Resource in Circular Economy [J]. *Ecological Economy*, 10, 020

Xue, B., Chen, X. P., Geng, Y., Guo, X. J., Lu, C. P., Zhang, Z. L., et Lu, C. Y. (2010). Survey of officials' awareness on circular economy development in China: Based on municipal and county level. *Resources, Conservation and Recycling*, 54(12), 1296-1302

Yu, H.M. (2007). Discussion on Development of Ningxia Wine Brewery in Circular Economy. *Liquor Making*, Vol. 34, No. 4, 29-31

Yuan, Z., Bi, J., et Moriguichi, Y. (2006). The circular economy: A new development strategy in China. *Journal of Industrial Ecology*, 10(1-2), 4-8

Zhang, B., Bi, J., Fan, Z., Yuan, Z., et Ge, J. (2008). Eco-efficiency analysis of industrial system in China: a data envelopment analysis approach. *Ecological economics*, 68(1), 306-316

Zhao, J.L., Liu, Z.G., Cao, Y.H., et Zou, D.T. (2006). Eco-industry Park Network Construction study-Take CETDZ for Example. *Journal of Changchun University of Technology*, Vol. 27, No. 2, 112-117

Zhou, X.S., Tong, L., Zhao, Q.Y., et Zheng, S.Q. (2010). Environmental Thinking on Low-carbon Use of China's High-carbon Resources. *China Population, Resources and Environment*. Vol. 20, No. 5, 12-16

Zhou, Z.F. (2008). Research on Development Model of Circular Agriculture, *Research of Agricultural Modernization*, Vol. 29, No. 1, 61-64

Zhu, D.J., et Qiu, S.F. (2008). Eco-Efficiency Indicators and Their Demonstration as the Circular Economy Measurement in China. *Resources and Environment in the Yangtze Basin*, Vol. 17, No 1, 1-5

Ziolkowska, J., et Ziolkowski, R. (2016). Effectiveness of Water Management in Europe in the 21st Century. *Water Resources Management, 30*(7), 2261-2274. 10.1007/s11269-016-1287-9

Chapter III
A CIRCULAR WATER MANAGEMENT IN EU: LIMITS AND PERSPECTIVES FOR AGRICULTURAL SECTOR

ABSTRACT

Despite standardized water management policies and legislation in place across the European Union, water reuse practices vary in different Member State resulting of several factors, e.g. demographic development, climate change, new efficient technologies and techniques in wastewater management. Italy, like other regions in Southern Europe, has to face with some challenges related to water scarcity and quality. The purpose of this paper is to investigate the relevance of the latest European policies by focusing on the opportunities generated by water reuse and other implications for the Member States. Firstly, the new EU *Regulation on minimum requirements for water reuse in irrigation* COM(2018) 337 is introduced within the framework of the Circular Economy (CE). Secondly, the study points out the case of Italy and how its mandatory rules could be considered double-edged. On one side, National authorities have set measures and parameters inspired by precautionary principle in order to protect environment and populations' health; and on the other hand, they undermine the effective water reuse due to the high costs of monitoring.

And finally, some examples of water reuse schemes for irrigation purpose are presented, focusing in particular on Italian territories of Adriatic-Ionian Macro-Region. The examined cases recognize that the feasibility of reusing water varies, not only with its origin and future uses but also with local specificities, namely legal, economic and social aspects. In this respect, the paper shows how transparency and public involvement are essential elements towards "closing the loop" of reclaimed water.

Keywords: environmental policy, agriculture, water reuse

1. INTRODUCTION

The paper provides an overview of new regulations on water reuse within the context of CE. Even if society tends to reject water reuse practices, the variety of modern analytical technologies has the potential to ensure safe water, and its benefits are well examined in the literature (Shuval et al., 1986; Mara et Cairncross, 1989; Asano, 1998; Asano et al., 2000; Angelakis et Bontoux, 2001; Grace et al., 2016). That is why the EU has been stepped to govern the matter. The research is based on the

framework of the Minimum quality requirements for reused water in the EU (new EU legislation) proposal. A multiple case study research design (Yin, 2003; Baxter et Jack, 2008, Yin, 2017) is adopted with the aim to investigate whether and to what extent European measures, as well as technologies solutions, could overcome the psychological barrier of water reuse and increase water reuse among SMEs and citizens. Could EU regulation of quality requirements lead to optimizing reuse potential and effectiveness? In this scenario, are institutions, decision-makers and citizens differently affected?

2. STATE OF WATER RESOURCES

As for the majority of primary resources, water demand has grown sharply since 2000, and in 2030 it is expected to reach +41% than 2010. This increase consists of agricultural demand for 65%, industrial one for 25% and municipal demand for the remaining 10% (McKinsey, 2009; UNWWD, 2017). Moreover, the agricultural intensification, caused by an unrestricted use of fertilizer has been a primary driver of the increased nitrogen and phosphorus consumption, which has negative effects on water pollution as well as the environment and human health (Rockström et al., 2009). The overexploitation and the deterioration of water quality in river basins, combined with climate change and events that increase the uncertainty of water resources availability, are vital enablers for water stress and the subsequent need to regulate its reuse (UNEP, 2012). In 2016, World Economic Forum has assessed the water stress as the global risk of highest concern for citizens and business over the next ten years (WEF, 2016).

Overall water resources need to be managed appropriately[27], for the purpose to mitigate the impacts of increasing its scarcity. Notwithstanding data shows as over 80% of global wastewater is neither collected nor treated (WWAP, 2012; UN-Water 2015a), 71% of the European municipal and industrial wastewater generated undergoes treatment (UNWWD, 2017).

The main reasons that lead the process to be subjected to proper rules will be shown. The purpose is to try and figure out how regulatory and operational aspects are affected by several external causes. Indeed, wastewater represents a potential risk when it is not treated or inadequately treated (Abu-Zeid, 1998), as a direct consequence of its negative impact on water quality and availability.

Pollution, due primarily to several agricultural purposes, climate change and weather related events has affected the final quality of the wastewater discharged. Firstly, the terminology used should be

[27] Reference is made to the 4Rs actions, which characterize a circular WR management: *reducing*, as well as preventing scarcity and pollution; *reusing* water for various applications in its crude; *removing* contaminants (i.e. treatment); and *recovering* nutrients, energy and other useful by-products (see Chapter II). Especially in the field of agriculture, some scholars replace *removing* with *recycling* to underline the water can be back to its natural cycle, after accomplishing its functions (Herui, 2004).

specified. Actually, *wastewater* must henceforth be replaced with *water resources*, since if it is properly handled it has positive effects on the economy, ecology and equity.

2.1 Economic issues in the 3Es scenario

Water resource is recognized as an economic good, although often difficult to measure in monetary terms. Economic impact can be classified into two different categories according to their origin: direct effects on economic activities adhere to purely economic factors; the indirect ones concern economic implications of ecologic and equity matters.

Table 1. Effects on economy

Direct		• A circular use of water is the empirical way forward to save and sustain resources (Abu-Ghunmi et al., 2016); • New technological solutions promise to increase resource efficiency further [28]; • Costs related to water scarcity and droughts are avoided (Zhu et Ierland, 2012); • Nutrient and energy are recovery from wastewater and biosolids, e.g. nitrogen and phosphorus (Steen, 1998; Van Vuuren et al., 2010; Drechsel et al., 2015a) or thermal and hydraulic energy (Meda et al., 2012; WWAP, 2014) and carbon footprint (Drechsel et al., 2015a); • Separating wastes at the source can be easier and more cost-effective than do it later (Andersson et al., 2016); • The lifespan of manufactured goods is extended (UNEP; RECPnet), • *1-to-5 ratio*[29]: five USD will be saved for every one invested in good sanitation services (Hutton and Haller, 2004); • It is estimated that a 1% increase in the rate of growth of the water industry in Europe could create up to 20.000 new jobs (EIP, 2012)
Indirect		• Water quantity and quality are enhanced (UNEP, 2015b; AMEC FW et al., 2016); • Contaminated water and goods are avoided;
	Ecology	• The use of additional fertilizers can be reduced (AMEC FW et al., 2016); • Water bodies and biodiversity are preserved, directly impacting on ecosystems and services related (Corcoran et al., 2010; Steffen et al., 2015); • Tourism and other demand for environmentally friendly activities are growing
	Equity	• Human health, human welfare and quality of life have a primary role; • Freshwater availability is ensured with no differences among urban-rural areas, or other minorities.

As shown in Table 1, water reuse devotes attention to environmental saving and social equity, while at the same time having a beneficial impact on the countries' economic growth. It could safely be used in several scenarios: from reuse of treated wastewater in agricultural irrigation to industrial wastewater within the industry, even for human consumption. Economic gains, as well as advantages related, support water reuse, despite health and environmental risks coming from water not

[28] M. Stuchtey, *Rethinking the water cycle: How moving to a circular economy can preserve our most vital resource,* McKinsey & Company, 2015.

[29] Verbal information from Stefan Uhlenbrook, Coordinator of the WWAP, UNESCO Programme and Director of the Programme Office on Global Water Assessment in Perugia, during the workshop *"Water, Wastewater – Center Pieces of the Circular Economy"*, 13 April 2017.

adequately treated (Aagaard-Hansen and Chaignat, 2010; Alcalde et Gawlik, 2014; Hutton and Varughese, 2016).

Recent technical and administrative measures, as well as guidelines and regulations, tend to satisfy the quality requirements for safe reuse (Gündüz, 2015). Despite the great progress made in this direction, the considerable literature shows that reclaimed water is not sociologically accepted (Gündüz, 2015; UNWWD, 2017).

This study collected a systematic review of the EU policy for water reuse with the aim to answer the following questions: Could the newest EU regulation of quality requirements really increase water reuse among SMEs and citizens? Does it affect the decision-making and the development processes of the water industry?

3. EU FRAMEWORK FOR WR INITIATIVES

Despite global challenges and responses related diversities (UNWWD, 2017), *water reuse* is among the most common action of circular WR management, which has prevailed in the literature and practice for over 50 years (Ziolkowska et Ziolkowski, 2016). According to the other international organizations[30], the EU has also taken specific measures to achieve water reuse effectiveness (UNESCO-WWAP 2006; WATERinCORE 2010; UN-Water 2014). As with the UN-SDG 6 targets by 2030, water policies have a key role in European competitiveness and sustainable growth. Therefore, EC has acknowledged the need to address at European level Water reuse and its maximization are recurring goals in EU action plans: first in the "Blueprint to safeguard Europe's water resources" COM(2012) 673 and then in the "Closing the loop – An EU action plan for the circular economy" COM(2015) 614, which committed a series of key actions to promote water reuse in this Annex, including legislative proposals[31].

Next to the Blueprint Communication, a Fitness check of EU Freshwater policy (SWD(2012) 393) was published pointing out the need to address water scarcity with alternative low environmental impact water supply options. As well as, an impact assessment study (2015) has been prepared along these lines. Simultaneously, consultation processes for new EU initiative on water reuse began in

[30] During last twenty years, water reuse guidelines have been developed by international organizations, as WHO ("Guidelines for the safe use of wastewater, excreta and greywater", 2006); UNEP ("Guidelines for municipal wastewater reuse in the Mediterranean region", 2005; "Development of performance indicators for the operation and maintenance of wastewater treatment plants and wastewater reuse", 2011); UNW-DPC ("Safe use of wastewater in agriculture", 2013); ISO (ISO/TC282 - Water reuse under development; ISO/PC 253 - Treated wastewater reuse for irrigation); FAO ("Water quality for agriculture", 1994).

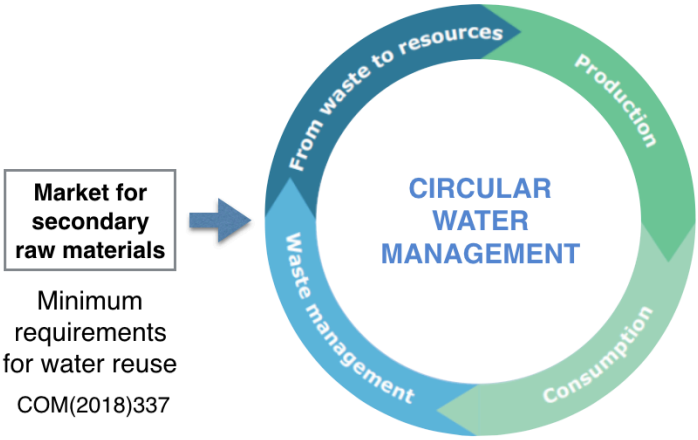
[31] On March 2016, an initial measure was taken in the agriculture sector with the legislative proposal on fertilizers that provides rules for the recovery of nutrients into secondary raw materials and for the free movement of all "CE-marked" fertilizing products across the EU, including organic products.

2012 and continued until July 2017 in various forms, e.g. 2014 and 2016 internet-based Public Consultation on Policy Options to Optimize Water Reuse in EU. Their outcomes underlined the necessity of an EU regulatory framework and considered EU minimum requirements as a means to protect environments and human health (Deloitte, 2015). Alongside this, European Commission has engaged in consultations with the Member States and stakeholders in the Common Implementation Strategy framework for the implementation of the Water Framework Directive (2000/60/EC, WFD), which mentions water reuse as one of the possible supplementary measures (Annex VI, part B).

Water reuse implementation is part of a broader European strategy for sustainability and innovation through the circular economy[32], which include the forthcoming EC policy framework on phosphorus, the resource-efficient Europe initiative[33], the EU biodiversity strategy[34], the EU climate change adaptation and disaster prevention policies and the European Initiative on Smart Cities.

In this scenario, many players are involved in the collective interest of WR management, that has performed a complex interplay between legal and regulatory instruments, financial opportunities and social aspects.

Considering water reuse in an integrated water management approach, the CE Action Plan included some actions to facilitate it and in particular a legislative proposal on minimum quality requirements for water reuse, e.g. for irrigation and groundwater recharge.



Since the main EU challenge concerns to ensure high levels of safety and an effective removal of emerging pollutants, the responses have been developed with the newest "Best Available

[32] 'Towards a circular economy: A zero waste Programme for Europe' (COM(2014) 398final).

[33] A resource-efficient Europe – Flagship Initiative under the Europe 2020 Strategy (COM(2011) 21) (http://ec.europa.eu/resource-efficient-europe/pdf/resource_efficient_europe_en.pdf).

[34] COM(2011) 244 final.

Techniques/Technologies" BAT Regulation[35] and the "Minimum quality requirements for reused water in the EU (new EU legislation)" proposal, which firstly set out the policy objectives and their impacts in 2016[36].

3.1 Minimum quality requirements for water reuse in irrigation

3.1.1 An overview

As announced in COM(2015)614: "other key legislative proposals" on fertilizers and water are going to follow to promote and facilitate the reuse of treated wastewater, EC has promoted a legislative proposal on minimum quality requirements for reused water.

On May 2018, the Commission proposed new rules on minimum requirements to reclaimed water destined for agricultural irrigation (Annex I, section 1) COM(2018) 337 in order to provide a coherent and comprehensive legislative framework within the EU and to contribute significantly to alleviating water scarcity, avoiding limited application of safe water reuse due to over-precautionary approaches (e.g. ban on reused water for aquifer recharge). Accordingly, it set up effective measures to ensure the application of Article 37 of the Charter of Fundamental Rights of the EU (2000/C 364/01)[37].

This regulation thus seeks to: (a) lay down minimum requirements for water quality and monitoring and define the process of risk management that should be carried out (e.g. Annex II defines key risk management principles to follow in Water Reuse Risk Management Plan); (b) guarantee a safe reclaimed water for its intended use, ensuring a high level of protection of human and animal health and the environment; (b) address the issue of water scarcity in a coordinated way throughout the EU

[35] The EU environmental legislation BAT addresses several management methods and various environmental impacts relating to: the chemical sector (2015), Non-ferrous metals industries (2015) and intensive rearing of poultry and pigs (2016).

Only at the beginning of 2017 the BAT has started to engage in water reuse (Commission Implementing Decision (EU) 2017/302 of 15 February 2017 establishing best available techniques conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the intensive rearing of poultry or pigs, C(2017) 688). To that end, BAT conclusions concern different management techniques for an 'Intensive rearing of poultry or pigs' (see Section 6.6 of Annex I to Directive 2010/75/EU), including good housekeeping and nutritional strategy in order to reduce total phosphorus and nitrogen excreted and consequently ammonia emissions (BAT 19; 20). This action forms part of the Nitrates Action Programme (NAP) and Phosphorus Regulations 2015-2018.

With a focus on WR management, EC has paid close attention to the efficient use of water, the reduction of WW generation and the emissions control from wastewater. To this end, BAT 5; 6; 7 are to use a combination of techniques, among these minimize use and reuse are frequently deployed. Lastly, BAT 29 reiterates the importance of monitoring of water consumption parameters at least once every year, as well as the BAT Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector 2016.

[36] http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_env_006_water_reuse_instrument_en.pdf

[37] Specifically, Article 37 on Environmental protection states that: *A high level of environmental protection and the improvement of the quality of the environment must be integrated into the policies of the Union and ensured in accordance with the principle of sustainable development.*

and contributing to the efficient functioning of the internal market, especially for primary agricultural products (Article 1).

The aforementioned proposal is coherent and completes by filling a previously existing gap (ESPON, 2017) without lowering the existing ambitious water goals within the EU legislative framework on water (the Water Framework Directive, the Groundwater Directive, the Environmental Quality Standards Directive, the Urban Waste Water Treatment Directive, the Sewage Sludge Directive, Waste Framework Directive, Regulation concerning the Registration, Evaluation, Authorization and Restriction of Chemicals and the Nitrates Directive) and even on Food safety (the Regulation on the Hygiene of Foodstuffs).

As explained in 28 May 2018 press release, this Proposal is part of the European Commission's Work Programme of 2017 and 2018, contributing to the Circular Economy policy priorities set in the Action Plan. In fact, water reuse in safe and cost-effective conditions *is a valuable but under-used means of increasing water supply and alleviating pressure on over-exploited water resources* in the EU (COM(2015)614). Water reuse in agriculture contributes not only to boost the market for secondary raw materials but also to recycle nutrients by substitution of solid fertilizers. In all these respects COM(2018) 337 complements the Paris Climate Agreement, the resource-efficient initiative under the Europe 2020 Strategy and the future modernization of the Common Agricultural Policy.

At the global level[38], the adoption of minimum requirements for water reuse is fully in accordance with the UN 2030 Agenda and contributes to the EU implementation of the SDGs, especially Goal 6 on *clean water and sanitation*, which sets water quality and water-use efficiency targets to increase recycling and safe reuse globally by 2030.

3.1.2 Policy options and legal instruments

In the case of agricultural activities, the main challenges are related to the availability and quality of water. Firstly, in agriculture, the use of water represents around 70% of its abstractions worldwide, and irrigation is the primarily use. Secondly, the increase in agricultural production has caused an environmental impact. Water pollution from agriculture occurs when the use of pesticides, and fertilizers exceeds the assimilation capacity of systems, including minerals and organic matter that deplete oxygen and increase the associated risk.

The conjunction of these factors points to the salinization of water bodies, soil erosion, sediments in groundwater, misuse of irrigation water and abuse of agricultural measures, which are dangerous for human health, environment, as well as for ecosystems and then for the food chain[39].

[38] See Ünver (2008) and also Kamizoulis (2008) with a focus on WHO Guidelines on Water Reuse in Agriculture.

[39] For the relationship between water and food production see Schenk et al. (2009).

In this scenario, a optimal water management is claiming to be a factor for resource efficiency, quality of products, in order to reduce business cost and minimize negative impacts for human health and the environment. These objectives reveal economic and social principles which have been set up in the latest European policies. Indeed, agricultural irrigation has a major role to play in water reuse towards tackling water scarcity challenges that the EU is facing and it offers considerable opportunities to set up efficacy and cost-effective measures within the whole area of the EU. In fact, agricultural irrigation has become the main source of water reuse demand considering its most significant potential in terms of its higher uptake, scarcity alleviation and EU relevance (ESPON, 2017).

To this end, COM(2018) 337 introduces three key elements:

I) Minimum quality requirements for reclaimed water[40] (e.g. levels of E. coli bacteria) and validation monitoring, which guarantee the safety for irrigation purpose of reclaimed water produced in compliance with the proposed Regulation;

II) Key risk management tasks add additional protection on top of the minimum requirements, namely conducting a risk assessment covering both risks to environment and to health with the aim to identify additional hazard and specific preventive measures for safety in water reuse;

III) Increased transparency, according with the provisions laid down in the *Fitness Check on Reporting*. In fact, Article 10 stipulates the information to made available online and in a user-friendly way by Member States to the public (e.g. the quantity and the quality of the reclaimed water supplied or information on monitoring implementation).

Increasing transparency by emphasizing open instrument instead of traditional reporting obligations means promoting consumers' confidence in water reuse and understanding its impacts, that could overcome the psychological barrier of reused water. EU regulation of quality requirements could lead to effective and optimized water reuse, as well as the impact assessment, this proposal has identified the "fit-for-purpose" policy option as the most sustainable for agricultural irrigation from an economic, social and environmental viewpoint. The legal instrument with a "fit-for-purpose" approach has been introduced as a core element of this Regulation. Actually, it guarantees the safety of agricultural products and thus of local public health and environment through setting up minimum quality requirements which vary depending on the category of food crop and the technique of irrigation, together with specific key risk management tasks.

[40] They are based on a JRC technical report available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109291/jrc109291_onlin e_08022018.pdf

Unlike in "one-size-fits-all" approach where the minimum requirements are set regardless of the food crop type and irrigation technique, the "fit-for-purpose" one can provide the most cost-effective solutions giving the higher volume of treated wastewater at the lowest cost for national authorities (see below). It is clear form its impact assessment that in preparing its policy on the environment the EU has taken account of all the criteria laid down in Article 191 (3) FTUE, i.e. *available scientific and technical data, environmental conditions in the various regions of the Union, the potential benefits and costs of action or lack of action, the economic and social development of the Union as a whole and the balanced development of its regions.*

COM(2018) 337 has been adopted on the basis of Article 192(1) FTEU[41] as it pursues the objectives fixed in Article 191 (1) FTUE, namely *preserving, protecting and improving the quality of the environment, protecting human health, prudent and rational utilisation of natural resources, promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.*

In order to reach these goals, the impact assessment has considered a wide range of legal form: amending an existing directive where water reuse is already mentioned (i.e. the UWWTD) or drafting a new directive, regulation or guidance. The legal instrument chosen was the Regulation in line with the principle of subsidiarity, given the following reasons:

I) It is timely. It would face faster the water scarcity issue with efficient and prompt actions (e.g. the ongoing evaluation of UWWTD is scheduled to be completed in 2019, and any potential future amendment requires a further impact assessment process)

II) It is mandatory. It shall be binding in its entirety and directly applicable in all Member States one year after the date of its entry into force, as Article 17 states. It does not require transposition in Member State legislation, unlike Directive (amended or new).

III) It meets the objectives and the overall harmonization. Not requiring transposition means not to leave leeway to national legislation and be capable of ensuring a high level of protection. In this regard, Regulation overcomes the main limitation of Directive, as already identified in the impact assessment of the Blueprint to Safeguard Europe's Water Resources.

According to the first part of Article 191 (2) FTUE which states *EU policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union*, Regulation could meet the need for flexibility related to the "fit-for-purpose" approach with tools such as the Water Reuse Risk Management Plan (Article 5), which is both *based on the*

[41] Specifically, Article 192(1) FTEU states that: *The European Parliament and the Council, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee and the Committee of the Regions, shall decide what action is to be taken by the Union in order to achieve the objectives referred to in Article 191.*

key risk management tasks (set out in Annex II) and at the same time it *shall propose any additional requirements to those specified in Annex I necessary to further mitigate any risks*, *and shall, inter alia, identify hazards, risks and appropriate preventive measures.*

3.1.3 Implications for the Member States

In view of the lack of EU minimum requirements to reclaimed water destined for specialized area of reuse, Article 12 of the UWWTD generally stipulates that *treated wastewater shall be reused whenever appropriate*. This means that Member States have a wide margin of discretion to decide on a case-by-case basis within EU legislation boundaries and hence water Rs actions diverge widely (AMEC FW et al., 2016). But at present only 6 Member States (Cyprus, Greece, Spain, France, Italy and Portugal) have developed their requirements on water reuse in domestic legislation or in national non-regulatory standards[42].

COM(2018) 337 thus seeks to complement the UWWTD with reference to agricultural irrigation purpose by setting EU minimum quality requirements for water reuse, monitoring and indicating key risk management tasks. In compliance with the principle of subsidiarity for which EU has shared competence with Member States (Article 5 TEU), COM(2018) 337 provides a harmonized approach to water reuse for irrigation across EU territory, while respecting the environment and human health. Whereas these objectives can be better attained at European level, the Union shall adopt measures bearing in mind also the principles of necessity and proportionality.

EU level initiatives on water management have been necessary in order to achieve the objectives set and it is justified because:

I) 60% of EU river basins are international (e.g. Danube);
II) action taken by a single or few Member State is not sufficient, and the costs to overcome the technical barriers are likely unnecessarily high;
III) different requirements could impair the internal market, in particular for primary agricultural products (e.g. E. Coli outbreak of 2011);
IV) changing requirements in national jurisdictions cause uncertainty and then discourages investments.

In accordance with this Regulation, EU should lay down substantive rules for water reuse permit ensuring harmonized approach, traceability and transparency. Whereas Member States should determine clear and specific provisions on the procedures for granting permits taking account of the standard requirements introduced by the Regulation. Competent authorities of Member States should

[42] See Annex 6 of COM(2018) 337 for a complete overview of the current situation of water reuse across the EU Countries.

also ensure its enforcement and lay down a system of *effective, proportionate* and *dissuasive* penalties for breach of the national provisions adopted to implement the directive.

To do this, no later than one year after the entry of enforcement of this Regulation, Member States shall set up the necessary administrative infrastructure as well as prepare operators, who must assume monitoring requirements on the quality of reclaimed water. However, impacts on national budgets and administrations will not be significant because existing reporting streams will be mainly used under previous directives, notably the WFD and the UWWTD. Moreover, as shown in the preparatory study of this proposal, the choice of the "fit-for-purpose" policy option was assessed as the most cost-efficient since investments of EUR 38/m^3/day are foreseen for a treat the available volumes of water, unlike a "one-size-fits-all" approach which requires EUR 271/m^3/day.

4. CURRENT LEGAL FRAMEWORK IN ITALY

4.1 An overview

First of all, it is fair to note that Italy was the first European country to adopt rules on water reuse (Collivignarelli et al., 2007), even if it has not always been facilitated. In fact, Italy has taken measures to protect populations' health using the precautionary principle. As in the case of agricultural irrigation, despite the so-called "Legge Merli" (Law No 319 of 10 May 1976) and General Technical Standards (G.U. 21.2.77) give incentives to wastewater reuse indeed they make it more difficult. Actually, they not only set different limits depending on the type of vegetables and grazing crops (Angelakis et al., 2002; Kamizoulis et al., 2003) but they also prescribe adequate preventive measures in order to avoid any deterioration of surface waters quality.

As far as Decree of Italian Environmental Ministry No. 185 of 2003 - *Regulations bearing technical standards for the reuse of wastewater in implementation of Article 26, paragraph 2, of Legislative Decree 152/1999* - defines quality requirements for 3 use categories (Article 3):

I) Agriculture (i.e. irrigation of crops for human and livestock consumption, of non-food crops and public green areas and sports facilities);
II) Non-potable urban uses (i.e. washing of streets, toilet flushing, heating and cooling networks);
III) Industrial uses (i.e. in every industrial process, as fire control, processing, washing, without coming into contact with food, pharmaceutical or cosmetic products)[43].

[43] As far as industrial reuse, the parties shall set characteristics and parameters on the basis of the single industrial process, complying with the limit values for water discharges to surface water (see Article 4 of the M.D. No. 185 of 2003 and also Table 3 of Annex 5 to part III of the Legislative Decree No. 152 of 2006).

As Scholars (Lavrnić et Mancini, 2016) noted, there are no considerable differences in the quality requirements for the three different uses referred to in Article 3, with the only exception of total nitrogen, total phosphorus and Escherichia coli. Salinity, nutrients, microbiological content are some assessment parameters to determine whether wastewater meets the conditions requiring to be reused in agriculture. In particular, this Ministerial Decree (M.D.) refers to 55 binding parameters, e.g. pH, ammonia nitrogen, specific electrical conductivity, aluminum, iron, manganese, chloride and sulphate concentrations, heavy metals, nutrients and other agronomic benchmarks[44]. Moreover, its Article 12 requires that water reuse must take place under healthy and environmental safe conditions, avoiding disorders in ecosystems, soil and living organisms.

Legislative Decree No. 152 of 3 April 2006 laying down environmental provisions repeals the previous Law No 319 of 10 May 1976 without changing its content. The new law aims to protect water bodies from pollution and it draws attention to the "hydrological cycle", covering:

I) Quality standard defined according to the intended use;
II) Monitoring of water bodies parameters and their possible source of pollution;
III) Identification and classification of water quality;
IV) Preservation of healthy waters and water bodies regeneration programs.

To this end, a participatory action plan provides for the involvement of regions and other administrative authorities in drafting their "Piano di Tutela delle Acque" ("Water Protection Plan") previously regulated by Article 44 of Legislative Decree No. 152 of 1999. This Plan lays down binding rules on water use and reuse taking account of estimated needs and water availability.

It is a valuable tool in the management of the territory to set up measures aimed at quality improvements, food safety and the preservation of natural resources from a local and regional perspective.

As to the concerns the introduction of the latest European standards for water reuse in the Italian context, no impact is to be expected because of the strict precautionary standards fixed by national legislation.

As in other countries subject to water scarcity issues (especially in southern Europe, i.e. Spain, Cyprus, Malta), water reuse has become an accepted practice of water resources management and agricultural irrigation is its main use.

[44] Nevertheless, a great quantity of parameters could hamper the reuse of water. A research of French Environment Ministry (2014) stressed that the best performing countries have the lowest amount of binding quality requirements and the easiest monitoring activities. It is not without reason that Italy are cited as the worst example, in which unjustifiable stringent rules and high cost in monitoring lead to a lack of effectiveness of water reuse (Angelakis et Gikas, 2014).

Verlicchi and other scholars (2012) conducted a cost-benefit analyzes of reuse of reclaimed wastewater for agriculture in the Po Valley, in Northern Italy. Even though important investment has substantial costs, their feasibility study believes that reuse is financially sound and has a payback period no longer than 20 years since benefits are estimated to be approximately €1 million per year alongside €5.3 million of environmental benefits, e.g. better water quality. We know that the same cannot be said for Southern Italy, where circumstances vary greatly: it is characterized by long periods of drought, even water scarcity and furthermore, the costs related to freshwater abstraction are higher (ISPRA, 2009). As Collivignarelli (2007) noted, the cost associated to wastewater reuse is larger than the cost of direct supply. In this respect, the situation is quite different in the developing countries where supply costs from primary sources are higher.

However, according to experts (Deloitte, 2015; AMEC FW et al., 2016), the biggest obstacles to wastewater reuse are the strict national requirements, which entail advanced technology, more protracted processing and significant operating, financial and administrative costs. One of the reasons for this is that Italian regulation requires to monitor above 50 parameters, even though, new European *Regulation on minimum requirements for water reuse in irrigation* COM(2018) 337 leaves national standards relatively unaffected since these last are more stringent for some values related to the bacteriological and physico-chemical water quality[45].

Additionally, regional authorities might set stricter quality standards, after undergoing the validation from national institutions, namely the Ministry of Environment and the other authorities designed to protect the natural resources. As a matter of fact, some Regions - namely Puglia, Emilia Romagna and Sicilia - have introduced much less stringent regulatory requirements deriving from international policy guidelines. For instance, microbiological standards of Emilia Romagna and Puglia are similar to the State of California's *Wastewater Reclamation Criteria* of 1978 which set parameters appropriate to the nature of their use. As well as this, Sicilian microbiological standards are based on those of the WHO guidelines. Since 1973, the World Health Organization and other institutions (e.g. United Nations Environment Program, Food and Agriculture Organization) have developed action plans to water reuse in agriculture, establishing laxer qualitative requirements. These guidelines provide the linkage necessary to issue a recommendation on water standards for an effective agricultural irrigation purpose, without taking into account other risks for human health[46].

[45] These judgments have been made despite the fact that the Blueprint to Safeguard Europe's Water Resources (COM(2012) 673) established EU guidelines and best management practices with the aim to avoid unnecessary restrictions and disadvantages of national regulations in reusing water. In fact, in Italy, as well as in France and Greece, the presence of too stringent and complex (national and regional) water reuse requirements with regard to the intended uses is considered as a key obstacle to the further development of water reuse practices (Deloitte, 2015).

[46] According to Kamizoulis (2003), even if there is no scientific evidence that the WHO guidelines failed to establish safe conditions

4.2 Regional practices of water reuse for agricultural irrigation

Generally, the reuse of untreated wastewater is forbidden in the country and it is punished by both penal and administrative sanctions. Even if all discharges comply with national water quality requirements, regional dispositions have generated a range of situations characterized by different treatment levels and reuse options. In Italy, the first wastewater plant for agricultural irrigation was performed in the city of Milan (Angelakis, 2002). Nowadays, practices have increased throughout Italy but there is still no water reuse network.

The following sections analyze and discuss some examples of water reuse schemes for irrigation purposed, focusing in particular on territories of Adriatic-Ionian Macro-Region, as defined by EU (see Chapter IV). The two cases selected concern agriculture that is the most water-heavy production sector (EEA, 2010) and show that several pilot-scale projects and applications have been carried out both in the north as well as in the south of the country.

4.2.1 Emilia Romagna Region

In the region of Emilia-Romagna agriculture accounts for 66% of total water consumption, compared to a national average of 60%. This has created issues with regard to the quality and quantity of water, both as water body deterioration and imbalance between surface and underground water ecosystems. According to Bianco, this has been also of great relevance for the Region since it crosses Apennine Rivers, namely *rivers with a limited flow subject to large fluctuations that empty into the Adriatic Sea, which also features limited depth and scarce water exchange and which is impacted by the quality of the waters of the Po River* (2018:240). Moreover, this has significant economic consequences since around 40% of Italy's GDP is produced in the Po basin area.

The Region drew up a "Water Protection Plan" (No. 41 of 21 December 2005) concerning local actions to control water resource through an integrated, multidisciplinary approach in compliance with standards required by M.D. 185 of 2003. Wastewater reuse is the main measure to ensure the supply of the resource for several purposes and to safeguard the qualitative status of water bodies reducing pollution.

First and foremost, the Region has individuated a list of 24 wastewater treatment plants (WWTPs) which have been found fit for agricultural irrigation corresponding to approximately 92.500 ha of cultivated land (Berrè, 2008). Secondly, the reuse of wastewater is mandatorily implemented through specific recovery plans drawn up by the Ambito Territoriale Ottimale (ATO, the local authority water board), together with the facility owners.

for all, additional research is encouraged to avoid uncertainties about the potential impacts on human health with the aim to increase confidence in water reuse.

In Emilia Romagna, the first wastewater reuse system for agricultural irrigation has been recently completed in Mancasale, in the industrial district north of the town of Reggio Emilia. It is equipped with an advanced tertiary treatment to recover and reuse urban wastewater, instead of surface water or groundwater resources, for irrigation of high quality crops complying with the regulatory requirements.

The Mancasale WWTP contributes to the implementation of the Water Management Plan of the Po River basin within the framework of EU-funded project LIFE + called ReQpro *A model to reclaim and reuse wastewater for quality crop production*[47]. It involves both SMEs, public authorities, consortiums and research centers working in areas related to agro-industry.

The project aims to:

I) Test new management practices in order to produce water suitable for reuse in the irrigation of high quality crops;

II) Perform cost-benefit analyzes of water reuse for irrigation by means of a new purification plant;

III) Provide transparent information on water quality and safety by means of an innovative wastewater traceability system and a concrete impact assessment with regard to soil and crops of farms;

IV) Evaluate social acceptability and increase awareness on wastewater reuse among farmers.

The Mancasale WWTP shall be capable of generating a mass flow to citizens of around 5 million cubic meters of high quality water per year. This will lead to a decrease in water abstraction and then, to generate savings in energy costs. Furthermore, a large number of nutrients, i.e. nitrogen and phosphorus, shall be used to fertilize the soil instead of being discharged to surface water.

4.2.2 Puglia Region

Relevant pilot-scale projects are also promoted in southern regions because they are particularly affected by drought and the lack of natural resources (Lopez et al., 2006; Saliba et al., 2018). .

Regional Law No. 28 of 1999 demarcates the ATO in accordance with national law No. 36 of 1994 *Provisions on water supply.* Puglia Region states that the ATO consists of its entire territory as set out in Article 2. Alongside this, it drew up a "Water Protection Plan" for reclaimed wastewater reuse following the prescription of M.D. 185 of 2003.

The Region has been invested in WWTPs since 2007. As far as water reuse for agricultural irrigation, plants are located in the south of the Region, e.g. Corsano (LE), Gallipoli (LE), Maruggio (TA), Trinitapoli (BT), Ostuni (BR), Fasano (BR) or Stornarella (FG).

[47] Project reference: LIFE11 ENV/IT/000156; Duration: 01-DEC-2013 to 28-FEB -2017.

Water is a decisive factor in the competitiveness of the farms and therefore its price differs throughout the Region's territories due to unequal conditions and infrastructures. Wastewater reuse for crop irrigation would result in substantial price stabilization in agriculture and environmental protection, e.g. a reduction in groundwater abstraction, lower salinization of costal areas, combating soil degradation and erosion, and also scaling down the use of pesticides and other crop protection products (Lopez, 2006).

However, scholars (Saliba et al., 2018) show a higher level of acceptance of water reuse among citizens and consumers than farmers, respectively 87% and 59%. In actuality, the lack of knowledge and transparency led to poor confidence in water reuse practices, not to mention the fact that their cost is even higher.

It is precisely for these reasons that Puglia Region, Water Research Institute (IRSA-CNR, as part of the Italian National Research Council) and local companies have performed basic and applied research activities on WWTP, such as the development of new methods and technology, pilot project, cost assessments, systems' evaluations and dissemination of results.

Fiordelisi S.r.l. (Fiordelisi), an Italian company leader in sun-dried and semi-dried vegetable production, is noteworthy in this connection. Puglia Region, IRSA-CNR and Fiordelisi, with other EU partners, have joined in several pilot projects, e.g. in Fasano and in Capitanata district.

They have tested innovative approaches and technologies for agro-industrial wastewater reclamation since 2011 in Fasano WWTP, where a huge storage capacity and the connection with a 30 km distribution network are its strengths. According to the principle of multiple uses of water resources, in the Plant the same water is used twice: before industrial vegetable processing (washing, conditioning, cooking, etc.) and after for crops' irrigation (Santoro, 2014). Fasano WWTP integrates treated wastewater reuse into Fiordelisi production processes and the Programme evaluates energy efficiency and savings in terms of primary resources.

The Capitanata district, which includes another WWTP of Fiordelisi, was recently chosen as one of the DEMOWARE[48] project's case studies in order to *demonstrate the feasibility of reusing agroindustrial wastewater for food crop irrigation and to determine its advantages in terms of nutrient recovery* (Demoware, 2017). Here again, the same water is used twice: first in the food production process and then stored in tanks and used for irrigation at trial fields.

By Decision No. 1150 of 11 July 2017, The Regional Council of Puglia approved a new project for Sava-Manduria WWTP in the Province of Taranto. As happened in the Fasano WWTP, the project

[48] DEMOWARE, *Innovation Demonstration for a Competitive and Innovative European Water Reuse Sector,* is co-funded by the EU's 7th Framework Programme for research, technological development and demonstration, theme ENV.2013.WATER INNO&DEMO-1 *Water innovation demonstration projects* under grant agreement no 619040.

avoids the reclaimed wastewater being dumped into the sea via a submarine pipe and is replaced by a storage system. In this way not only can the water be reused for agricultural irrigation, but also any infringement procedures for underground pollution will be avoided.

5. CONCLUSION

Water, like other primary resources, is the focus of a large number of EU policies, not only geared to protecting the environment but also to increase agriculture and rural development, e.g. the Water Framework Directive, the Pillars I and II of the Common Agricultural Policy (Cabello Villarejo et Madrid Lopez, 2014). And although all EU policies and programs do promote water reuse, it is still not widely accepted. The cases examined recognize that the feasibility of reusing water varies, not only with its original and future uses, but also with local specificities, namely legal, economic and social aspects.

As discussed above, Italian quality requirements for reclaiming wastewater are too stringent and similar to those for drinking water and other purposes (e.g. industrial processing or agricultural irrigation), albeit some Regions (Emilia Romagna, Puglia, Sicilia) follow Californian standards as concerns irrigation of fields.

The EU decision to reform primarily the agricultural irrigation is justified by technical grounds: firstly, this sector demands the greatest amount of water; and secondly, nutrients in the greywater could replace the use of pesticides and other chemicals fertilizers (Abu-Zeid, 1998).

In addition to the objectives of environmental policy (Article 191 (1) FTUE), COM(2018) 337 Regulation is expected to have a positive impact on research and innovation, and then in the internal market, in part due to its directly applicable provisions to Member States as well as business operators.

EU priorities arising under the unifying wastewater recycling and reuse regulations shall be identified as follows:

I) setting higher quality standards without reducing existing ambitious water goals (e.g. UWWTD and WFD);
II) strengthening cohesion and equity across EU (e.g. Article 9 provide the modalities for an appropriate and prompt *information exchange between authorities of Member States, when relevant, before a permit for water reuse is issued*);
III) achieving a high level of protection for users and consumers as well as for ecosystems and soil, and thus increasing public confidence in water reuse;
IV) fostering a free movement of goods across Europe's internal borders, avoiding potential trade barriers and thereby economic losses due to changing requirements in national jurisdictions.

It is remarkable, however, that the EU SCHEER (Scientific Committee on Health, Environmental and Emerging Risks) is of the opinion that *Minimum quality requirements regulation* should draw up more detailed guidelines to MS and operators (Rizzo et al., 2017). Conversely, it is unrealistic to handle all local situations when preparing guidance on water quality because European countries are significantly unequally developed. Differences occur not only in their policies, financial resources, wastewater collection systems and other infrastructures but also in institutional and human capacities and awareness. For these reasons in particular, a European rule-based system is necessary but needs to be both clear and flexible (e.g. the "fit-for-purpose" approach). One of the main issues has certainly been to find the balance between water reuse and precaution, which seeks to assure public health, environmental protection and food security (Abu-Zeid, 1998; Kamizoulis et al., 2003; Mizyed, 2012; Alcalde et Gawlik, 2014; Fawell et al., 2016). Public acceptance could be influenced by several factors including growing confidence in methods and technologies (e.g. U-V disinfection in Fasano and Capitanata WWTPs) and the knowledge of qualitative aspects of renewed facilities.

It is clear that transparency and access to information are crucial for *promoting trust among users and also the general public as regards the safety of reclaimed water.* Therefore, EU emphasizes *providing information to the public instead of traditional reporting obligations* as referred to in Article 10 of COM(2018) 337 Regulation.

In this regard, a good communication and information policy is a fundamental element to give proof of the quality of the actions (Bianco, 2018) and improve stakeholders' involvement for a successful implementation of the measures (Unver, 2008; Saliba et al., 2018). Their cooperation in the planning and decision-making process at every stage of reuse projects gives the perception of local situations and encourages possible solutions, as confirmed by the results of the consultation process (see section 2.1). Cultural and social change has been taking place over the last few years, which involves agricultural communities (Mizyed, 2012). Farmers have become equipped with the right skills and education in agriculture as well as in other areas and, hence, they want to play an active role in defining the policies that affect them directly and indirectly. Conversely, farmers and users have called for more institutional awareness about the complexity of the issue, infrastructures and financial incentives, which will bring improvements in wastewater reuse (Saliba et al., 2018; Futran, 2013).

Only by doing so will it be possible to make a more efficient use of water by managing wastewater better and then to move towards CE, thus "closing the loop" (e.g. in the cases examined).

6. REFERENCES

Aagaard-Hansen, J., et Chaignat, C. L. (2010). Neglected tropical diseases: equity and social determinants. *Equity, social determinants and public health programmes*, 135

Abu-Ghunmi, D., Abu-Ghunmi, L., Kayal, B., et Bino, A. (2016). Circular economy and the opportunity cost of not 'closing the loop' of water industry: The case of Jordan. *Journal of Cleaner Production*, 131, 228-236

Abu-Zeid, K. M. (1998). Recent trends and developments: Reuse of wastewater in agriculture. *Environmental Management and Health, 9*(2), 79-89

Ait-Mouheb, N., Bahri, A., Thayer, B. B., Benyahia, B., Bourrié, G., Cherki, B., et Kitir, N. (2018). The reuse of reclaimed water for irrigation around the Mediterranean Rim: a step towards a more virtuous cycle? *Regional Environmental Change*, 1-13

Alcalde Sanz, L., et Gawlik, B. (2014). *Water Reuse in Europe—Relevant Guidelines, Needs for and Barriers to Innovation.* Publications Office of the European Union

Alcalde, S. L. et Gawlik, B. (2014). *Water Reuse in Europe - Relevant guidelines, needs for and barriers to innovation*. Publications Office of the European Union, http://publications.jrc.ec.europa.eu/repository/handle/JRC92582

AMEC FW et al. (2016). *EU-level instruments on water reuse*. Final report to support the Commission's Impact Assessment, http://ec.europa.eu/environment/water/blueprint/pdf/EU_level_instruments_on_water-2nd-IA_support-study_AMEC.pdf

Andersson, K., Rosemarin, A., Lamizana, B., Kvarnström, E., McConville, J., Seidu, R., Dickin, S. et Trimmer, C. (2016). *Sanitation, Wastewater Management and Sustainability: From Waste Disposal to Resource Recovery*. Nairobi/Stockholm, United Nations Environment Programme/Stockholm Environment Institute (UNEP/SEI). www.sei-international.org/mediamanager/documents/Publications/ NEW/SEI-UNEP-2016-SanWWM&Sustainability.pdf

Angelakis, A. N., et Gikas, P. (2014). Water reuse: overview of current practices and trends in the world with emphasis on EU states. *Water Utility Journal*, 6, 67-78

Angelakis, A.N. (2002). *Wastewater Reclamation and Reuse Practices in Mediterranean Region.* WHO regional Office for Europe, EURO Project Office, MAP, Athens, 78

Angelakis, A.N. et Bontoux, L. (2001). Wastewater Reclamation and Reuse in European Countries. *Water Policy*, 3, 47- 59

Angelakis, A.N., Bontoux L. et Lazarova, V. (2003). Main Challenges and Prospectives for Water Recycling and Reuse in EU Countries. *Water Science and Technology*, 3(4), 59-68

Asano, T. (1998). Wastewater Reclamation and Reuse. *Water Quality Management Library*, Vol. 10. Technomic Publishing Inc., Lancaster, Pennsylvania, USA

Asano, T., Ogoshi, M. et Suzuki, Y. (2000). *Lessons Learned from the Japanese Water Reuse Experiences*. Water Reuse 2000 Conference, San Antonio, Texas, January 30-February 2

Bahri, A. et Brissaud, F. (2002). *Guidelines for Municipal Water Reuse in the Mediterranean Countries.* WHO regional Office for Europe, Euro Project Office, MAP, Athens, Greece, 62

Baxter, P. et Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, 13(4), 544-559

Berrè, F. (2008). Il riuso delle acque reflue depurate. *ArpaRivista,* 3/2008

Bianco, M. (2018). Circular Economy and WWTPs: Water Reuse and Biogas Production. In: Gilardoni, A. (eds) *The Italian Water Industry*. Springer

BIO by Deloitte (2015). *Optimising water reuse in the EU* – Final report prepared for the European Commission (DG ENV), Part I. In collaboration with ICF and Cranfield University

Blumenthal, U.J., Mara, D.D., Peasey, A., Ruiz-Palacios, G. et Stott., R. (2000). Guidelines for the microbiological quality of treated wastewater used in agriculture: recommendations for revising WHO guidelines. *Bulletin of the World Health Organization*, 78 (9), 1104-1116

Borja, A., et Elliott, M. (2007). What does 'good ecological potential'mean, within the European Water Framework Directive?

Cabello Villarejo, V., et Madrid Lopez, C. (2014). Water use in arid rural systems and the integration of water and agricultural policies in Europe: The case of Andarax river basin. *Environment, Development and Sustainability, 16*(4), 957-975

Casani, S., Rouhany, M., et Knøchel, S. (2005). A discussion paper on challenges and limitations to water reuse and hygiene in the food industry. *Water research*, 39(6), 1134-1146

Collivignarelli, C., Bertanza, G., Cavallari, S. et Sorlini, S. (2007). Riutilizzo delle acque reflue. *Ingegneria Ambientale*, XXXVI, 1-2, gen-feb, 23-35

Corcoran, E., Nellemann, C., Baker, E., Bos, R., Osborn, D. et Savelli, H. (eds). 2010. *Sick Water? The Central Role of Wastewater Management in Sustainable Development*. United Nations Environment Programme/United Nations Human Settlements Programme/GRID-Arendal (UNEP/UN- Habitat). www.unep.org/pdf/SickWater_screen.pdf

D. Bixio, C. Thoeye, J. De Koning, D. Joksimovic, D. Savic, T. Wintgens, T. Melin (2006). Wastewater reuse in Europe. *Desalination*, 187, 1–3, 5 February 2006, 89-101

DEMOWARE Innovation Demonstration for a Competitive and Innovative European Water Reuse Sector (2017). *Final Publishable Summary Report*

Dolores, M., Barrio, H., et Martin, J. M. (2016). *Urban Water Reuse in Agriculture*

Drechsel, P., Qadir, M. et Wichelns, D. (eds) (2015). *Wastewater: Economic Asset in an Urbanizing World*. Springer Netherlands

EC (2017). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan - COM(2017) 33 final

EC (2018). Commission Staff Working Document Impact Assessment accompanying the document Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse - SWD(2018) 250 final

EC (2018). *Proposal for a regulation of the European Parliament and of the Council on minimum requirements for water reuse* (Text with EEA relevance).COM(2018) 337 final

EC (2018). *Water reuse: Commission proposes measures to make it easier and safer for agricultural irrigation.* Press release, Brussels, 28 May

EIP (2012). *Strategic Implementation Plan of the European Innovation Partnership on Wate*r, Brussels 18 December 2012

ESPON (2017). *Development of minimum quality requirements for reused water in agricultural irrigation and aquifer recharge*. Territorial Impact Assessment Report

FAO (1992). *Wastewater treatment and use in agriculture*. FAO Irrigation and Drainage, paper n. 47

Fawell, J., Le Corre, K. et Jeffrey, P. (2016). Common or independent? The debate over regulations and standards for water reuse in Europe. *International Journal of Water Resources Development*, DOI: 10.1080/07900627.2016.1138399

Grace, M.A., Clifford, E. et Healy M.G. (2016). The potential for the use of waste products from a variety of sectors in water treatment processes. *Journal of Cleaner Production*, doi: 10.1016/j.jclepro.2016.07.113

Gündüz, O. (2015). Water Quality Perspectives in a Changing World. *Water Quality, Exposure and Health*, 7(1), 1-3

Hutton, G. et Haller, L. (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level*. Geneva, Switzerland, World Health Organization (WHO). www.who.int/water_ sanitation_health/wsh0404.pdf

Hutton, G., et Varughese, M. (2016). The Costs of Meeting the 2030 sustainable Development Goal Targets on Drinking Water. *Sanitation and Hygiene*

ISPRA (2009). *L'ottimizzazione del servizio di scarico urbane: massimizzazione dei recuperi di risorsa (acque e fanghi) e riduzione dei consumi energetici.* Rapporto 93/2009 http://www.isprambiente.gov.it/it/pubblicazioni/rapporti/l2019ottimizzazione-del-servizio-di-depurazione

Kamizoulis, G. (2008). Setting health based targets for water reuse (in agriculture). *Desalination*, 218(1-3), 154-163

Kamizoulis, G., Bahri, A., Brissaud, F. et Angelakis, A.N. (2003). *Wastewater recycling and reuse practices in Mediterranean region*. Recommended Guidelines

Khadra, R., D'Agostino, D.R., Scardigno, A. et Lamaddalena, N. (2011). Down-scaling pan-European water scenarios to local visions in the Mediterranean: the Candelaro Basin case study in Italy. *Journal of Water and Climate Change,* 2:180–188

Koop, S. H. A., et Van Leeuwen, C. J. (2016). The challenges of water, waste and climate change in cities. Environment. *Development and Sustainability*, 1-34

Lavrnić, S., et Mancini, M. L. (2016). Can constructed wetlands treat wastewater for reuse in agriculture? Review of guidelines and examples in South Europe. *Water Science and Technology*, 73(11), 2616-2626

Mara, D. et Cairncross, S. (1989). *Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture.* Measures for public health protection, WHO, Geneva, Switzerland

McKinsey Global Institute (2009). *Charting our water future: Economic frameworks to inform decision-making*. 2030 Water Resources Group, available online at http: //www.mckinsey.com/Client_Service/ Sustainability/Latest_thinking/Charting_our_water_future.aspx

McKinsey Global Institute (2011). *Resource Revolution: Meeting the world's energy, materials, food, and water needs*

Meda, A., Lensch, D., Schaum, C. et Cornel, P. (2012). Energy and water: Relations and recovery potential. V. Lazarova, K. Choo and P. Cornel (eds), *Water–Energy Interactions in Water Reuse*. London, IWA Publishing

Mizyed, N. (2013). Challenges to treated wastewater reuse in arid and semi-arid areas. *Environmental Science and Policy, 25*, 186-195

Paranychianakis, N. V., Salgot, M., Snyder, S. A. et Angelakis, A. N. (2015). Water reuse in EU states: necessity for uniform criteria to mitigate human and environmental risks. *Critical Reviews in Environmental Science and Technology*, 45(13), 1409-1468

RECPnet (Resource Efficient and Cleaner Production). n.d.a. *Capturing and Promoting Knowledge on Resource Efficient and Cleaner Production*. Factsheet. United Nations Industrial Development Organization/United Nations Environment Programme (UNIDO/UNEP). recpnet.org/wp-content/uploads/2016/05/KMS_Capturing-and-Promoting-Knowledge-on-RECP.pdf

Rizzo, L., Krätke, R., Linders, J., Scott, M., Vighi, M., et de Voogt, P. (2017). Proposed EU minimum quality requirements for water reuse in agricultural irrigation and aquifer recharge: SCHEER scientific advice. *Environmental Science & Health*

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E. et Nykvist, B. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and society*, 14(2)

Salgot, M., Oron, G., Cirelli, G. L., Dalezios, N. R., Díaz, A., et Angelakis, A. N. (2017). Criteria for Wastewater Treatment and Reuse under Water Scarcity. *Handbook of Drought and Water Scarcity: Environmental Impacts and Analysis of Drought and Water Scarcity*

Saliba, R., Callieris, R., D'Agostino, D., Roma, R. et Scardigno, A. (2018). Stakeholders' attitude towards the reuse of treated wastewater for irrigation in Mediterranean agriculture. *Agricultural Water Management*, 204, 60-68

Santoro, O. (2014). *Back to Future: The Success Story of Fasano's Agricultural Wastewater Reuse Plant*. Conference Proceeding

Schenk, C., Roquier, B., Soutter, M., et Mermoud, A. (2009). A System Model for Water Management. *Environmental Management,43*(3), 458-469

Schmidt, G., Bauer, S., Baur, T., Fleischmann, N., Kaltenböck, M., Leeuw, E. et Misiga, P. (2016). The European Innovation Partnership on Water (EIP Water): approach and results to date (2012–2015). *Journal of Cleaner Production*

Shuval, H., Adin, A., Fattal, B., Rawitz, E. et Yekutiel, P. (1986). *Wastewater irrigation in developing countries: Health effects and technical solutions.* World Bank Technical paper 51, The World Bank, Washington, DC

Steen, I. (1998). Management of a non-renewable resource. *Phosphorus and Potassium*, Vo. 217, 25–31

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B. et Sorlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347, 6223. Doi: 10.1126/science.1259855

Stuchtey, M. (2015). *Rethinking the water cycle: How moving to a circular economy can preserve our most vital resource*. McKinsey & Company

UN-Water (2014). *Investing in Water and Sanitation: Increasing Access, Reducing Inequalities*. UN-Water (2014). *Global Analysis and Assessment of Sanitation and Drinking Water* - GLAAS 2014 Report. Geneva, Switzerland, WHO apps.who.int/iris/bitstream/10665/139735/1/9789241508087_eng.pdf?ua=1

UNEP (2012). *Responsible Resource Management for a Sustainable World: Findings from the International Resource Panel*

UNEP (2015). *Economic Valuation of Wastewater - The Cost of Action and the Cost of No Action*. Nairobi, unep.org/gpa/Documents/GWI/Wastewater%20Evaluation%20Report%20Mail.pdf

UNESCO (2014). *The United Nations World Water Development Report 2014: Water and Energy*. Paris, United Nations Educational, Scientific and Cultural Organization

Unver, O. (2008). Global governance of water: A practitioner's perspective. *Global Governance, 14*(4), 409

UNWWD (2017). *Wastewater: The Untapped Resource*

Van Vuuren, D. P., Bouwman, A. F., et Beusen, A. H. W. (2010). Phosphorus demand for the 1970–2100 period: A scenario analysis of resource depletion. *Global Environmental Change*, Vol. 20, No. 3, 428–439. doi.org/10.1016/j.gloenvcha.2010.04.004

Vergine, P., Lonigro, A., Salerno, C., Rubino, P., Berardi, G., et Pollice, A. (2016). Nutrient recovery and crop yield enhancement in irrigation with reclaimed wastewater: a case study. *Urban Water Journal*, 14(3):325–330, https://doi.org/10.1080/1573062X.2016.1141224

Vergine, P., Salerno, C., Libutti, A., Beneduce, L., Gatta, G., Berardi, G., et Pollice, A. (2017). Closing the water cycle in the agro-industrial sector by reusing treated wastewater for irrigation. *Journal of Cleaner Production*, 164, 587-596

Vergine, P., Saliba, R., Salerno, C., Laera, G., Berardi, G., et Pollice, A. (2015). Fate of the fecal indicator Escherichia coli in irrigation with partially treated wastewater. *Water Research* 85:66–73, https://doi.org/10.1016/j. watres.2015.08.001

Verlicchi, P., Al Aukidy, M., Galletti, A., Zambello, E., Zanni, G., et Masotti, L. (2012). A project of reuse of reclaimed wastewater in the Po Valley, Italy: Polishing sequence and cost benefit analysis. *Journal of hydrology*, *432*, 127-136

WEF (2016). *The Global Risks Report 2016*. Geneva, Switzerland

WHO (1989). *Health guidelines for use of wastewater in agriculture and aquaculture*. World Health Organization, Technical Report Series 778, Ginevra

WWAP (2006). *The United Nations World Water Development Report 2: Water: A Shared Responsibility*. Paris, United Nations Educational, Scientific and Cultural Organization

Yin, R. K. (2003). Case study research design and methods third edition. *Applied social research methods series*, 5

Yin, R. K. (2017). Case study research and applications: Design and methods. *Sage publications*

Zhu, X., et Ierland, E. (2012). Economic Modelling for Water Quantity and Quality Management: A Welfare Program Approach. *Water Resources Management, 26*(9), 2491-2511

Ziolkowska, J. R., et Ziolkowski, B. (2016). Effectiveness of Water Management in Europe in the 21st Century. *Water Resources Management*, 30(7), 2261-2274

Chapter IV

LIFELONG LEARNING, MANAGERIAL SKILLS AND ACTIVE PARTICIPATION FOR A CE IMPLEMENTATION: THE CASE OF SMEs IN THE ADRIATIC-IONIAN MACRO-REGION

ABSTRACT

This paper aims to investigate the role of education and managerial skills for human resources in the adoption of Circular Economy (CE). It analyzes the main business models of reference and try to map the skills that the CE requires to be implemented in a company. In this context, the focus is on Adriatic-Ionian Macro-Region as a place of circulation both of resources and goods, and also knowledge and competences. A map of European-funded projects in this area shows relevant findings related to business needs concerning value creation, where education plays a crucial role to raise the right skills at all levels and other measures to support value creation for jobs in the new framework of CE.

Keywords: Circular Economy, Adriatic-Ionian Macro-Region, education and training

1. CIRCULAR ECONOMY SHIFT: SYSTEMATIC CHANGE AND INNOVATION

Circular Economy (CE) has become a cornerstone for businesses as well as policymakers both at European Union (EU) and Member State (MS) level since it is essential to reach the EU's 2050 vision of *living well within the limits of our planet* (EU, 2013). Notwithstanding the strongly increased awareness on the role of CE in supporting sustainable consumption and production patterns (see Chapter II), much uncertainty remains about the pathways to achieving CE approach, because there is no consistent assessment of existing European and national policy frameworks. In actual fact, whereas the concept of sustainable development has been around at worldwide level for long time (e.g. Paris Climate Change Agreement, the United Nations Agenda 2030 on Sustainable Development) this has not always been the case in practice, especially among national systems (Daly, 2001; Eurobarometer, 2009). For instance, traditional index as GDP disregards this aspect of development. GDP has been criticized for a long time, as it fails to indicate long-term sustainability. Among other aspects, it does not take into account forest degradation and decline in biodiversity as well as of quality and efficiency of services provided (Repetto, 1989; EC, 2009; Commission on the

Measurement of Economic Performance and Social Progress, 2010; Amerighi et Felici, 2011; Frey, 2013).

This section tries to answer to the following questions: are there any policy frameworks in place favoring the moving from linear to CE? What are the most appropriate educational tools?

There is a need for structural changes (see Chapter I) and it requires an innovative approach among stakeholders both on the demand and on the supply side. Government and consumers are two sides to the demand. As shown in Chapter I, the role of government and public administration meet CE principles through the rules on green public procurement and life cycle costing, including end of life costs and environmental externalities.

As far as consumer awareness, an environmentally responsible behavior has been boosted through environmental communication plan and new consumption models: sharing is preferred over ownership and repair over replace (see Paragraph 1.3).

On the other side, companies are currently facing great challenges on account of an increasing social responsibilities which requires new product designs and - as a consequence - then new business models (see Paragraph 2.1).

However, while the capability to display a sustainable world is *the first step* towards its construction (Brown et al. 1992:115), CE transition is compared to *trying to sail across the ocean:* there is a clear idea of the *desired destination* but a plan is not enough (EEA, 2017: 31). A greater transparency is required to measure and monitor CE in order to understand the effects of actions at different levels, evaluate them and, where appropriate, make corrections. To assist the necessary structural changes, research, innovation and education have aimed to empower policy makers, SMEs, citizens and other stakeholders (Biondi, 2013; Lucia et Lazzarini, 2015).

Innovation is the cornerstone of this systemic change and it will also boost to the competitiveness and modernization of EU industry, as recognized within the "Closing the loop – An EU action plan for the circular economy" COM(2015) 614. In order to rethink the ways of producing and consuming and to transform waste into high value-added products, new technologies, processes, services and business models are required, as well as qualified workforce with new specific skills.

Amongst other initiatives (e.g. *Industry 2020 in the circular economy* under Horizon 2020, LIFE, COSME), the Cohesion Policy grants important R&I funding opportunities for CE, which is considered as one of the priorities in the Smart Specialisation Strategies (S3) of the Regions.

The paper is structured as follows: first, it provides an overview of the main business models of reference for CE and how they are confronting the new market demands. The following section shows relevant findings emerging from a map of European-funded projects related to education and training systems to raise the right skills at all levels and other measures to support job creation in CE.

Subsequently, it analyzes the case of SMEs in the Adriatic-Ionian (A-I) Macro Region as part of S3 cooperation. After discussing the results, the final section concludes with some indications for future research and managerial implications.

2. THEORETICAL BACKGROUND

2.1 The role of business model within societal challenges

Revised business models of reference for CE have been confronting the new market demands. In fact, according to Fabris (2010), consumers' insights shall determine a new view of production and of industrial relations, paying particular attention to consumption patterns. The society that we are living is based on a new ethics, where waste and overconsumption are conceived as disvalues (Coyle, 2012; Leismann et al., 2013; Belk, 2014) and collaborative consumption is increasingly becoming an important dimension of human behavior (see EEA, 2017 and the 2016 Flash Eurobarometer, a survey by the EC).

As was apparent in Chapter I, there is a strong sense of urgency with regard to this matter and also a high level of awareness of the fact that the eco-innovation of the system and the transition towards a CE shall require of new industrial relations supported by a favorable environment[49] which takes account of their particular characteristics (Gregson et al., 2015), as new design, integrated production chains, Industry 4.0, industrial symbiosis. In addressing new societal challenges (e.g. automated, multi-modal and on-demand systems), this knowledge has created an environment conducive to investors, innovators and entrepreneurs, and to there being competitive economic structures.

Scholars (Lacy et Rutqvist, 2015; EEA, 2016) have identified some new models of business for circular growth:

Sustainable supplies and purchases. This model is based on the abilities to replace non-renewable with renewable materials (e.g. recycled or compostable) and to rationalize the use of resources, preferring local level, as well as optimizing production processes through removing inefficiencies at all stages and improving logistic[50]. An important contribution is given both by industrial symbiosis and eco-design, favoring the use of renewable or fewer resources and avoiding hazardous materials.

Waste-as-a-resource business models: recovery, reuse and recycling. Reducing consumption is the first step in preventing waste generation. Alongside this, reusing some components or the whole product boosts the resource flows and the markets for secondary raw materials. Moreover, recycling

[49] Furthermore, Webster (2013) highlights six temptations to avoid when framing the CE since a systems perspective has a central role in this scenario.

[50] For more on effectiveness, as the result of the balance between resilience and efficiency see Goerner et al., 2009.

process, which keep the quality of the materials as stable as possible, shall avoid a lower economic value. Industrial symbiosis and local activities are being favored and then waste can be transformed into an added value for society innovative reuse and recycling systems.

Product life extension. Applying the principles of modularity, products could last longer. Even here, design for disassemblability is essential to create a long-lived manufacture because it can be readily repaired, restyled or updated. There are several ways to prolong the life span of products and components, which make it possible to reduce energy and materials costs and to create new job opportunities, especially in the automotive, electronics and manufacturing sectors.

Sharing platforms. Collaborative consumption patterns have developed significantly in recent years partly thanks to new information and communication technologies, which enable online interactions between supply and demand side. Citizens, in particular, are called upon to take an active part in this process in application of the principle of sharing economy in order to bring forward ideas proposal and to fill some of their needs.

From product to service: function-based business models. In this case, consumers no longer have physical ownership of products, but they are shared and used through a pay-per-use contract. It has been largely adopted for cars and IT devices, and even for clothing, furniture, toys and other gadgets over the last few years. This model shall enhance customer loyalty and the value of new technologies and products in an innovative, efficient and cost-effective manner.

Creative and collaborative participation is especially evident in sharing platforms and function-based business models, given that also scholars are talking about “prosumer and prosumption” or “produser and produsage” (Bruns, 2009). It is clear that a new model of responsibility, which involves the entire life-cycle of products (EEA, 2017), concerns not only supply side (Extended Producer Responsibility, EPR, see Chapter I, Paragraph 4.1) but also the whole community (so-called Extended Consumer Responsibility, ECR).

Special mention should be made in this context of the driver for innovation: the introduction of these new economic patterns comes from start-ups and spin-offs (e.g. testing new materials, products and devices, establishing new systems and processes, as smart or mobile working).

In this scenario, an increasing number of companies have have begun to embark on important CE initiatives for big corporations (e.g. the CE100 promoted by the Ellen Macarthur Foundation) and also SMEs (e.g. FISE UNICIRCULAR, Ecoforum of Legambiente or other regional forum illustrated in Chapter I). The large-scale production, which allows to contain costs and develop efficiency in manufacturing and supply channel, has been replaced by a customized approach, creating a loyalty-enhancing effect through access over ownership systems, take-back programs and continuous service programs. Activities and services have been designed with a bottom-up strategy and shall gain high

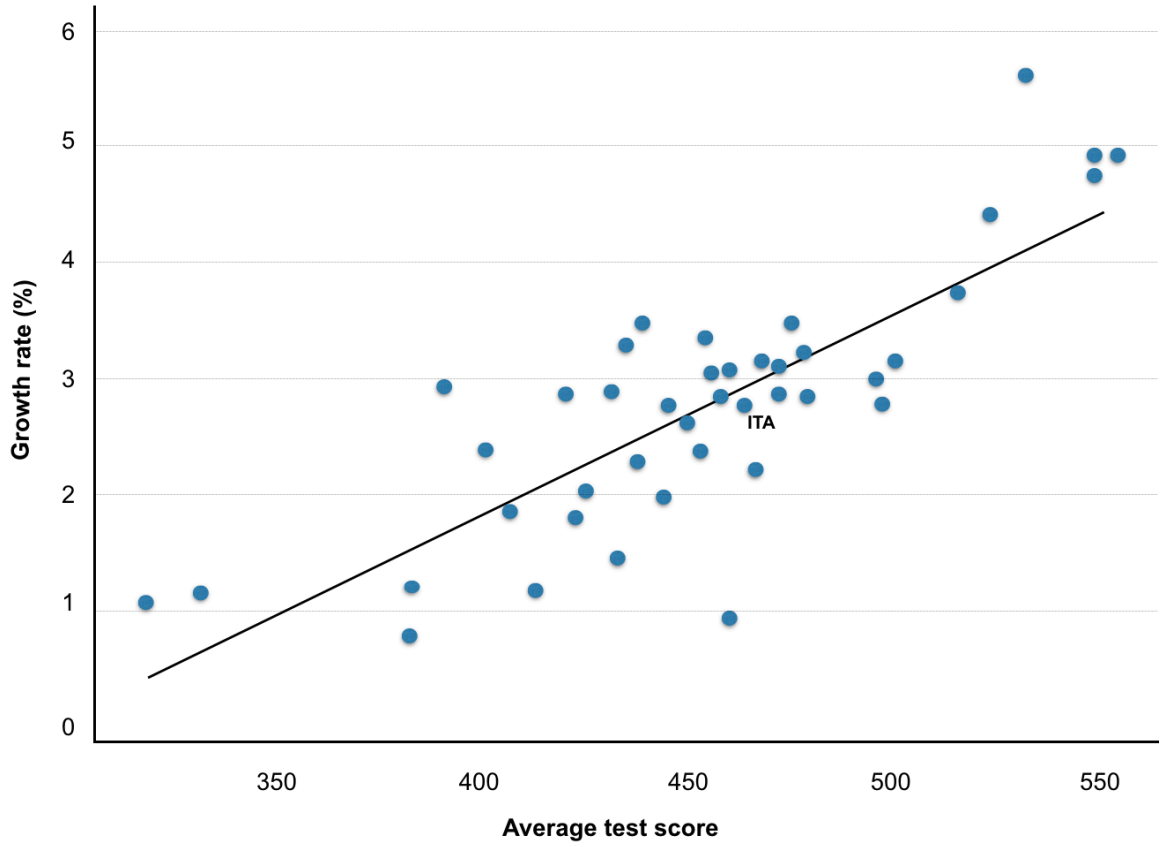
added value. This is the core of *Circular Economy Advantage* - as Scholars said (Lacy et Rutqvist, 2015) – that is based on the assumption that both economic and social development must be addressed using shared principles for companies and stakeholders[51].

2.2 The role of education and training systems: the New Skills Agenda for Europe

Taking CE model in itself is challenging, so what factors influence the uptake of CE practices? One-size-fits-all solution shall not apply (National Zero Waste Council, 2016; EEA, 2017) because it depends on several factors: not only related to resources availability and business models, but also to mindset, skills and participant's capability to take action and to tailor to different circumstances.

Moreover, scholars (Hanushek et Woessmann, 2015) have recognized that investing in skills is a driver for a more competitive economy. As Figure 1 shows using regression analyzes, the line reveals the correlation between average test scores on international student achievement tests and national growth rate in GDP per capita over the period 1960-2009.

Figure 1. Knowledge capital and economic growth



[51] In this context, the analyzes of Porter and Kramer (2011) on creating shared value is worth mentioning. A shared value perspective shall lead to new business models that enhance not only innovation and growth for companies but also benefits for citizens. It has to supersede corporate social responsibility in guiding investments and other actions of companies, avoiding "greenwashing" marketing strategies (Levinson et Horowitz, 2010; Shiva, 2013).

Source: Hanushek et Woessmann, 2015

For these reasons the Commission is also acting through its New Skills Agenda for Europe, as 2015 CE Package foretold. It was adopted on 10 June 2016 and sets out goals and actions to make the right training and skills, compared to *a pathway to employability and prosperity*[52].

In the context of CE, the ways people work and do business are changing, as well as the types of skills needed for implementing and adapting to business models and new job opportunities. Thus, what are the most suitable skills to maximize the capacity to drive innovation and to determine competitiveness? How will education and mindset boost the adoption of CE measures?

According to EC, the key set of competences which everyone should have include traditional ones and more transversal skills, both cognitive and practical, as logical, intuitive, creative and critical thinking, problem solving, entrepreneurship ability, digital competences and also learning to learn (Bacigalupo et al., 2016).

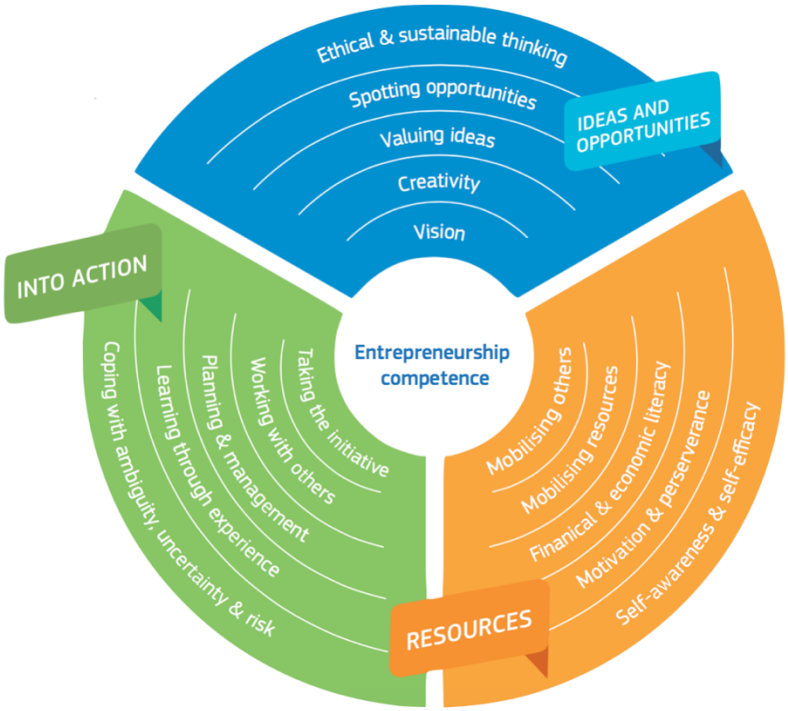
At the beginning of 2017, to address skills shortages in specific economic sectors, EC launched a *Blueprint for Sectorial Cooperation on Skills* as part of the New Skills Agenda. It supports initiatives to foster competence development, for instance the sectorial skills alliances at EU-level, that facilitates sharing of knowledge expertise and good practice, networking and cooperation, encouraging private investment, promoting a strategic use of EU (e.g. European Social Fund, European Regional Development Fund, European Fund for Strategic Investments) and national funding programmes, as well as supporting smart specialisation strategies in finding the greatest potential for competitive advantage of each region (see below). The New Skills Agenda has also launched a review of the 2006 *Recommendation on Key Competences for Lifelong Learning* and adopted a new proposal in January 2018 with the aim to strengthen a common understanding of lifelong learning and to improve digital, entrepreneurial competences and innovation-oriented mindsets and skills[53]. Special relevance has been given to shared values in the developing of social, cultural and economic environment, in compliance with 2030 UN Agenda for Sustainable Development and specifically Target 4.4, entitled *Relevant skills for decent work: substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.*

[52] COM(2016) 381 final, A NEW SKILLS AGENDA FOR EUROPE. Working together to strengthen human capital, employability and competitiveness

[53] Proposal for a COUNCIL RECOMMENDATION on Key Competences for Lifelong Learning Brussels, 17.1.2018 COM(2018) 24 final

Furthermore, the New Skills Agenda has highlighted how people could get the benefit of learning experience and ongoing training both at the workplace and abroad. They could not only update their capability and exploit new job opportunities but also adjust quickly to the different circumstances.
By focusing on SMEs skills and pro-activeness, the EU Entrepreneurship Competence Framework, known as EntreComp, enables better entrepreneurial capacity of citizens, both as an individual and collective, by defining a list of 15 competences within 3 key competence areas (see Figure 2 below).

Figure 2. EntreComp conceptual model



Source: Bacigalupo et al., 2016

EntreComp framework can be used across sectors as a tool for the improvement of curricula and learning activities breaking down the borders between education, work and civic engagement and enhancing entrepreneurship competence. And since entrepreneurship competence is a cross-cutting skill, it is the core to cope with economic, social and cultural challenges and opportunities, which the new business models hold even under the CE scenario, creating value for society as whole.

3. METHODOLOGY/ PRELIMINARY INVESTIGATIONS

The following sections analyze and discuss the main cases emerged from European-funded projects, with particular attention to experience on education and skills enhancing to boost circular business

models in the Adriatic-Ionian (A-I) Macro Region. The most suitable experience and knowledge which can also be of benefit to others will be listed[54].

3.1 The Adriatic-Ionian Macro-Region at a glance

Various motivations were behind the choice of A-I Macro Region. Firstly, Adriatic Sea is identified as an element of powerful connection between the two shores and then their populations in geographical and historical terms, one thinks of the Roman heritage, the authority of Venice or the role of Apulia. Secondly, for a long time Adriatic Sea has been considered the main crossroad of the Orient-Occident trade exchange, characterized by a great intensity of contacts, circulation of goods and exploitation of the resources (Moroni, 2010; ECB, 2018). Moreover, circulation has also affected knowledge and competences: from manpower of immigrants to clergymen, often lawyers or people of culture, who collected and disseminated techniques in arts and crafts, aesthetic taste and cultural heritage. Lastly, the several foreign dominations, including Italy, have contributed to create complex political, cultural and religious stratifications (Ivetic, 2017). And even today, tourist and cultural connections, as well as commercial, migrational and entrepreneurial relations testify the great interest in this Area (Canullo et al., 2011). Likewise in the banking sector, investment trends of neighboring EU MS were primarily attracted by a market not only *with good potential* but also *with cultural and historical similarities* (Cutrini et al., 2011:241).

However, as Ivetic (2017) emphasized, lastly EU transfrontier policies regionalize the Adriatic Sea by placing a new political and cultural vision, namely a transnational heritage shared between countries in Adriatic littorals. EC has working on fostering inclusion of the Balkans in the EU (Cutrini et Spigarelli, 2012). Since 2000 an EU Strategy for the Adriatic and Ionian Region (EUSAIR) has been developed in order to support strategic actions with a cooperative approach in the area defined by the Adriatic and Ionian Seas basins. This project involves four EU Member States - Croatia, Greece, Italy, Slovenia - and candidate and potential candidate countries - Albania, Bosnia and Herzegovina, Montenegro, Serbia. As far as Italy, the regions participating are Friuli Venezia Giulia, Veneto, Lombardia, Emilia Romagna, Marche, Umbria, Abruzzo, Molise, Basilicata, Puglia, Calabria and Sicilia and the autonomous province of Bolzano and Trento (see Figure 3 below).

[54] The reason for choosing A-I Macro Region is linked to the original project "Formazione e mindset imprenditoriale per l'internazionalizzazione delle imprese della green economy" of "Eureka" scholarship where the supporting firm intended to explore training opportunities in that area.

Figure 3. Members of the Adriatic-Ionian Macro-Region

Source: EUSAIR website, Published On October 27, 2015

EUSAIR strategy aims to create synergies and foster coordination on issues of common interest with high relevance for the Countries, categorized in four main thematic pillars:

I) 'Blue Growth';

II) 'Connecting the Region';

III) 'Environmental Quality';

IV) 'Sustainable Tourism'.

In addition to these, CE and innovation cover a cross-cutting role.

Recently, another policy method carried out by the EU is the Smart Specialization approach, which selects a limited number of promising objectives to stimulate regional growth, job creation and collaboration among stakeholders, as well as it disseminates good practices and lessons relevant for all the countries involved. In the areas of discussions on the EUSAIR cooperation, the latest Smart Specialisation Strategy (S3) has the function to identify the right policy needs and priorities in EU regions with the aim to facilitate decision-making, even through the S3 Platform[55].

S3 has offered several opportunities for networking and collaborations since it uses a transversal approach. Numerous actors are involved in the S3 cooperation, e.g. policy-makers, entrepreneurs, education and research institutions and civil society. In addition, appropriate coordination should be

[55] http://s3platform.jrc.ec.europa.eu/

sought with other similar initiatives and instrument involving this area (e.g. the Interreg Adriatic-Ionian - ADRION Transnational Cooperation Programme, the Adriatic Ionian Euro-Region, the inter-governmental Adriatic and Ionian Initiative -AII, the AIC Forum of the Adriatic and Ionian Chambers of Commerce and the Adriatic and Ionian Interregional Group at the Committee of the Regions).

4. THE ANALYSIS

The following paragraph provides a map of EU – Balkans relationship and the European-funded projects related with a strong focus on implementing CE policies and business models. As shown in the literature, CE concept has gained increasing relevance in academic and non-academic field (see Chapter I) and it is mainly related to sustainable development in both cases (see Chapter II).

Furthermore, a significant contribution was recently made by the DG Environment of the European Commission, which furnished valuable information on how to implement the "ambitious" Circular Economy Action Plan with the purpose of achieving a more sustainable economy[56].

In this context, main EU instruments to support CE is noteworthy. For instance, the platform for financing CE launched by the EC, the European Investment Bank, financial market participants and companies in January 2017 with the aim to increase awareness of the CE business models, including financing instrument and banking industry. CE has been also a recurring topic in the uptake of Cohesion policy funds (e.g. in 'Urban innovative actions' call or in the 2016 RegioStars awards won by Circular Ocean INTERREG project) and of Smart Specialisation Strategies, where priorities related to CE principle guide the regions' investments in research and innovation (e.g. 2016 thematic S3 platforms).

The EC concretely support SMEs transition towards a CE through EU funds, namely the Cohesion policy funds amounting to EUR 150 billion in the 2014-2020, as well as innovative projects within HORIZON 2020 and LIFE programmes.

4.1 A map of European-funded projects

The main objective of this section is to show collaboration networks able to foster CE adoption in A-I Macro Region, by collecting the data through the EC web portal CORDIS, where the European projects funded are available by the first Framework Programme up to Horizon 2020.

[56] Reference is made to the new set of measures adopted by the EC in January 2018, namely the EU Strategy for Plastics in the Circular Economy; a Communication on options to address the interface between chemical, product and waste legislation; a Monitoring Framework on progress towards a CE at EU and national level; a Report on Critical Raw Materials and the CE.

The collection of EU-funded project was carried out by the utilization of specific criteria within A-I area without any limit of year or programme. The keywords used to find data is based on the search cues: “circular economy” or “circular innovation” further refined by Countries in the A-I Macro-Region. This searching procedure delivered 254 results concerning CE topic in the area under investigation, specifically: 14 projects involve Croatian partners; 36 Greek; 81 Italian; 18 Slovenian; 2 Serbian; only 1 with partner from Bosnia and Herzegovina; and no one from Albania and Montenegro. As a matter of fact, about 10 percent of projects focus on developing a circular approach through cooperation between Italian and other EUSAIR partners (see Table 4 below).

Table 4. Italian - EUSAIR Cooperation

Project acronym	**Italian partners**	**Other EUSAIR partners**
AFTERLIFE	EGGPLANT SOCIETA’ A RESPONSABILITA’ LIMITATA, Italy AUSTEP-AUSTEAM ENVIRONMENTAL PROTECTION SPA, Italy INNOVEN SRL, Italy	MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia
AgroCycle	CONSIGLIO NAZIONALE DELLE RICERCHE, Italy CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA, Italy	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS, Greece MEDUNARODNI CENTAR ZA ODRZIVI RAZVOJ ENERGETIKE VODA I OKOLISA, Croatia ELLINIKOS GEORGIKOS ORGANISMOS – DIMITRA, Greece EKO KVARNER ORGANIZATION, Croatia
BIO-QED	NOVAMONT SPA, Italy MATER-BIOTECH SPA, Italy RINA SERVICES SPA, Italy	MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia
C-SERVEES	RINA CONSULTING SPA, Italy	PARTICULA GROUP DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA USLUGE, Croatia
CINDERELA	UNIVERSITA’ COMMERCIALE LUIGI BOCCONI, Italy OPENCONTENT SOCIETA’ COOPERATIVA, Italy POLO TECNOLOGICO DI PORDENONE SOCIETA’ CONSORTILE PER AZIONI, Italy	ZAVOD ZA GRADBENISTVO SLOVENIJE, Slovenia BEXEL CONSULTING DOO BEOGRAD, Serbia NIGRAD KOMUNALNO PODJETJE DD, Slovenia I.G.K. RECIKLAZA DOO ZA PROIZVODNJU, TRGOVINU I USLUGE, Croatia
CIRC-PACK	NOVAMONT SPA, Italy MATER-BIOTECH SPA, Italy MATER-BIOPOLYMER SRL, Italy Fater S.p.A., Italy CENTRO RICERCHE FIAT SCPA, Italy RINA CONSULTING SPA, Italy	MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia SAPONIA KEMIJSKA, PREHRAMBENA I FARMACEUTSKA INDUSTRIA D.D., Croatia GRAD RIJEKA-GRADSKO VIJECE, Croatia
CLIC	CONSIGLIO NAZIONALE DELLE RICERCHE, Italy FACILITYLIVE OPCO SRL, Italy COMUNE DI SALERNO, Italy	UNIVERZA V NOVI GORICI, Slovenia GRAD RIJEKA-GRADSKO VIJECE, Croatia
DIBBIOPACK	CONSIGLIO NAZIONALE DELLE RICERCHE, Italy CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI, Italy LABORATORI ARCHA SRL, Italy	Gorenje Orodjarna, d.o.o., Velenje, Partizanska 12, Slovenia RAZVOJNI CENTER ORODJARSTVA SLOVENIJE, Slovenia TSATSOS GEORGIOS, Greece

		HELP INDUSTRIAL COMMERCIAL PHARMACEUTICAL & HOSPITAL PRODUCTS SA, Greece TEHNOS PODJETJE ZA PROIZVODNJO OROD IJ STROJEV IN PREDELAVO PLASTICNIH MAS DOO ZALEC, Slovenia
EMBRACED	Fater S.p.A., Italy LEGAMBIENTE ASSOCIAZIONE ONLUS, Italy NOVAMONT SPA, Italy CONTARINA SPA, Italy EDIZIONI AMBIENTE SRL, Italy	SAPONIA KEMIJSKA, PREHRAMBENA I FARMACEUTSKA INDUSTRIA D.D., Croatia
ERA-MIN 2	MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITA' E DELLA RICERCA, Italy	Ministrstvo za izobrazevanje, znanost in sport, Slovenia
FISTERA	TELECOM ITALIA LAB S.P.A., Italy	ZDRUZENJE RAZISKOVALCEV SLOVENIJE, Slovenia
INNO-DEAL	FINANZIARIA LAZIALE DI SVILUPPO, Italy	MESTNA OBCINA LJUBLJANA - MUNICIPALITY OF LJUBLJANA, Slovenia
NoAW	INNOVEN SRL, Italy UNIVERSITA' DEGLI STUDI DI ROMA LA SAPIENZA, Italy ALMA MATER STUDIORUM - UNIVERSITA' DI BOLOGNA, Italy CONFEDERAZIONE GENERALE DELL'AGRICOLTURA ITALIANA, Italy	PREDUZECE ZA PROIZVODNJU PROMET I USLUGE VINARIJA ALEKSANDROVIC DOO, VINCA, Serbia INSTITUT ZA ARHITEKTURU I URBANIZAM SRBIJE, Serbia NATIONAL TECHNICAL UNIVERSITY OF ATHENS – NTUA, Greece
PlastiCircle	CENTRO RICERCHE FIAT SCPA, Italy CONSORZIO PER LA PROMOZIONE DELLA CULTURA PLASTICA PROPLAST, Italy	MESTNA OBCINA VELENJE, Slovenia
Project Ô	IRIS SRL, Italy UNIVERSITA' DEGLI STUDI DI TORINO, Italy EKSO SRL, Italy POLITECNICO DI MILANO, Italy ACQUEDOTTO PUGLIESE SPA, Italy REGIONE PUGLIA, Italy ENTE NAZIONALE ITALIANO DI UNIFICAZIONE-UNI, Italy	OLIMPIAS TEKSTIL DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA PROIZVODNJU, Croatia PARTICULA GROUP DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA USLUGE, Croatia
RESYNTEX	DETTIN SPA, Italy BIOCHEMTEX SPA, Italy	IOS, INSTITUT ZA OKOLJEVARSTVO IN SENZORJE, DOO, Slovenia UNIVERZA V MARIBORU, Slovenia TEKSTILNA INDUSTRIJA AJDOVSCINA DD, Slovenia NATIONAL TECHNICAL UNIVERSITY OF ATHENS – NTUA, Greece CHIMAR HELLAS AE, Greece
ROBUST	UNIVERSITA' DI PISA, Italy PROVINCIA DI LUCCA, Italy	OIKOS SVETOVANJE ZA RAZVOJ DOO, Slovenia REGIONALNA RAZVOJNA AGENCIJA - LJUBLJANSKE URBANE REGIJE ZAVOD, Slovenia
UrBAN-WASTE	COMUNE DI SIRACUSA, Italy AMBIENTE ITALIA SRL, Italy REGIONE TOSCANA, Italy	ANAPTIXIAKI ANONIMI ETAIRIA DIACHIRISIS APORRIMATON ANOTILIKIS MAKEDONIAS-THRAKIS AE – DIAAMATH, Greece DUNEA DOO ZA REGIONALNI RAZVOJ I POSLOVNE USLUGE, Croatia PERIFEREIA IPEIROY, Greece

VULKANO	RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA, Italy	BOSIO PROIZVODNO-TRGOVSKO PODJETJE DOO, Slovenia VALJI PROIZVODNJA VALJEV IN ULITKO DOO, Slovenia
Water2REturn	ENCO SRL, Italy 2B Srl, Italy	ALGEN, CENTER ZA ALGNE TEHNOLOGIJE, DOO, Slovenia UNIVERZA V LJUBLJANI, Slovenia

Without any claim to covering this issue exhaustively, the following list of projects aims to offer some real examples of the development of latest circular business models in A-I Macro-Region (see Table 5)[57].

Table 5. Case studies

Starting year	Acronym	Title
2002	FISTERA	Foresight on Information Society Technologies in the European Research Area
2006	INNO-DEAL	Analysis, diagnosis, evaluation, pilot actions and learning processes for joint innovation programmes
2012	DIBBIOPACK	Development of Injection and Blow extrusion molded Biodegradable and multifunctional packages by nanotechnology: Improvement of structural and barrier properties, smart features and sustainability
2014	BIO-QED	Quod Erat Demonstrandum: Large scale demonstration for the bio-based bulk chemicals BDO and IA aiming at cost reduction and improved sustainability
2015	RESYNTEX	A new circular economy concept: from textile waste towards chemical and textile industries feedstock
2016	AgroCycle	Sustainable techno-economic solutions for the agricultural value chain
2016	ERA-MIN 2	Implement a European-wide coordination of research and innovation programs on raw materials to strengthen the industry competitiveness and the shift to a circular economy
2016	NoAW	Innovative approaches to turn agricultural waste into ecological and economic assets
2016	UrBAN-WASTE	Urban strategies for Waste Management in Tourist Cities
2016	VULKANO	Novel integrated refurbishment solution as a key path towards creating eco-efficient and competitive furnaces
2017	AFTERLIFE	Advanced Filtration TEchnologies for the Recovery and Later conversIon of relevant Fractions from wastEwater
2017	CIRC-PACK	Towards circular economy in the plastic packaging value chain
2017	CLIC	Circular models Leveraging Investments in Cultural heritage adaptive reuse
2017	EMBRACED	Establishing a Multi-purpose Biorefinery for the Recycling of the organic content of AHP waste in a Circular Economy Domain
2017	PlastiCircle	Improvement of the plastic packaging waste chain from a circular economy approach
2017	ROBUST	Rural-Urban Outlooks: Unlocking Synergies
2017	Water2REturn	REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture
2018	C-SERVEES	Activating Circular Services in the Electric and Electronic Sector
2018	CINDERELA	New Circular Economy Business Model for More Sustainable Urban Construction
2018	Project Ô	Project Ô: demonstration of planning and technology tools for a circular, integrated and symbiotic use of water

[57] For a full description of the selected projects see Appendix N. 2.

5. DISCUSSION

5.1 Eco-innovative projects, circular value and culture

The research performed in the previous paragraph offered a list of heterogeneous projects from different scientific fields. It demonstrates the economic and environmental feasibility of the CE approach and at the same time gives great impetus to the SMEs competitiveness and reindustrialization of the EU sectors. All of the projects deliver new CE business models based on both systemic eco-innovative products (e.g. CINDERELLA for the use of secondary raw materials in urban areas; or concerning new bio-materials used notably for packaging, as CIRC-PACK, DIBBIOPACK, EMBRACED, ERA-MIN 2) and processes (e.g. C-SERVEES in the electrical and electronic industry; RESYNTEX in the chemical and textile industry; PlastiCircle in the plastics sector; NoAW in the agrifood; VULKANO in preheating and melting industrial furnaces, applied on three energy–intensive sectors, i.e. steel, ceramic and aluminum). Another relevant issue to be highlighted regards the key role of ICT as early as 2002 (see FISTERA project). It is no surprising that water is confirmed as being the main element affected by CE transition, considering not only the linkages with agrifood production (AFTERLIFE; Water2REturn) but also the integrated water management as whole (Project Ô).

As 2015 CE Package required, *a continued, broader commitment from all levels of government, in MS, regions and cities and all stakeholders concerned will also be necessary* by means of public-private partnerships, best practices exchanges, voluntary business approaches, entrepreneurial consortium (BIO-QED), as well as social consultations. Place-based case study approach is fundamental to reduce the EU's Innovation Divide addressing the regional S3 (AgroCycle) with better tailored policies, which take into account the special dimensions of local development and economic activities (e.g. UrBAN-WASTE, ROBUST, INNO-DEAL) including the valorization of cultural heritage (CLIC).

As long as the EC has recently set rules more flexible and a tailored approach to help SMEs and small entrepreneurs to get easier access to the funds for innovation focusing, inter alia, on CE and industrial modernization, as released in the new proposal for modernize and reform the Regional Development and Cohesion Policy for the next programming period 2021-2027[58]. Vice-President responsible for Jobs, Growth, Investment and Competitiveness, Jyrki Katainen, claimed that the proposal would

[58] EC Strasbourg, 29.5.2018 COM(2018) 375 final 2018/0196(COD). Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, and the European Maritime and Fisheries Fund and financial rules for those and for the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument.

further contribute to a business-friendly environment in Europe, setting the right conditions for growth, job creation and investment (EC, 2018 *Press release*).

5.2 Collaboration and nudging

Since many SMEs have lacked the resources or competence, A-I Countries need to identify and promote sustainable financial models, innovative thinking and forming partnerships to implement CE (Ilić et Nikolić, 2016). These complex social and environmental challenges need to be tackled on a collaborative basis. For instance the Sustainability Transition Lab of The Natural Step, a non-profit organization, applies designing expertise to companies and their stakeholders to create disruptive solutions *by learning to think, work, and innovate together differently*[59].

First of all, senior management needs to invest in implementation through a leader who clearly pursues goals and targets according to circular principles, defining new tasks and skills needed for effective execution. It is essential to supervise and monitor the progress, on a case-by-case basis, generating a new operational environment, that is a huge opportunity to create and disseminate circular culture both within and outside companies, across the traditional business boundaries (i.e. Industrial Symbiosis). Secondly, rethinking how company creates value does not only drive substantive change in conventional business models but also in traditional attitudes and behaviors. New circular culture, which is determinated by SMEs, engages all stakeholders, including customers with different forms: from the mere availability of information and education to consultation gaining opinions and feedback, to involving and working directly, and then to collaboration with a tailored approach. The latter form makes the financial benefits clear to the end user and therefore it fosters co-innovation, testing and piloting projects with a minority group of early adopters (Fischer et Achterberg, 2016). However, in order to made all costumers made aware of the value creation within CE model education research and education are essential to overcome behavioral barriers and bring forward new ways of thinking and acting.

According to scholars (Schaltegger and Wagner, 2007; Hall et al., 2010) entrepreneurship is the cornerstone in the transition towards sustainable innovative products and processes as a valuable solution for social and environmental concerns. Nevertheless, socio-cultural conditions and institutional realities influence SMEs' will in the adoption of CE practices (Iyigun, 2015). And furthermore, most durable changes in society have been carried out by bottom-up initiatives within stakeholders' collaboration because knowledge and expertise have greater consequences when shared, also by the means of broad networks and platforms (e.g. S3 Platform). Raise awareness of the importance of CE depends also on communication skills: how a situation of choice is designed and options presented (i.e., the "choice architecture") influence decisions and behavior. For this reason,

[59] http://www.thenaturalstep.org/en, accessed on July 2018.

nudging plays a key role in support of both SMEs (Cialdini, 2007; Martin et al., 2014) and public institutions (Sunstein et Thaler, 2009). In 2016, for instance, some consultants from Copenhagen Economics carried out a study on using nudging to increase sustainable consumption on mobile phones among young people[60]. The experiment noted that nudge leads to a statistically significant difference in order to increase reuse and repair actions.

As well as, policy instrument qualified as a nudge (Bovens, 2009) have been more widely used, notably pro-environmental behavior interventions (Thomas et al., 2013). It contributes to making people aware of environmental values and to change their behavior in a predictable manner without restricting individual choice options.

6. CONCLUSION

The suggestions deriving from the analyzed results are the clear signal that achieving the CE approach will depend not only on technological eco-innovation and business models, but also on governance, mindset, skills and knowledge. It is evident that stakeholders' collaboration plays a central role through information and education, data, monitoring and indicators, exchange of experience and public participation. As well as, improve SMEs synergies and help consumers to make more sustainable choices have been identified as some of the priorities to be pursued *(*EEB, 2017). As previously shown, nudge approach shall be useful in order to raise awareness about changing lifestyles and preferences in consumption patterns. First of all, a primary managerial implication of the research refers to the emerging of new business and consumption models, which create eco-innovation and job opportunities. Secondly, it is essential figure out what shall stimulate all stakeholders in the transition towards CE and then identify the tailored policy frameworks that address different groups. This could support the transition towards CE: the most favorable cultural environment.

[60] See the main report: TN2016:511 Nudging för hållbar konsumtion av elektronikprodukter, 2016.

APPENDIX n. 2

AFTERLIFE

Project title	Advanced Filtration TEchnologies for the Recovery and Later conversIon of relevant Fractions from wastEwater
Project acronym	AFTERLIFE
Project ID	745737
Funded under	H2020-EU.3.2.6. - Bio-based Industries Joint Technology Initiative (BBI-JTI)
Project Duration	From 2017-09-01 to 2021-08-31
Topic(s)	BBI-2016-R01 - Valorisation of the organic content of wastewater as feedstock, contributing to the renewable circular economy
Total cost	EUR 4 180 166,38
EU contribution	EUR 3 890 593,13
Coordinator	EGGPLANT SOCIETA' A RESPONSABILITA' LIMITATA, Italy
Brief Description	Following a holistic view in the zero-waste and circular economy approach for maximising the recovery and valorisation of the relevant fractions from wastewater, the project aims to: I) improve wastewater treatment performance; II) reduce their costs. A flexible, cost- and resource-efficient process is proposed in order to demonstrate both an integrated pilot using real wastewater from three water intensive food processing industries (namely, fruit processing, cheese and sweets manufacturing) and the applicability of the recovered compounds and the value added bioproducts in manufacturing environments.
Participants	OPTIMIZACION ORIENTADA A LA SOSTENIBILIDAD SL, Spain AUSTEP-AUSTEAM ENVIRONMENTAL PROTECTION SPA, Italy BIO BASE EUROPE PILOT PLANT VZW, Belgium CELABOR SCRL, Belgium L'UREDERRA, FUNDACION PARA EL DESARROLLO TECNOLOGICO Y SOCIAL, Spain MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia NOVA-INSTITUT FUR POLITISCHE UND OKOLOGISCHE INNOVATION GMBH, Germany Teknologian tutkimuskeskus VTT Oy, Finland AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, Spain ASOCIACION EMPRESARIAL DE INVESTIGACION CENTRO TECNOLOGICO NACIONAL DE LA CONSERVA, Spain NOVA ID FCT - ASSOCIACAO PARA A INOVACAO E DESENVOLVIMENTO DA FCT, Portugal JAKE SA, Spain HERITAGE 1466, Belgium CITROMIL SL, Spain INNOVEN SRL, Italy

AgroCycle

Project title	Sustainable techno-economic solutions for the agricultural value chain
Project acronym	AgroCycle
Project ID	690142
Funded under	H2020-EU.3.2. - SOCIETAL CHALLENGES - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2016-06-01 to 2019-05-31
Topic(s)	WASTE-7-2015 - Ensuring sustainable use of agricultural waste, co-products and by-products
Total cost	EUR 7 650 049,75
EU contribution	EUR 6 960 293,75
Coordinator	UNIVERSITY COLLEGE DUBLIN, NATIONAL UNIVERSITY OF IRELAND, DUBLIN, Ireland

Brief Description	AgroCycle will convert low value wastes from several agricultural sectors (wine, olive oil, horticulture, fruit, grassland, swine, dairy and poultry) into highly valuable products. It allows to achieve a 10% increase in waste recycling and valorisation by 2020 by developing a detailed and holistic understanding of the waste streams and piloting a key number of waste utilisation/valorisation pathways. The AgroCycle Protocol will deliver sustainable waste valorisation pathways addressing the European policy target of reducing food waste by 50% by 2030.
Participants	UNIVERSITEIT GENT, Belgium HARPER ADAMS UNIVERSITY, United Kingdom FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany CONSIGLIO NAZIONALE DELLE RICERCHE, Italy ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS, Greece MEDUNARODNI CENTAR ZA ODRZIVI RAZVOJ ENERGETIKE VODA I OKOLISA, Croatia ELLINIKOS GEORGIKOS ORGANISMOS – DIMITRA, Greece CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA, Italy The National Non-Food Crops Centre, United Kingdom CHINA AGRICULTURAL UNIVERSITY, China NANJING UNIVERSITY OF TECHNOLOGY, China IRIS TECHNOLOGY SOLUTIONS, SOCIEDAD LIMITADA, Spain TOMSA DESTIL SL, Spain EXERGY LTD, United Kingdom AXEB BIOTHECH SL, Spain MASSTOCK ARABLE UK LIMITED, United Kingdom RESET CARBON LIMITED, Hong Kong CARTON BROS, Ireland NATIONAL UNIVERSITY OF IRELAND MAYNOOTH, Ireland EUROPEAN BIOMASS INDUSTRY ASSOCIATION, Belgium COMITE EUROPEEN DES GROUPEMENTS DE CONSTRUCTEURS DU MACHINISME AGRICOLE, Belgium CONFEDERATION INTERNATIONALE DES BETTERAVIERS EUROPEENS, Belgium EKO KVARNER ORGANIZATION, Croatia INSTITUTO TECNOLOGICO AGRARIO DE CASTILLA Y LEON, Spain INNOVATION FOR AGRICULTURE, United Kingdom

BIO-QED

Project title	Quod Erat Demonstrandum: Large scale demonstration for the bio-based bulk chemicals BDO and IA aiming at cost reduction and improved sustainability
Project acronym	BIO-QED
Project ID	613941
Funded under	FP7-KBBE
Project Duration	From 2014-01-01 to 2017-12-31
Topic(s)	KBBE.2013.3.3-01 - Support for demonstrating the potential of biotechnological applications
Total cost	EUR 11 179 694,29
EU contribution	EUR 6 365 659
Coordinator	NOVAMONT SPA, Italy
Brief Description	In the transition towards a resource efficiency bioeconomy, the project built an entrepreneurial consortium with the joint ambition to quickly develop innovative bio-based processes through generating hard evidence and collecting all technical and economic key design parameters needed for investment decisions guided by the principle of regeneration of local areas to create new industries, new products and new jobs. The consortium is based on strong industrial leadership on both of the selected products, and covers the full supply chains for bio-based BDO and IA. The planned demonstrations are solidly based on preceding research results originating from the KBBE Flagship Project BioConSepT and the internal research programs of the industrial partners.

Participants	Lubrizol, Spain MATER-BIOTECH SPA, Italy CARGILL HAUBOURDIN SAS, France MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO, Netherlands FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany PATENTOPOLIS BV, Netherlands RINA SERVICES SPA, Italy NOVA-INSTITUT FUR POLITISCHE UND OKOLOGISCHE INNOVATION GMBH, Germany VAN LOON CHEMICAL INNOVATIONS BV, Netherlands ITACONIX CORPORATION, United States

C-SERVEES

Project title	Activating Circular Services in the Electric and Electronic Sector
Project acronym	C-SERVEES
Project ID	776714
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2018-05-01 to 2022-04-30
Topic(s)	CIRC-01-2016-2017 - Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Total cost	EUR 8 034 707,31
EU contribution	EUR 6 349 067,37
Coordinator	AIMPLAS - ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS, Spain
Brief Description	C-SERVEES aims to boost a resource-efficient CE in the electrical and electronic sector through the development, testing, validation and transfer of new business models based on systemic eco-innovative service (i.e., eco-leasing, customization of products, circular management and ICT services to support the other eco-services). The main eco-innovative ICT tool relyies on QR codes, which are able to take synergically full advantage of the CE and the Industry 4.0. Setting the foundation for realistic market-ready solutions, the project shall raise new opportunities both for end-users and for social and solidarity economy.
Participants	FUNDACION GAIKER, Spain LOUGHBOROUGH UNIVERSITY, United Kingdom OSTERREICHISCHE GESELLSCHAFT FUR SYSTEM- UND AUTOMATISIERUNGSTECHNIK VEREIN, Austria LEXMARK INTERNATIONAL, Belgium ADVA OPTICAL NETWORKING SE, Germany ARCELIK A.S., Turkey RINA CONSULTING SPA, Italy EMAUS FUNDACION SOCIAL, Spain INDUMETAL RECYCLING, S.A., Spain GREENTRONICS SRL, Romania WASTE OF ELECTRICAL AND ELECTRONICAL EQUIPMENT FORUM AISBL, Belgium CIRCULARISE BV, Netherlands EXERGY LTD, United Kingdom PARTICULA GROUP DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA USLUGE, Croatia VERTECH GROUP, France

CINDERELA

Project title	New Circular Economy Business Model for More Sustainable Urban Construction

Project acronym	CINDERELA
Project ID	776751
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2018-06-01 to 2022-05-31
Topic(s)	CIRC-01-2016-2017 - Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Total cost	EUR 7 635 365,25
EU contribution	EUR 6 729 219
Coordinator	ZAVOD ZA GRADBENISTVO SLOVENIJE, Slovenia
Brief Description	CINDERELLA project aims to develop a new CE business model for secondary use of raw materials in urban areas, connecting different sectors (e.g., the construction sector and municipal services), decision-makers and the general public with the support of ICT. The suitability for use for building materials will be demonstrated through large scale demonstration activities in Slovenia, Croatia and Spain while the ICT platform will be demonstrated in Slovenia, Croatia, Spain, Poland, Italy and The Netherlands. The project will contribute to 20% reduction of environmental impacts along the value and supply chain, reducing virgin material exploitation and converting wastes to products. Sustainability of CEBM will be proven with the environmental, economic and social assessment through whole life (LCA, LCC and S-LCA).
Participants	UNIVERSITA' COMMERCIALE LUIGI BOCCONI, Italy BEXEL CONSULTING DOO BEOGRAD, Serbia OPENCONTENT SOCIETA' COOPERATIVA, Italy FUNDACION BENEFICO-DOCENTE GOMEZ-PARDO, Spain FUNDACION TECNALIA RESEARCH & INNOVATION. Spain NIGRAD KOMUNALNO PODJETJE DD, Slovenia INSTYTUT EKOLOGII TERENOW UPRZEMYSLOWIONYCH, Poland ASOCIACION DE EMPRESARIOS DEL HENARES, Spain TECHNISCHE UNIVERSITEIT DELFT, Netherlands I.G.K. RECIKLAZA DOO ZA PROIZVODNJU, TRGOVINU I USLUGE, Croatia POLO TECNOLOGICO DI PORDENONE SOCIETA' CONSORTILE PER AZIONI, Italy KPLUSV ORGANISATIEADVIES BV, Netherlands

CIRC-PACK

Project title	Towards circular economy in the plastic packaging value chain
Project acronym	CIRC-PACK
Project ID	730423
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2017-05-01 to 2020-04-30
Topic(s)	CIRC-01-2016-2017 - Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Total cost	EUR 9 252 466,25
EU contribution	EUR 7 308 180,13
Coordinator	FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS, Spain
Brief Description	Supported by CE and industrial symbiosis principles, CIRC-PACK project will provide breakthrough biodegradable plastics using alternative biobased raw materials. In addition, eco-design packaging for improving and end-of-life multilayer and multicomponent packaging will be technologically advanced and adapted also to the new materials produced. Lastly, a multi-sectorial cascaded approach along plastic packaging value chain will be applied with critical impacts in other value chains beyond the targeted plastic packaging value chain.
Participants	FUNDACION AITIIP, Spain NOVAMONT SPA, Italy MATER-BIOTECH SPA, Italy MATER-BIOPOLYMER SRL, Italy BUMAGA BV, Netherlands

	NUEVAS TECNOLOGIAS PARA EL DESARROLLO DE PACKAGING Y PRODUCTOS AGROALIMENTARIOS CON COMPONENTE PLASTICA SL, Spain MI-PLAST DOO ZA PROIZVODNJU TRGOVINU I PRUZANJE USLUGA - MI-PLAST LLC MANUFACTURING, TRADING AND SERVICES MIPLAST, Croatia GRUPO SADA P A SA, Spain SAPONIA KEMIJSKA, PREHRAMBENA I FARMACEUTSKA INDUSTRIA D.D., Croatia Fater S.p.A., Italy CENTRO RICERCHE FIAT SCPA, Italy ASOCIACION ESPANOLA DE NORMALIZACION, Spain RINA CONSULTING SPA, Italy EKODENGE MUHENDISLIK MIMARLIK DANISMANLIK TICARET ANONIM SIRKETI, Turkey ECOEMBALAJES ESPANA, S.A., Spain GRAD RIJEKA-GRADSKO VIJECE, Croatia KARTAL BELEDIYE BASKANLIGI, Turkey CALAF TECNIQUES INDUSTRIALS SL, Spain OCU EDICIONES SA, Spain ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH)*, Germany PLASTIPOLIS, France

CLIC

Project title	CLIC - Circular models Leveraging Investments in Cultural heritage adaptive reuse
Project acronym	CLIC
Project ID	776758
Funded under	H2020-EU.3.5.6. - Cultural heritage
Project Duration	From 2017-12-01 to 2020-11-30
Topic(s)	SC5-22-2017 - Innovative financing, business and governance models for adaptive re-use of cultural heritage
Total cost	EUR 4 957 033
EU contribution	EUR 4 957 033
Coordinator	CONSIGLIO NAZIONALE DELLE RICERCHE, Italy
Brief Description	Despite cultural heritage is considered as a resource for local development strategies, there are some contradictions: the sites are increasing and the costs for functional reuse are growing, while financial support is becoming scarcer. On the other side, cultural heritage is non-renewable and needs to be the focus of conservation proposals. The CLIC project addresses the investment gap in cultural heritage and landscape regeneration through careful evaluation of all costs and impacts of adaptive reuse. Its functions are not only linked to tourism attractiveness, but also for the well-being improvement, providing critical evidence of wealth, jobs, social, cultural, environmental and economic returns on the investment. The overarching goal of the CLIC trans-disciplinary research project is to identify evaluation tools to test, implement, validate and share innovative "circular" financing, business and governance models for systemic adaptive reuse of cultural heritage and landscape, demonstrating the economic, social, environmental convenience, in terms of long lasting economic, cultural and environmental wealth.
Participants	UPPSALA UNIVERSITET, Sweden GROUPE ICHEC - ISC SAINT-LOUIS – ISFSC, Belgium UNIVERSITY COLLEGE LONDON, United Kingdom TECHNISCHE UNIVERSITEIT EINDHOVEN, Netherlands UNIVERSITY OF PORTSMOUTH HIGHER EDUCATION CORPORATION, United Kingdom UNIVERZA V NOVI GORICI, Slovenia WIRTSCHAFTSUNIVERSITAT WIEN, Austria UNIWERSYTET WARSZAWSKI, Poland ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH)*, Germany

	FACILITYLIVE OPCO SRL, Italy VASTRA GOTALANDS LANS LANDSTING, Sweden GRAD RIJEKA-GRADSKO VIJECE, Croatia COMUNE DI SALERNO, Italy STICHTING PAKHUIS DE ZWIJGER, Netherlands

DIBBIOPACK

Project title	Development of Injection and Blow extrusion molded Biodegradable and multifunctional packages by nanotechnology: Improvement of structural and barrier properties, smart features and sustainability
Project acronym	DIBBIOPACK
Project ID	280676
Funded under	FP7-NMP
Project Duration	From 2012-03-01 to 2016-02-29
Topic(s)	NMP.2011.1.1-1 - Smart and multifunctional packaging concepts utilizing nanotechnology
Total cost	EUR 7 745 570,31
EU contribution	EUR 5 702 632
Coordinator	FUNDACION AITIIP, Spain
Brief Description	The project aims to the development of new biobased materials, as well as the improvement of thermal, mechanical and barrier properties of these packages through nanotechnology and innovative coatings. Moreover, the project uses different intelligent technologies and smart devices to provide to the packaging value chain more information about the products and the processes, increase safety and quality of products through supply chain and improve the shelf-life of the packaged products.
Participants	CONSORZIO INTERUNIVERSITARIO NAZIONALE PER LA SCIENZA E TECNOLOGIA DEI MATERIALI, Italy LABORATORI ARCHA SRL, Italy Gorenje Orodjarna, d.o.o., Velenje, Partizanska 12, Slovenia RAZVOJNI CENTER ORODJARSTVA SLOVENIJE, Slovenia CENTAR ZA PLAZMA TEHNOLOGII PLAZMA DOO Former Yugoslav Republic of Macedonia AVANZARE INNOVACION TECNOLOGICA SL, Spain INCERPLAST SA., Romania FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany TSATSOS GEORGIOS, Greece VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V., Belgium PURAC BIOCHEM BV, Netherlands Condensia Quimica SA, Spain GEORGIA TECH IRELAND, Ireland SOCIEDADE GALEGA DO MEDIOAMBIENTE SA, Spain AYMING, France INNOVIA FILMS LIMITED, United Kingdom NUTRECO SERVICIOS,S.A., Spain CONSIGLIO NAZIONALE DELLE RICERCHE, Italy HELP INDUSTRIAL COMMERCIAL PHARMACEUTICAL & HOSPITAL PRODUCTS SA, Greece TEHNOS PODJETJE ZA PROIZVODNJO OROD IJ STROJEV IN PREDELAVO PLASTICNIH MAS DOO ZALEC, Slovenia NATIONAL UNIVERSITY OF IRELAND GALWAY, Ireland

EMBRACED

Project title	Establishing a Multi-purpose Biorefinery for the Recycling of the organic content of AHP waste in a Circular Economy Domain
Project acronym	EMBRACED
Project ID	745746

Funded under	H2020-EU.3.2.6. - Bio-based Industries Joint Technology Initiative (BBI-JTI)
Project Duration	From 2017-06-01 to 2022-05-31
Topic(s)	BBI-2016-D06 - Valorisation of the organic content of Municipal Solid Waste and contributing to the renewable circular economy
Total cost	EUR 17 334 553,75
EU contribution	EUR 10 695 211,13
Coordinator	Fater S.p.A., Italy
Brief Description	Within EMBRACED project, a first-of-its-kind multi-purpose integrated biorefinery will be established in order to valorize in a relevant environment scenario the cellulosic fractions obtained from waste of Absorbent Hygiene Products (AHP) towards the production of bio-products of significant commercial interest, and – concurrently – high added-value co-products, such polyolefinic plastics and SAP (superabsorbent polymers). This innovative biorefinery model will involve all the main actors of the whole value chain, from AHP consumers and local population to waste management and logistic companies, leading AHP producers and bioprocess developers, as well as final products developers. In a view of circular economy, all the fractions obtained from the processed AHP waste will be reused through valorization into final products, and in particular the high-quality cellulosic fraction of AHP (ca. 1,275,000 ton/y in Europe), which has significant advantages vs. traditional 2nd generation lignocellulosic feedstocks in terms of homogeneity and downstream bioprocessing costs, will be converted and valorized in two parallel value chains, leading to the production of biobased building blocks, polymers and fertilizers.
Participants	LEGAMBIENTE ASSOCIAZIONE ONLUS, Italy NOVAMONT SPA, Italy CONTARINA SPA, Italy FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS, Spain EDIZIONI AMBIENTE SRL, Italy AEB EXPLOITATIE BV, Netherlands TERRACYCLE UK LTD, United Kingdom PROCTER & GAMBLE INTERNATIONAL OPERATIONS SA, Switzerland SAPONIA KEMIJSKA, PREHRAMBENA I FARMACEUTSKA INDUSTRIA D.D., Croatia FERTINAGRO BIOTECH SL, Spain BV RUBBERFABRIEK WITTENBURG, Netherlands

ERA-MIN 2

Project title	Implement a European-wide coordination of research and innovation programs on raw materials to strengthen the industry competitiveness and the shift to a circular economy
Project acronym	ERA-MIN 2
Project ID	730238
Funded under	H2020-EU.3.5.3. - Ensuring the sustainable supply of non-energy and non-agricultural raw materials
Project Duration	From 2016-12-01 to 2021-11-30
Topic(s)	SC5-17-2016 - ERA-NET Cofund on Raw materials
Total cost	EUR 16 058 787,31
EU contribution	EUR 4 999 890,01
Coordinator	FUNDACAO PARA A CIENCIA E A TECNOLOGIA, Portugal
Brief Description	Improving synergy, co-ordination and coherence between regional, national and EU funding in research and innovation, ERA-MIN 2 addresses the three segments of the non-energy non-agricultural raw materials (metallic, industrial and construction minerals) covering the whole value chain (exploration, extraction, processing/refining, as well as recycling and substitution of critical raw materials).
Participants	VERKET FÖR INNOVATIONSSYSTEM, Sweden FORSCHUNGSZENTRUM JULICH GMBH, Germany Unitatea Executiva pentru Finantarea Invatamantului Superior, a Cercetarii, Dezvoltarii si Inovarii, Romania MINISTERIO DE ECONOMIA, INDUSTRIA Y COMPETITIVIDAD, Spain

	Ministerio de Ciencia, Tecnología e Innovación Productiva, Argentina NARODOWE CENTRUM BADAN I ROZWOJU, Poland COMISION NACIONAL DE INVESTIGACION CIENTIFICA Y TECNOLOGICA, Chile Ministrstvo za izobrazevanje, znanost in sport, Slovenia AGENCE NATIONALE DE LA RECHERCHE, France CENTRO PARA EL DESARROLLO TECNOLOGICO INDUSTRIAL., Spain DEPARTMENT OF SCIENCE AND TECHNOLOGY, South Africa COMMUNICATIONS, CLIMATE ACTION AND ENVIRONMENTS, Ireland AGENCE DE L'ENVIRONNEMENT ET DE LA MAITRISE DE L'ENERGIE, France TURKIYE BILIMSEL VE TEKNOLOJIK ARASTIRMA KURUMU, Turkey INNOVAATIORAHOITUSKESKUS BUSINESS FINLAND, Finland FONDS FLANKEREND ECONOMISCH EN INNOVATIEBELEID, Belgium INSTITUTO PARA LA COMPETITIVIDAD EMPRESARIAL DE CASTILLA Y LEON, Spain FONDS VOOR WETENSCHAPPELIJK ONDERZOEK-VLAANDEREN, Belgium MINISTERO DELL'ISTRUZIONE, DELL'UNIVERSITA' E DELLA RICERCA, Italy FINANCIADORA DE ESTUDOS E PROJETOS, Brazil

FISTERA

Project title	Foresight on Information Society Technologies in the European Research Area
Project acronym	FISTERA
Project ID	IST-2001-37627
Funded under	FP5-IST
Project Duration	From 2002-09-01 to 2005-08-31
Topic(s)	2002-6.1.1 - FET Open domain
Total cost	EUR 1 499 500
EU contribution	EUR 1 499 500
Coordinator	GOPA - CARTERMILL INTERNATIONAL, Belgium
Brief Description	According to EU objectives, FISTERA aims to build a competitive knowledge-based economy by means of information society technologies (ISTs). It describes the ISTs trends: firstly, it clarifying application areas for ISTs; secondly, looking at the concept of "Technology Trajectories". In this view, over 100 key technologies were discussed by experts and ten technology trajectories were selected for the study on the basis of the considerable impacts they would have on the information society (Bandwidth, Communications, Data Capturing, Human Interfacing, Info Visual Display, Info Retrieval, Pinpointing, Printing, Processing and Storage).
Participants	APPLIED RESEARCH AND COMMUNICATIONS FUND, Bulgaria ARC SEIBERSDORF RESEARCH GMBH, Austria DANISH TECHNOLOGICAL INSTITUTE, Denmark EUROPEAN COMMISSION - JOINT RESEARCH CENTRE, Belgium FORSCHUNGSZENTRUM KARLSRUHE GESELLSCHAFT MIT BESCHRAENKTER HAFTUNG, Germany FUNDACIO TECNOCAMPUS, FUNDACIO PRIVADA, Spain IQSOFT INTELLIGENS SOFTWARE RT, Hungary MCCAUGHAN ASSOCIATES, United Kingdom NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC RESEARCH – TNO, Netherlands OBSERVATORIO DE PROSPECTIVA DA ENGENHARIA E DA TECNOLOGIA, Portugal TELECOM ITALIA LAB S.P.A., Italy THE VICTORIA UNIVERSITY OF MANCHESTER, United Kingdom TURKIYE BILIMSEL VE TEKNIK ARASTIRMA KURUMU – TUBITAK, Turkey UNIVERSITY COLLEGE CORK, NATIONAL UNIVERSITY OF IRELAND, CORK, Ireland UNIVERSITY OF CALIFORNIA, BERKELEY, United States ZDRUZENJE RAZISKOVALCEV SLOVENIJE, Slovenia

INNO-DEAL

Project title	Analysis, diagnosis, evaluation, pilot actions and learning processes for joint innovation programmes
Project acronym	INNO-DEAL
Project ID	38831
Funded under	FP6-INNOVATION
Project Duration	From 2006-09-01 to 2009-08-31
Topic(s)	INNOVATION-2005-1.2.3 - Fostering coordination of national and sub-national innovation programmes
Total cost	EUR 2 148 000
EU contribution	EUR 2 148 000
Coordinator	FINANZIARIA LAZIALE DI SVILUPPO, Italy
Brief Description	The INNO-DEAL project aims at creating the conditions for promoting a systematic exchange of information and good practice on existing programmes, which foster innovation and support SMEs development with a special focus to start-up and spin-off creation. The identification and analyzes of common strategic issues in support of innovation and the development of a mentoring mutual learning cycle among regional programme managers will be the base for the structuring of a common ground for cooperation and for the implementation of joint programmes of trans-regional innovation activities. The activities described and implemented during the whole project have been structured in order to design a circular chain of actions so to allow a replication of activities once new needs comes to surface following the "IDEAMutual Learning Cycle" structured in 5 phases: Identification, Diagnosis, Engineering, Pilot Actions and Monitoring process.
Participants	MEDITERRANEE TECHNOLOGIES, France WIENER WISSENSCHAFTS-, FORSCHUNGS-UND TECHNOLOGIEFONDS, Austria AGENTIA PENTRU DEZVOLTARE REGIONALA NORD-EST, Romania ADVANTAGE WEST MIDLANDS, United Kingdom GOBIERNO DE NAVARRA DEPARTAMENTO DE INDUSTRIA Y TECNOLOGIA, COMERCIO Y TRABAJO, Spain KOUVOLAN SEUDUN KUNTAYHTYMÄ / KOUVOLA REGION FEDERATION OF MUNICIPALITIES, Finland LIETUVOS INOVACIJU CENTRAS, Lithuania MESTNA OBCINA LJUBLJANA - MUNICIPALITY OF LJUBLJANA, Slovenia PODLASKA REGIONAL DEVELOPMENT FOUNDATION, Poland REGIONÁLNÍ ROZVOJOVÁ AGENTURA STREDNÍ CECHY, Czech Republic WIRTSCHAFTSFÖRDERUNG REGION STUTTGART GMBH / STUTTGART REGION ECONOMIC DEVELOPMENT CORPORATION, Germany

NoAW

Project title	Innovative approaches to turn agricultural waste into ecological and economic assets
Project acronym	NoAW
Project ID	688338
Funded under	H2020-EU.3.2. - SOCIETAL CHALLENGES - Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2016-10-01 to 2020-09-30
Topic(s)	WASTE-7-2015 - Ensuring sustainable use of agricultural waste, co-products and by-products
Total cost	EUR 7 816 232,50

EU contribution	EUR 6 887 570
Coordinator	INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, France
Brief Description	NoAW aims to generate innovative efficient approaches to convert growing agricultural waste issues into eco-efficient bio-based products opportunities with direct benefits for both environment, economy and EU consumer. To achieve this goal, the NoAW involves all agriculture chain stakeholders in a territorial perspective and develops holistic life cycle thinking able to support environmentally responsible R&D innovations on agro-waste conversion at different TRLs, in the light of regional and seasonal specificities, not forgetting risks emerging from circular management of agro-wastes (e.g. contaminants accumulation).
Participants	INNOVEN SRL, Italy RISE RESEARCH INSTITUTES OF SWEDEN AB, Sweden UNIVERSITA' DEGLI STUDI DI ROMA LA SAPIENZA, Italy SCHIESSL PETER, Germany ALMA MATER STUDIORUM - UNIVERSITA' DI BOLOGNA, Italy DANMARKS TEKNISKE UNIVERSITET, Denmark INSTITUT ZA ARHITEKTURU I URBANIZAM SRBIJE, Serbia Campden BRI Magyarorszag Nonprofit Korlatolt Felelossegu Tarsasag, Hungary INSTITUTO DE BIOLOGIA EXPERIMENTAL E TECNOLOGICA, Portugal FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany INSTITUT FRANCAIS DE LA VIGNE ET DU VIN, France NATIONAL TECHNICAL UNIVERSITY OF ATHENS – NTUA, Greece UNIVERSITE DE MONTPELLIER, France GRAP'SUD SOCIETE COOPERATIVE AGRICOLE, France IBBK FACHGRUPPE BIOGAS GMBH, Germany AALBORG UNIVERSITET, Denmark SOFIES SA, Switzerland STICHTING WAGENINGEN RESEARCH, Netherlands CONFEDERAZIONE GENERALE DELL'AGRICOLTURA ITALIANA, Italy ECOZEPT GBR, Germany AGRIPORT A7 B.V., Netherlands INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE INCORPORATED, Taiwan CITY UNIVERSITY OF HONG KONG, Hong Kong SUN YAT-SEN UNIVERSITY, China INSTITUTE OF AGRO-PRODUCTS PROCESSING SCIENCE AND TECHNOLOGY, CHINESE ACADEMY OF AGRICULTURAL SCIENCES, China INRA TRANSFERT S.A., France PREDUZECE ZA PROIZVODNJU PROMET I USLUGE VINARIJA ALEKSANDROVIC DOO, VINCA, Serbia VERMICON AKTIENGESELLSCHAFT, Germany BioVantage.dk ApS, Denmark NINGBO TIANAN BIOLOGIC MATERIAL CO. LTD, China ASSOCIATION POUR L'ENVIRONNEMENT ET LA SECURITE EN AQUITAINE, France

PlastiCircle

Project title	Improvement of the plastic packaging waste chain from a circular economy approach
Project acronym	PlastiCircle
Project ID	730292
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2017-06-01 to 2021-05-31
Topic(s)	CIRC-01-2016-2017 - Systemic, eco-innovative approaches for the circular economy: large-scale demonstration projects
Total cost	EUR 8 674 540,89
EU contribution	EUR 7 774 016,75
Coordinator	INSTITUTO TECNOLOGICO DEL EMBALAJE, TRANSPORTE Y LOGISTICA, Spain

Brief Description	In order to align the the European plastic market with the CE, PlastiCircle aims to develop and implement a holistic process to increase recycling rates of packaging waste. This will allow to reprocess again plastic waste in the same value chain (i.e. CE; closure of plastic loop). This process is based on four axes: collection (to increase quantity of packaging collected), transport (to reduce costs of recovered plastic), sorting (to increase quality of recovered plastic), and valorization in value-added products (i.e. foam boards, automotive parts like engine covers/bumpers/dashboards, bituminous roofing membranes, garbage bags, asphalt sheets/roofing felts and urban furniture like fences/benches/protection walls).
Participants	STIFTELSEN SINTEF, Norway AXION RECYCLING LTD, United Kingdom CENTRO RICERCHE FIAT SCPA, Italy GEMEENTE UTRECHT, Netherlands FUNDACION DE LA COMUNITAT VALENCIANA PARA LA PROMOCION ESTRATEGICA EL DESARROLLO Y LA INNOVACION URBANA, Spain MUNICIPALITY OF ALBA IULIA, Romania MESTNA OBCINA VELENJE, Slovenia SOCIEDAD ANONIMA AGRICULTORES DE LAVEGA DE VALENCIA, Spain POLARIS M HOLDING SRL, Romania INDUSTRIAS TERMOPLASTICAS VALENCIANAS, S.A., Spain Armacell Benelux S.A., Belgium Imperbel N.V., Belgium CONSORZIO PER LA PROMOZIONE DELLA CULTURA PLASTICA PROPLAST, Italy HAHN PLASTICS LTD, United Kingdom ECOEMBALAJES ESPANA, S.A., Spain Fundacio Knowledge Innovation Market Barcelona, Spain PLASTICSEUROPE, Belgium ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH)*, Germany PICVISA MACHINE VISION SYSTEMS SL, Spain

Project Ô

Project title	Project Ô: demonstration of planning and technology tools for a circular, integrated and symbiotic use of water
Project acronym	Project Ô
Project ID	776816
Funded under	H2020-EU.3.5.2.2. - Developing integrated approaches to address water-related challenges and the transition to sustainable management and use of water resources and services H2020-EU.3.5.2.3. - Provide knowledge and tools for effective decision making and public engagement H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2018-06-01 to 2022-05-31
Topic(s)	CIRC-02-2016-2017 - Water in the context of the circular economy
Total cost	EUR 10 692 937,68
EU contribution	EUR 9 261 272,38
Coordinator	IRIS SRL, Italy
Brief Description	The project seeks to apply the pillars of integrated water management (IWM) as a model for "water planning" (akin to spatial planning) putting together the needs of different users and wastewater producers, involving regulators, service providers, civil society, industry and agriculture. Technologies and planning instruments support the regulators in implementing policy measures, as foreseen by IWM, for convincing stakeholders (like developers and industry) to implement water efficiency strategies and could include instruments for rewarding virtuous behaviours, as advantageous water tariffs.
Participants	AALBORG UNIVERSITET, Denmark UNIVERSITA' DEGLI STUDI DI TORINO, Italy UNIVERSITAT POLITECNICA DE VALENCIA, Spain CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS, France NANOQUIMIA S.L., Spain

	HEIM.ART - KULTURVEREIN-FLUSSIG, Austria SOCAMEX SA, Spain TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY, Israel VERTECH GROUP, France EKSO SRL, Italy EXERGY LTD, United Kingdom UNIVERSIDADE DE AVEIRO, Portugal POLITECNICO DI MILANO, Italy KALUNDBORG KOMMUNE, Denmark OLIMPIAS TEKSTIL DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA PROIZVODNJU, Croatia MUNICIPALITY OF EILAT, Israel ACQUEDOTTO PUGLIESE SPA, Italy REGIONE PUGLIA, Italy HOCHSCHULE RHEIN-WAAL-HSRW RHINE-WAAL UNIVERSITY OF APPLIED SCIENCES, Germany PARTICULA GROUP DRUSTVO S OGRANICENOM ODGOVORNOSCU ZA USLUGE, Croatia

RESYNTEX

ROBUST

Project title	Rural-Urban Outlooks: Unlocking Synergies
Project acronym	ROBUST
Project ID	727988
Funded under	H2020-EU.3.2.1.3. - Empowerment of rural areas, support to policies and rural innovation
Project Duration	From 2017-06-01 to 2021-05-31
Topic(s)	RUR-01-2016 - Consolidated policy framework and governance models for synergies in rural-urban linkages
Total cost	EUR 5 999 937,50
EU contribution	EUR 5 999 934
Coordinator	WAGENINGEN UNIVERSITY, Netherlands
Brief Description	Well-designed governance arrangements at local and regional levels shall create beneficial synergies between rural and urban areas. Adopting a place-based case study approach, particular attention will be paid to the capacities of municipal and regional governments, the related administrations and other stakeholders to deliver and enhance mutually beneficial relations. ROBUST will contribute to a better understanding of rural-urban interactions and in order to provide practice-oriented information about successful governance models applicable to different settings as well as related communication and training material.
Participants	ABERYSTWYTH UNIVERSITY, United Kingdom NODIBINAJUMS BALTIC STUDIES CENTRE, Latvia TUKUMA NOVADA DOME, Latvia UNIVERSITY OF GLOUCESTERSHIRE LBG, United Kingdom BUNDESANSTALT FUER BERGBAUERNFRAGEN, Austria PLANUNG & FORSCHUNG POLICY RESEARCH & CONSULTANCY BERGS UND ISSA PARTNERSCHAFTSGESELLSCHAFT WIRTSCHAFTS-UND SOZIALWISSENSCHAFTLER, Germany PERI-URBAN REGIONS PLATFORM EUROPE, Belgium UNIVERSITAT DE VALENCIA, Spain OIKOS SVETOVANJE ZA RAZVOJ DOO, Slovenia LUONNONVARAKESKUS, Finland HELSINGIN KAUPUNKI, Finland REGIONALNA RAZVOJNA AGENCIJA - LJUBLJANSKE URBANE REGIJE ZAVOD, Slovenia ICLEI EUROPEAN SECRETARIAT GMBH (ICLEI EUROPASEKRETARIAT GMBH)*, Germany GEMEENTE EDE, Netherlands

	feedstock
Project acronym	RESYNTEX
Project ID	641942
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2015-06-01 to 2018-10-30
Topic(s)	WASTE-1-2014 - Moving towards a circular economy through industrial symbiosis
Total cost	EUR 11 432 336,25
EU contribution	EUR 8 787 542,25
Coordinator	SOEX TEXTIL-VERMARKTUNGSGESELLSCHAFT MBH, Germany
Brief Description	The RESYNTEX project aims at designing, developing and demonstrating new high environmental impact industrial symbiosis between the unwearable blends and pure components of textile waste and the chemical and textile industries.
Participants	COMISSAO DE COORDENACAO E DESENVOLVIMENTO REGIONAL DE LISBOA E VALE DO TEJO, Portugal INSTITUTO SUPERIOR TECNICO, Portugal UNIVERSITA' DI PISA, Italy GLOUCESTERSHIRE COUNTY COUNCIL, United Kingdom REGIONALVERBAND FRANKFURTRHEINMAIN, Germany PROVINCIA DI LUCCA, Italy WELSH LOCAL GOVERNMENT ASSOCIATION, United Kingdom REGIONALMANAGEMENT STEIRISCHER ZENTRALRAUM GMBH, Austria IOS, INSTITUT ZA OKOLJEVARSTVO IN SENZORJE, DOO, Slovenia ARKEMA FRANCE, France UNIVERZA V MARIBORU, Slovenia UNIVERSITAET FUER BODENKULTUR WIEN, Austria Conseil Européen de l'Industrie Chimique, Belgium TEKSTILNA INDUSTRIJA AJDOVSCINA DD, Slovenia DETTIN SPA, Italy QUANTIS, Switzerland NATIONAL TECHNICAL UNIVERSITY OF ATHENS – NTUA, Greece VALAGRO CARBONE RENOUVELABLE POITOU-CHARENTES, France INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM, Belgium SEPAREX SAS, France CHIMAR HELLAS AE, Greece THE MANCHESTER METROPOLITAN UNIVERSITY, United Kingdom ABOUTGOODS COOMPANY, France SUSTAINABILITY CONSULT, Belgium BIOCHEMTEX SPA, Italy PROSPEX INSTITUTE, Belgium EUROPEAN APPAREL AND TEXTILE CONFEDERATION, Belgium ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH LIMITED, Israel ENTE NAZIONALE ITALIANO DI UNIFICAZIONE-UNI, Italy

UrBAN-WASTE

Project title	Urban strategies for Waste Management in Tourist Cities
Project acronym	UrBAN-WASTE
Project ID	690452
Funded under	H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2016-06-01 to 2019-05-31
Topic(s)	WASTE-6b-2015 - Eco-innovative strategies
Total cost	EUR 4 248 782,50
EU contribution	EUR 4 248 782,50
Coordinator	GOBIERNO DE CANARIAS, Spain
Brief Description	The project will develop eco-innovative and gender-sensitive waste prevention and management strategies in cities with high levels of tourism in order to reduce the amount of municipal waste production as well as to develop further instruments to re-use, recycling, collection and disposal of waste. Considering waste as resource to be reintegrated in the urban flow, UrBAN-WASTE performs a metabolic analyzes of the state of art of urban metabolism in 11 pilot cities. And then, these will be object of strategies to implement, monitor and disseminate facilitating the transfer and adaptation of the project outcomes in other cases.
Participants	TECHNISCHE UNIVERSITEIT DELFT, Netherlands ASSOCIATION DES VILLES ET REGIONS POUR LA GESTION DURABLE DES RESSOURCES, Belgium AARHUS UNIVERSITET, Denmark AYUNTAMIENTO DE SANTANDER, Spain

	UNIVERSITAET FUER BODENKULTUR WIEN, Austria KOBENHAVNS KOMMUNE, Denmark CABILDO INSULAR DE TENERIFE, Spain ANAPTIXIAKI ANONIMI ETAIRIA DIACHIRISIS APORRIMATON ANOTILIKIS MAKEDONIAS-THRAKIS AE – DIAAMATH, Greece KOBENHAVNS UNIVERSITET, Denmark COMUNE DI SIRACUSA, Italy OBSERVATOIRE REGIONAL DES DECHETS D'ILE DE FRANCE, France INSTITUT D'AMENAGEMENT ET D'URBANISME DE LA REGION D'ILE DE FRANCE, France BIOAZUL, Spain SVERIGES LANTBRUKSUNIVERSITET, Sweden DUNEA DOO ZA REGIONALNI RAZVOJ I POSLOVNE USLUGE, Croatia CONSULTA EUROPA PROJECTS AND INNOVATION SL, Spain AGENCE OBSERVAT AMENAGE HABITAT REUNION, France CAMARA MUNICIPAL DE LISBOA, Portugal UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA, Spain AMBIENTE ITALIA SRL, Italy ASOCIACION HOTELERA Y EXTRAHOTELERA DE TENERIFE LA PALMA LA GOMERA Y EL HIERRO, Spain METROPOLE NICE COTE D'AZUR, France PERIFEREIA IPEIROY, Greece FUNDO REGIONAL PARA A CIENCIA E TECNOLOGIA, Portugal LINNEUNIVERSITETET, Sweden LEFKOSIA MUNICIPALITY, Cyprus REGIONE TOSCANA, Italy

VULKANO

Project title	Novel integrated refurbishment solution as a key path towards creating eco-efficient and competitive furnaces
Project acronym	VULKANO
Project ID	723803
Funded under	H2020-EU.2.1.5.3. - Sustainable, resource-efficient and low-carbon technologies in energy-intensive process industries
Project Duration	From 2016-07-01 to 2019-12-31
Topic(s)	SPIRE-04-2016 - Industrial furnace design addressing energy efficiency in new and existing furnaces
Total cost	EUR 6 940 813,75
EU contribution	EUR 6 940 813,75
Coordinator	FUNDACION CIRCE CENTRO DE INVESTIGACION DE RECURSOS Y CONSUMOS ENERGETICOS, Spain
Brief Description	VULKANO project contributes to update the mainly old-aged European furnaces, as well as to create a path to follow in order to ensure a successful design in case of new furnaces by means of the development of improved designs based on new materials, alternative feedstocks, equipment and the latest monitoring and control systems. VULKANO aims to design, implement and validate an advanced retrofitting integrated solution to increase the energy and environmental efficiency in two types of industrial furnaces, namely preheating and melting, applied on three energy–intensive sectors (steel, ceramic and aluminium) fostering competitiveness and CE and reducing the environmental impact of the product value chain from an LCA and LCC perspective.
Participants	BOSIO PROIZVODNO-TRGOVSKO PODJETJE DOO, Slovenia FIVES STEIN, France RINA CONSULTING - CENTRO SVILUPPO MATERIALI SPA, Italy PHASE CHANGE MATERIAL PRODUCTS LTD, United Kingdom VALJI PROIZVODNJA VALJEV IN ULITKO DOO, Slovenia FUNDACION TECNALIA RESEARCH & INNOVATION, Spain INSTYTUT ENERGETYKI, Poland TORRECID SA, Spain FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., Germany

	ASAS ALUMINYUM SANAYI VE TICARET ANONIM SIRKETI, Turkey FUNDACION CIDAUT, Spain

Water2Return

Project title	REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture
Project acronym	Water2REturn
Project ID	730398
Funded under	H2020-EU.3.5.2.2. - Developing integrated approaches to address water-related challenges and the transition to sustainable management and use of water resources and services H2020-EU.3.5.2.3. - Provide knowledge and tools for effective decision making and public engagement H2020-EU.3.5.4. - Enabling the transition towards a green economy and society through eco-innovation
Project Duration	From 2017-07-01 to 2020-12-31
Topic(s)	CIRC-02-2016-2017 - Water in the context of the circular economy
Total cost	EUR 7 129 322,50
EU contribution	EUR 5 871 895,76
Coordinator	BIOAZUL, Spain
Brief Description	Water2REturn develops a full-scale demonstration process for integrated nutrients recovery from wastewater from the slaughterhouse industry using biochemical and physical technologies and a positive balance in energy footprint. Fostering synergies between the food and sustainable agriculture industries, the project proposes innovative business models and opens new market opportunities for the European industries and SMEs in this two key economic sectors. Water2REturn closes the loop by producing a nitrates and phosphate concentrate available for use as organic fertiliser in agriculture and using an innovative fermentative process designed for sludge valorisation.
Participants	UNIVERSIDAD DE SEVILLA, Spain UNIVERSIDAD DE CADIZ, Spain FUNDACION CENTRO DE LAS NUEVAS TECNOLOGIAS DEL AGUA, Spain AGROINDUSTRIAL KIMITEC SL, Spain ADVENTECH - ADVANCED ENVIRONMENTAL TECHNOLOGIES LDA, Portugal ALGEN, CENTER ZA ALGNE TEHNOLOGIJE, DOO, Slovenia UNIVERZA V LJUBLJANI, Slovenia SLOROM SRL, Romania ENCO SRL, Italy 2B Srl, Italy UNION EUROPEENNE DU COMMERCE DU BETAIL ET DE LA VIANDE, Belgium ISITEC GMBH, Germany EXERGY LTD, United Kingdom EUROPEAN LANDOWNERS ORGANIZATION, Belgium SLOROM D&C DRAGHICENI SRL, Romania

7. REFERENCES

Amerighi, O. et Felici, B. (2011). Sviluppo sostenibile e green economy: oltre il PIL. *Energia, Ambiente Innovazione,* 3

Bacigalupo, M., Kampylis, P., Punie, Y. et Van den Brande, G. (2016). *EntreComp: The Entrepreneurship Competence Framework*. Luxembourg: Publication Office of the European Union; EUR 27939 EN; doi:10.2791/593884

Belk, R. (2014). You are what you can access: Sharing and collaborative consumption online. *Journal of Business Research*, 67(8), 1595-1600

Biondi, V. (2013). Dallo sviluppo sostenibile alla green economy: il caso del Green Economy Network. *Impresa Progetto-Electronic Journal of Management,* 3

Bovens, L. (2009). The ethics of nudge. In Gru¨ne-Yanoff T. et Ove Hansson S. (Eds.), *Preference change: Approaches from philosophy, economics and psychology* (207–209). Berlin: Springer

Brown, L.R., Flavin, C. et Postel, S. (1992). Saving the planet: how to shape an environmentally sustainable global economy. London: *Earth scan*

Bruns, Axel (2009). From Prosumer to Produser: Understanding User-Led Content Creation. *Transforming Audiences 2009*, 3-4 Sep, 2009, London

Canullo, G., Chiapparino, F., et Cingolani, G. (2011). The Adriatic-Balkan Area from Transition to Integration. *Edizioni scientifiche italiane*

Carroll, A. (1979). A Three-Dimensional Conceptual Model of Corporate Performance. *The Academy of Management Review,4*(4), 497-505. Retrieved from http://www.jstor.org/stable/257850

Cialdini, R. (2007). *Influence: The psychology of persuasion*. New York: Harper Business

Commission on the Measurement of Economic Performance and Social Progress (2010), *Mismeasuring our lives: why GDP doesn't add up*, report by Stiglitz, J. E., Sen, A. et Fitoussi, J-P., New Press, New York

Coyle, D. (2012). The economics of enough: How to run the economy as if the future matters, Reprint edition, *Princeton University Press*, Princeton, NJ, USA

Cutrini, E. et Spigarelli, F. (2012). The role of Italian FDI in Southeast Europe's international integration. A focus on investors from the Marche region. *The European Journal of Comparative Economics,* Vol. 9, n. 3

Cutrini, E., Galeazzi, G. et Spigarelli, F. (2011). Foreign Direct Investment and the Financial Crisis: Spotlight on Italian-Balkan Countries Flows. *Edizioni scientifiche italiane*

Daly, H. (2001). Oltre la crescita. *Edizioni di Comunità*

EC (2009). Communication from the Commission to the Council and the European Parliament. GDP and beyond. Measuring progress in a changing world - COM(2009) 433 final

EC, (2017). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan - COM(2017) 33 final

EC (2016). *Flash Eurobarometer 438: The use of collaborative platforms*, Brussels

EC (2016). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Eegions. A new skills agenda for Europe. Working together to strengthen human capital, employability and competitiveness - COM(2016) 381 final

EC (2018). EU budget: Regional Development and Cohesion Policy beyond 2020. *Press release*, Strasbourg, 29 May

ECB (2018). Economic Bullettin, 3

EEA (2016), *Circular economy in Europe: Developing the knowledge base*, EEA Report N. 2, European Environment Agency, Copenhagen

EEB (2017). *Policy options for a Circular Economy*. An EEB report and recommendations for the Italian Ministry for the Environment, Land & Sea. Voluntary National Review Italy National Sustainable Development Strategy. Italian Ministry for the Environment Land and Sea, Directorate-General for Sustainable Development, Environmental Damage and International Affairs - Division I *www.minambiente.it*

EU (2013). Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 Living well, within the limits of our planet, OJ L 354, 20.12.2013, 171-200

EU (2017). Blueprint for sectoral cooperation on skills. Responding to skills mismatches at sectoral level. A key action of the New Skills Agenda for Europe

Eurobarometer (2009), *Europeans' attitudes towards the issue of sustainable consumption and production,* http://ec.europa.eu/ public_opinion/flash/fl_256_en.pdf

European Environment Agency, 2017 Circular by design Products in the circular economy EEA report No 6/2017

Fabris, G. (2010). La società post-crescita. *Consumi e stili di vita,* Egea, Milano

Fischer, A. et Achterberg, E. (2016). Create a financeable circular business in 10 steps

Frey, M. (2013). La green economy come nuovo modello di sviluppo. *Impresa Progetto-Electronic Journal of Management,* 3

Goerner, S., Lietaer, B. et Ulanowicz, R. (2009). Quantifying economic sustainability: Implications for free enterprise, theory, policy and practice. *Ecological Economics* 69 (1): 76–81

Gregson, N., Crang, M., Fuller, S., et& Holmes, H. (2015). Interrogating the circular economy: the moral economy of resource recovery in the EU. *Economy and Society*, *44*(2), 218-243

Hall, C. M. (2013). Framing behavioral approaches to understanding and governing sustainable tourism consumption: Beyond neoliberalism, "nudging" and "green growth"?. *Journal of Sustainable Tourism*, *21*(7), 1091-1109

Hanushek, E. A., & Woessmann, L. (2015). *The knowledge capital of nations: Education and the economics of growth*. MIT press

Ilić, M. et Nikolić, M. (2016). Drivers for development of circular economy – A case study of Serbia. *Habitat International, 56*, 191-200

Ivetic, E. (2017). History as identity: the Adriatic sea. *Identity (ies): A multicultural and Multidisciplinary Approach*, 51

Iyigun, N.O. (2015). What could entrepreneurship do for sustainable development? A corporate social responsibility-based approach. *Procedia Social and Behavioral Sciences* 195, 1226-1231

Lacy, P. et Rutqvist, J. (2015). *Waste to Wealth: The Circular Economy Advantage*. Accenture Strategy, Palgrave Macmillan

Leismann, K., Schmitt, M., Rohn, H. et Baedeker, C. (2013). Collaborative consumption: Towards a resource-saving consumption culture. *Resources* 2(3), 184-203

Levinson, J. C., et Horowitz, S. (2010). *Guerrilla marketing goes green: winning strategies to improve your profits and your planet*. John Wiley & Sons

Lucia, M. G., et Lazzarini, P. (2015). *La terra che calpesto. Per una nuova alleanza con la nostra sfera esistenziale e materiale.* Franco Angeli

Martin, S. J., Goldstein, N., et Cialdini, R. (2014). *The small big: Small changes that spark big influence*. Hachette UK

Moroni, M. (2010). Tra le due sponde dell'Adriatico. Rapporti economici, culturali e devozionali in età moderna. *Edizioni scientifiche italiane*

National Zero Waste Council (2016), *Circular Economy Business Toolkit*, Canada

Porter, M. E., et Kramer, M. R. (2011). The big idea: Creating shared value. *Harvard Business Review*, January–February2011

Repetto, R. (1989). *No accounting for pollution: a new means of calculating wealth can save the environment*. Washington post, 28 May

Schaltegger, S. et Wagner, M. (2007). Types of Sustainable Entrepreneurship and Conditions for Sustainability Innovation: From the Administration of a Technical Challenge to the Management of an Entrepreneurial Opportunity. In Wüstenhagen, R.J., Hamschmidt, Sharma, S. et Starik, M. (eds.), *Sustainable Innovation and Entrepreneurship.* 27-48, UK: Edward Elgar, Cheltenham

Shiva, V. (2013). *Will green be the color of money or life? Paradigm wars and the green economy*

Sunstein, C. et Thaler, R. (2009). *Nudge: Improving decisions about health, wealth and happiness*. London: Penguin

Thomas, C., Slater, R., et Cox, J. (2013). *Influencing resourceful behaviors*

Webster, K. (2013). What might we say about a circular economy? Some temptations to avoid if possible. *World Futures*, *69*(7-8), 542-554

SUMMARY CONCLUSIONS

The composition of the chapters collected in this thesis reflects a comprehensive perspective on circular economy. The main scope is to show how relevant are circular economy (CE), entrepreneurial mindset and social competences for the process of internationalization and, most importantly, to find the links between them and economic growth.

For this reason, I carried out an empirical analysis focusing firstly on the circular economy implementation across European countries and later, on Italy. This research confirmed the relevance of CE as a factor of sustainability for long-term growth. Scholars have worked on CE concept under different perspectives by considering a variety of features and initiatives: cross-cutting or highly specialized in a particular area. Even though a holistic approach is essential and desirable in terms of the effectiveness, it might tend to be a restraining force.

As was apparent in Chapter I, there is a strong sense of urgency with regard to this matter and also a high level of awareness of the fact that the eco-innovation of the system and the transition towards a CE shall require of new industrial relations supported by a favorable environment which takes account of their particular characteristics, as new design, integrated production chains, Industry 4.0 and industrial symbiosis.

There is a wide range of opportunities for future lines of research can follow up this study, especially some of them are particularly critical to the advancement of literature. Firstly, the elaboration of a new theoretical framework with the purpose to investigate whether and to what extent a causal link exists between regional legislation and development. Secondly, entrepreneurial and individual levers could also be examined. In this case, the strengths and weaknesses of a top-down and bottom-up approach to pursue common goals might arise. The analysis could be conducted at firm or industry level by taking into account every type of policy instrument (e.g. public tenders, financial incentives and other subsides) and their efficacy to introduce new and sustainable products and services and then to change the behavior of consumers with the main aim of preserving the integrity of the environment.

In Chapter II, CE is analyzed from various perspectives and features, involving several kinds of resources, actors and initiatives. It is clear that CE is a sustainable development-related strategy covering all its three areas: economic, environmental and social. Meanwhile, SDGs are instrumental in developing and implementing better CE methods and technologies. This concept may also be applied to wastewater management, as emphasized by the Sustainable Development Goal n. 6 - *Ensure availability and sustainable management of water and sanitation for all*.

Focusing on water resource management, one of the main issues has certainly been to find the balance between water reuse and precaution, which seeks to assure public health, environmental protection and food security. The cases studied in Chapter III shows how public acceptance could be influenced by several factors including growing knowledge of qualitative aspects of renewed facilities and confidence in methods and technologies (e.g. U-V disinfection in Fasano and Capitanata WWTPs).
It is clear that transparency and access to information are crucial to give proof of the quality of the actions and improve stakeholders' involvement. Their cooperation in the planning and decision-making process at every stage of reuse projects gives the perception of local situations and encourages possible solutions, as confirmed by the results of the consultation process.
Two future lines of research can follow up this study. First of all, the influence of regulatory framework and appropriate financing mechanisms over the behavioral change and social acceptance will be investigated to overcome the multi-barrier attitude in wastewater use and resource recovery. And lastly, how education, managerial skills and active participation of stakeholders could be useful in the identification of potential symbiosis for managing resources.
The research performed in the last Chapter offered a list of heterogeneous projects from different scientific fields in the Adriatic-Ionian Macro-Region. As Chapter IV shows, most durable changes in society have been carried out by bottom-up initiatives within stakeholders' collaboration because knowledge and expertise have greater consequences when shared, also by the means of broad networks and platforms (e.g. S3 Platform). As well as this, raise awareness depends also on communication skills since the "choice architecture" influences decisions and behavior. According to data, nudging leads to a significant difference in order to increase reuse and repair actions, supporting SMEs and public institutions in the transition towards a CE.
The suggestions deriving from the analyzed results are the clear signal that achieving the CE approach will depend not only on technological eco-innovation and business models, but also on governance, mindset, skills and knowledge. Special relevance has been given to shared values in the developing of social, cultural and economic environment, in compliance with 2030 UN Agenda for Sustainable Development and specifically Target 4.4, entitled *Relevant skills for decent work: substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.*
In the context of CE, the ways people work and do business are changing, as well as the types of skills needed for implementing and adapting to business models and new job opportunities. One-size-fits-all solution shall not apply because it depends on several factors: not only related to resources availability and business models, but also to mindset, skills and participant's capability to take action and to tailor to different circumstances.

The general conclusion of the study is that the society that we are living is based on a new ethics, where waste and overconsumption are conceived as disvalues and collaborative consumption is increasingly becoming an important dimension of human behavior. In this transition, stakeholders' collaboration plays a central role through information and education, data, monitoring and indicators, exchange of experience and public participation.

Overall, this work demonstrates the economic and environmental feasibility of the CE approach and how it gives great impetus to the SMEs competitiveness and reindustrialization of the EU sectors, improving synergies and helping citizens to make more sustainable choices.