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Circular Economy: What kind of strategic planning  
would be most appropriate for the Port of Genoa

by

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## **Acknowledgements**

With this thesis I conclude my Academic year, I prepare myself for the degree and to face the working life: strong of a renewed confidence in my means and of a deep knowledge in the world of maritime business.

This Master has represented a turning point in my life; I arrived in the Netherlands 2 years ago, following a difficult situation. I faced all the adversity one by one, learned the language, found a temporary job, changed two cities, all complicated by the pandemic that characterized the whole of 2020, 2021 and part of 2022.

I faced up the academic year with the utmost commitment, dividing my days among study and work and I realized how right the choice was made, in a sector that I had never really considered before, but which has always been present in my life.

This thesis was difficult, because it comes at a time of physiological effort after a really demanding year, but it was at the same time very interesting and exciting.

Fortunately, along this path I have met many people who have helped me and have been close to me.

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## **Abstract**

Starting from the 70s, humanity became aware of the damage that the dominant economic model had caused and was causing to the planet and its ecosystems. The starting point was the awareness of this phenomenon. Over the decades, the theme of pollution, global temperature rising, melting ice, garbage, clean energy, etc. has become part of everyday life: at the same time, the most diverse theories to tackle the problem have spread, through targeted interventions to reduce the impact of the human economy on climate change.

Starting from this point, the concept of circular economy was introduced: this is an economic model that provides for the circulation of goods already used in order to reduce to zero, or almost zero, the products that once used become waste. The same concept of circularity can be adopted to create clean energy without using fossil fuels.

The concept we analyzed was to apply this sustainable model to the port dimension, and in particular to the Port of Genoa.

In the paper we tried to introduce the concept of circularity in its general dimension, then trying to understand how this model can be applied to a complex and vital system such as that of ports. Once given the proportion of the phenomenon, we defined the situation of the port of Genoa and tried to understand, through empirical analyzes and interviews, which could be the best plan for the development of this circularity in the Italian port.

As often happens, the answers are not simple and are not unique: in our case it is a combination of factors that will be decisive for the development of this economic model, and that will determine its success or failure.

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## Research Objectives

This research aims to understand the advantages and the real benefits of an economic model called Circular Economic, in particular, applied to the port environment.

Due to climate change now demonstrated by thousands of academic researches, governments over the years have set goals in the direction in which the economic system will have to move: we speak in general of sustainability.

Circularity certainly has to do with this problem: however, it is not a simple reduction in pollution or a way to reduce the environmental impact. We will try to explain how circularity has to do with the economic system in general.

The paper investigates how Circular economics can be connected to port systems. As we know, ports are essential to the global economy: most global trade passes through ports, incredibly most valuable goods. Moreover, ports are often located in densely populated urban agglomerations that provide the necessary workforce to carry out the myriad of necessary activities, handling goods and related activities. Due to the environmental issue, ports are starting to plan systems to improve their management, trying to adopt practices that can effectively combat climate change and be sustainable.

In the paper, we tried to talk about a practice that has to do with sustainability and the management and flows of goods, or how to apply circularity to the Genoese port system. In the future, a diffusion of the Circular Economy will be foreseeable, and therefore, the port, as a nodal point of traffic, can also become a central hub for circularity.

The purpose of the research is to understand how Genoa has received the input on circularity, and therefore, the main question we aim to answer is the following.

***"Circular Economy: What kind of strategic planning would be most appropriate for the Port of Genoa."***

The main idea is to investigate the situation in the port of Genoa and define its circularity. First, an outline is there to present the future program based on the interviews and the documents collected.

To adequately answer the research questions, it is necessary to refer to a series of sub-questions:

*"What is the context in which the circular economy must be defined, and what it is about."*

*"How the circular economy is characterized as applied to port systems."*

*"What is the reality of the port of Genoa, and how is it tackling the problem of sustainability first and then circularity: how circular economy will be developed"*

In the next section this study will explain the structure of the thesis.

## **Thesis Structure**

**Chapter 1** is introductory to circularity. We have divided circularity from sustainability and energy transition: although they can be overlapped in some respects, they are different in others.

**Chapter 2** deals with the circular economy in port, how it can develop, and how it can change the role of the port as we know it today.

**Chapter 3** deals with methodology and its explanation.

**Chapter 4** analyzes the Port of Genoa in its entirety and what has been done in the Circularity direction to date: the chapter also includes the part about the interviews and the result of the research.

**Finally**, the 5th part is that relating to the conclusions.

## **1. Introduction: Sustainability, Energy Transition, Circular Economy**

This section will disclose the concept of sustainability and energy transition. It is divided in 4 parts. To better understand the concept of the Circular Economy, it is necessary to have a brief introduction. Then, it takes a small step back, starting from the concept of sustainability and energy transition.

### **1.1 Sustainability**

Environmental sustainability was introduced in 1972 in the report "Limits to Growth," commissioned by the Club of Rome to the MIT. Donella and Dennis Meadows, Jorgen Randers, and William W. Behrens III make the obvious yet revolutionary statement: "It is not possible to have infinite growth on a finite and resource-limited planet" ([www.italiachecambia.org](http://www.italiachecambia.org), 2020). The same year, the United States had its first environmental conference, which led to the Stockholm Declaration. For the first time, it asserts at the political level "the right of all human beings to adequate living conditions, in an environment that allows them to live in dignity and well-being." As a result of the need to preserve ecosystems and reduce non-renewable resources and investment based on the planet's ability to restructure. Fundamental principles that, despite their importance, initially received little attention: but at least starting from the 2000's they began to be part of everyday life, both from the point of view of society and the economy ([www.italiachecambia.org](http://www.italiachecambia.org), 2020).

Moreover, the approach to sustainability has struggled to take off also because it was associated with the enormous costs that this idea seemed to bring with it: contrary to popular belief, the development of innovative technologies and investments in sustainable projects represent a once-in-a-lifetime opportunity for the economy, with the creation of new professional roles and the development of novel business models, to which tangible benefits for the entire society are added ([www.enelgreenpower.com](http://www.enelgreenpower.com), 2019).

Economic sustainability is the bedrock of sustainable development. The idea of economic growth that must always be accompanied by environmental considerations emerged in the 1970s. Still, it was not fully realized until 1987: the Brundtland Report, also known as Our Common Future, issued by the United Nations Commission on Environment and Development, defined sustainable development for

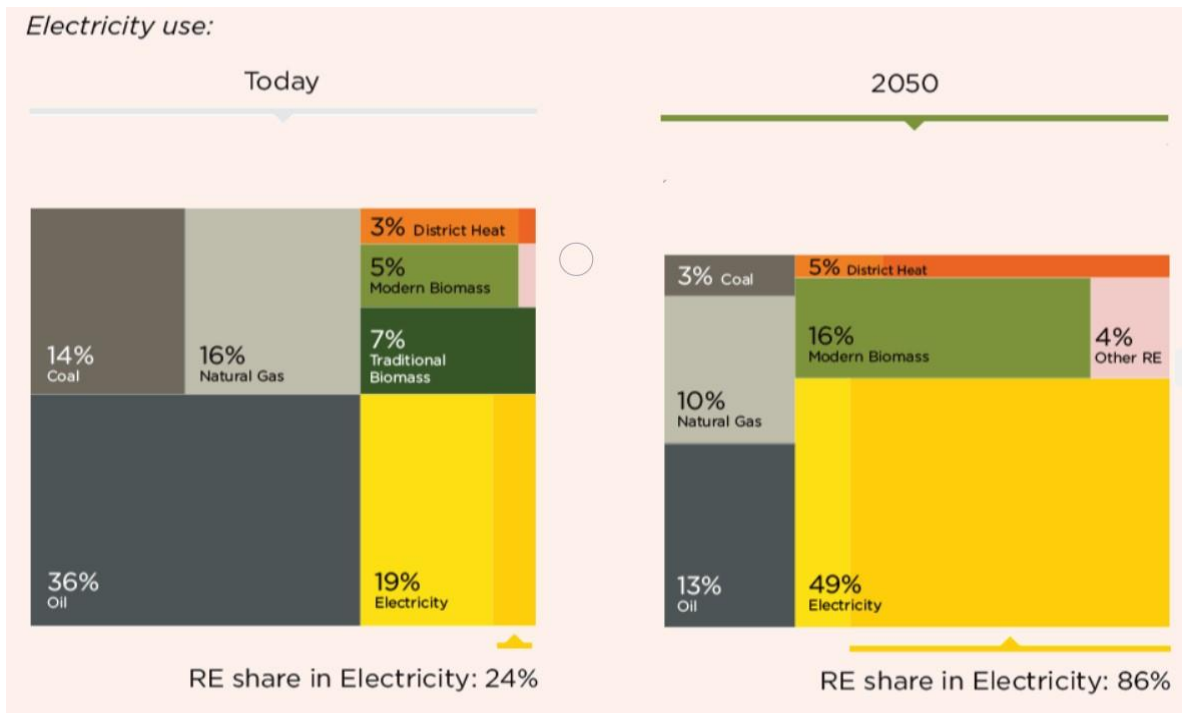
the first time as that which ensures the satisfaction of future generations' needs. The Commission (World Commission on Environment and Development) announced that: "humanity has the possibility of making development sustainable, that is, of ensuring that it meets the needs of the current generation without compromising the ability of future generations to respond to theirs" (International Institute for Sustainable Development, 2020). Economic sustainability may be defined as a system's ability to generate long-term growth in economic indicators. In particular, the ability to generate revenue and work for the sustenance of populations. Inside a territorial system for economic sustainability, the ability to produce and maintain the maximum amount of value-added within the territory by effectively combining resources is intended: to valorize the uniqueness of products and services (S.r.l, D., 2021). The great pillar of sustainability has subsets that are sometimes connected, intersect and have typical dynamics. One of these is undoubtedly the energy issue and supply.

In 2020, global energy demand shrank by 4% due to covid, but the projected increase of 4.6% in 2021 will push consumption slightly above the pre-pandemic level of 2019. The energy transition is connected with sustainability, and it is one of the mechanisms we will try to combat global warming (redazioneisonline. it, 2021).

## **1.2 Energy Transition**

The energy transition is modifying the planetary energy sector from fossil fuels, which have been the primary energy source during the last century, to zero-carbon ones. This challenge is urgent for our planet, both because it is mandatory to limit global warming to 1.5 ° C and at the same to allow a satisfactory (and equitable) socio-economic development: all in a historical moment in which we await the results of post-pandemic Covid efforts (Vanegas Cantarero, 2020). To achieve the objectives, it is estimated that, according to the IPCC (Intergovernmental Panel on Climate Change), renewable or otherwise clean energy must provide 70% -85% of global electricity in 2050. However, the large-scale diffusion of zero carbon emissions technologies has been made difficult by institutional, social, and economic barriers. Nevertheless, post-pandemic economic recovery allows for shaping energy infrastructures for a sustainable future (Vanegas Cantarero, 2020). Energy transition is connected with circular economy, it is explained in the next part.





At irena.org

Of course, the transition we are talking about is already underway, and plans and policies for the future have, in part, been outlined. The information on key technologies will have to be clear: for both wind and solar energy (which are the most common but not the only ones that do not emit CO<sub>2</sub>), global capacity is steadily increasing with the consequence that, for a purely economic theory, the cost of such technologies will decrease equally (Child, Koskinen, Linnanen, and Breyer, 2018). Many studies on a continental scale have given a representation of the new transition dependent on meteorological conditions (sun, wind). They have concluded that the mix of these energies is an option that is not purely technical but also economically viable. Not only that, but they are also economically attractive in terms of opportunities and business. Furthermore, it should be emphasized that this energy transition is certainly technological but also political, socio-cultural, and structural in terms of the rethinking of infrastructures and services. The challenge, therefore, is 360 degrees and must be seen not only as a general reconversion but as a fundamental objective to prevent damage to human beings and natural ecosystems (Child, Koskinen, Linnanen, and Breyer, 2018).

Renewable energy is only one component. We must also consider the rethinking and re-engineering of infrastructures, the electrification of the industrial and civil network, and electric mobility. Buildings equipped with solar systems can feed the generated energy in excess, behaving as consumers/producers.

Similarly, the reduction of emissions passes not only from strictly renewable energies but also from the use of fuels other than those derived from petroleum, such as natural gas or even better hydrogen, with applications ranging from industries to mobility (ships, etc.): The goal is always to reduce CO<sub>2</sub> emissions (McKinsey & Company, 2019).

### **1.3 Circular Economy**

Intuitively, every product or system used and consumed affects the environment and the life of living beings: both during the production, consumption, and disposal phases. Moreover, the consequences that this system generates affect what surrounds us: air, water, and soil, putting the survival of the beings that populate the planet at risk. Therefore, what man does and produces must be conceived bearing the principle of sustainability (Research into Design for Communities, Volume 2 - Proceedings of I-cord 2017, Amaresh Chakrabarti, Springer, 2021). As we said, The United Nations has defined sustainable development as that which, while guaranteeing the needs of the present, does not compromise the future and the ability of the next generations to develop. Considering the limited resources on a non-infinite planet, society will have to focus on protecting the environment and balancing the human and natural environment ([www.twi-global.com](http://www.twi-global.com), 2018).

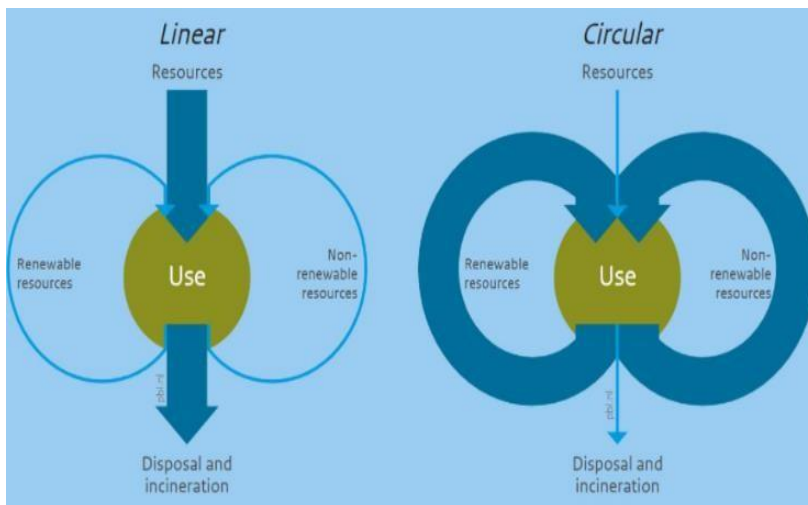
The European Union alone produces between 2.5 and 3 billion tons of waste (European Environment Agency, 2019). EU is updating its legislation on waste management: the goal is to facilitate the transition to a cleaner and more sustainable model, commonly called Circular Economy. The European Parliament, in February 2021, issued a significant resolution (Resolution of 10 February 2021 on the New Circular Economy Action Plan (2020/2077 (INI)) ([www.europarl.europa.eu](http://www.europarl.europa.eu), 2021) precisely on the development of the circular economy and launched further measures: this both for actions aimed at environmental protection but also for those that, from the EC, may increase GDP and jobs. Theoretically, the circular economy is a model that involves recycling, reusing, renting, repairing, sharing, and restoring existing products for as long as possible. The goal is to extend the life cycle of the products trying to minimize waste; when the product's life cycle is considered finished, it is attempted to maintain its use within the economic circle to extend its productivity and value. It is a way of overcoming the Linear model, which is strongly contraindicated in terms of sustainability, for which the good is consumed and thrown away (European Parliament, 2015).

The purpose of the Circular economy is therefore ambivalent: on the one hand, it aims to present strategies for sustainability and, on the other, obtain the circularity of processes by generating economic prosperity, guaranteeing sustainable production and consumption (Prieto-Sandoval, Jaca, and Ormazabal, 2017).

The definition by Ellen McArthur Foundation is "A circular economy is a systemic approach to economic development designed to benefit businesses, society, and the environment. In contrast to the "take-make-waste" linear model, a circular economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resources." Accepting the definition of the MacArthur Foundation, the circular economy has, by definition, three central pillars: circulation of goods, protection of the natural element, and development of resources through circularity. All of this helps reduce negative externalities. Furthermore, through this system, the life of resources is extended, and new connections are created between different sectors and subjects (archive.ellenmacarthurfoundation.org, 2019).

Another "Territorial" definition is given by The ESPON (European Spatial Planning Observation Network) research project "CIRCTER - Circular Economy and Territorial Consequences": "A circular economy is one characterized by higher regenerative capacity. This quality expresses itself through territorially-bound enablers like local food systems, local waste-to-resource circuits, community-driven collaborative schemes, industrial symbiosis networks, etc. However these initiatives are characterized by high levels of territorial specificity, meaning that they cannot be extrapolated to other territorial contexts without major structural adaptations" (Tapia, Bianchi, Pallaske, and Bassi, 2021).

Circularity is not defined only through these concepts; it also finds application to broader and more nuanced categories such as political or economic investment. Circularity provides for synergies between the various players in the system, public, private, etc. The differences between linearity and circularity concern the cycle of use. While in linearity, the product is thrown away after use, circularity changes how the value is created and preserved. Linear economics follows the take-use-eliminate rule whereby the product becomes waste once used. In this system, which characterizes our society, value is generated by producing and selling as many goods as possible. With the circular model, the approach is to reduce/reuse/recycle, which means trying to reduce the use of resources as much as possible, reuse them when possible, and recycle what remains. In this system, the focus is on the preservation of value (Kenniskaarten - het Groene Brein, 2019).  
skenniskaarten.hetgroenebrein.nl



*Kenniskaarten - het Groene Brein, 2019*

As mentioned at the beginning, in February 2021, the European Parliament launched a plan that aims to have a circular economy by 2050. The aim is to adapt the system and rethink competitiveness while protecting the environment: the project provides that the resources used are kept in circulation in the Community economy for as long as possible. The points touched on concern three macro areas:

Reduce waste production by ensuring that it is re-integrated into production processes.

-New policies to make new products more durable (no planned obsolescence and no single-use / plastic packaging).

-Consumers must be aware and responsible and make decisions that favor sustainability.

Executive Vice-President for the European Green Deal, Frans Timmermans, said: "To achieve climate-neutrality by 2050, to preserve our natural environment, and to strengthen our economic competitiveness, requires a fully circular economy. Today, our economy is still mostly linear, with only 12% of secondary materials and resources being brought back into the economy. Many products break down too easily, cannot be reused, repaired or recycled, or are made for single use only. There is a huge potential to be exploited both for businesses and consumers." (New Circular Economy Action Plan shows the way to a climate-neutral, competitive economy of empowered consumers, European Commission).

This transition is complex and requires simultaneous changes in various subsystems, such as energy, logistics, and finances. It also needs clear guidance and monitoring, as circular systems are not necessarily "better" than linear systems in all circumstances. Inefficient circular systems can also create a lot of social, economic, and environmental damage (for example, excessive use of transport

and energy or unattractive working conditions, such as in product recovery). The shift to a value-creating circular economy will lead to new business models, value chains, and product and service delivery models. It influences the design, manufacturing, use, and disposal process and the collection of products and materials for reuse. It also adds new processes to facilitate, maintain, share, repair, update and regenerate products (Van Buren et al., 2016).

#### **1.4 Differences Between Energy Transition and Circular Economy**

The explanation just concluded makes it easier for the reader to understand how sustainability, energy transition, and circularity are different things. However, it is good to specify that circularity and energy transition sometimes overlap. For example, while the energy transition has its main objective of reducing emissions of polluting or harmful gases for global warming, starting with CO<sub>2</sub>, not all circular activities have this objective. In some circumstances, it is the case of green hydrogen, for example (or offshore wind and solar energy); therefore, in this case, there is overlapping because the circularity also has the result of reducing emissions and using fewer fossil fuels. In other circumstances, the circular economy and the energy transition remain two distant things. In the next chapter, we will deepen the circular economy concept in Port.

## **2. Circular Economy in Port**

### **2.1 General information**

This section is developed on 9 parts and explains the main idea of circular economy in port. More than 75% of the global population will be living in metropolitan areas in 2050 (World Bank, 2020). Cities are growing without stopping becoming large agglomerations. Many of the world's cities are, first of all, ports: the Port, as we have seen, is today a cornerstone for the sustainable development of a given geographical area. Even in the awareness that port cities are distinctly different from each other, some challenges, such as climate change and the energy transition, are common (digital. it, 2020). Most of the economically strongest cities are port cities. In port areas, the administrative entities are connected with the Port in a specific metropolitan system: it can be said that the port metropolitan areas are a union of many subsets ranging from natural to the residential one plus the productive/industrial/logistic one, passing through the energy one and ending with the cultural/social one. All functional economic activities are concentrated in this area and combined: they act as a boost for economic development. This area is the starting point for the sustainable development of the port/city/region and macro area system. While the benefits are not tangible even in the Port's areas, the negative impacts are mainly located in the port city. Therefore pollution, congestion, overuse of land, etc., lead to a decrease in well-being and respect for the surrounding ecosystem (Nocca and

Fusco Girard, 2018). Ports are privileged places for exchanging goods and products and consequently waste. In the concept of circularity, the Port takes on a central role both as a nerve center to create added value and as a place where the logistic chain changes the modes of transport: the Port, therefore, becomes privileged as a place of activity linked to circularity and the port authorities should stimulate companies and start-ups to trigger this long-term innovation/revolution (Kuipers et al., 2015). The new economic model will have to assess the needs of the stakeholders, including them in the conversion and use of new port areas for new business: this is to avoid loss-making investments (Akhavan, 2017).

## **2.2 Transformation and role of the Port**

To create new synergies, it will be necessary to identify the most promising connections between the economic lines and through the various port/city/hinterland activities. All this with the involvement of local communities: the integration of the community in the development of this new economy is fundamental: there are three main issues for port cities.

- The transformation of the port city
- Modify them because of the constant development of the maritime, Port, and logistics sector
- Port Authority as a bridge between economic activities and local communities

Normally, when we talk about Port, the vision in the collective imagination is that of a place where we can see cranes, shipyards, containers, and large ships intent on loading and unloading. However, within the borders of the European Union, there are many different types of ports dedicated to different activities: from passengers, ferries, all energies to logistics ports or large chemical and container complexes, etc. (Blogs on Nicole van der Hoeven, 2021).

The port sector is extremely complex, and the Port of tomorrow will be considerably different from today: many factors will affect the future, the development of technology, demographic, and geopolitical factors, and above all, environmental and sustainability factors (Deloitte -ESPO, 2021). Climate change requires the green transaction of the economy on multiple levels. The impact on the maritime sector will be substantial and consequently also on the port sector: all types of cargo will be affected, and above all, the port infrastructures of the future. Ports are engaged in a radical transformation of their maritime and logistic projects precisely with a view to sustainability. We can also add that the Port boasts advantages compared with normal industrial areas in the hinterland: due to greater connectivity with other locations and greater ease of access to circularity and markets. But it is also the demand that puts the Port in an advantageous position: around the port hubs, the demand

for certain circular products (energy, fuels, raw materials, etc.) is high, and access to these goods is simpler (Carpenter, Lozano, R, Sammalisto, K et al.,2018).

If, on the one hand, the Port will have to structurally adapt to what will be the expected rise in the level of the oceans, on the other hand, for what interests us, the Port will become even more at the center of this economic revolution: they are and will be clusters of energy and economy and a crossroads for logistics. Twenty- Five percent of European ports trade more than 50% in energy raw materials; the most classic example to understand the current transaction concerns energy and fuels: the transition from fossils to renewables is underway, and the same is true for the circularity that can reduce the amount of waste through regeneration of their value (Deloitte - ESPO, 2021). The change will also be infrastructural, with new investments in this sense and adaptations for the existing ones: The negative externality will have to be reduced. Still, this rethinking will be much deeper, and each actor involved in the Port will have to have its plan. Therefore, port authorities will play a decisive role as intermediaries, supporting circularity and mitigating negative externalities as much as possible; an example of this statement is the Port of Rotterdam which, in agreement with the Dutch government, is carrying out a strategy aimed at drastically reducing pollution and negative externalities (V. Balz, A 100% Circular Port in 2050, 2021). Indeed, we know how economic activities, and the consequent logistical organization, are responsible for multiple negative externalities (Mankiw, Taylor, 2017) that have historically never been seriously considered by governmental/administrative authorities (and consequently by companies). Only in the last few decades, as we have seen, pressure from governments and various stakeholders increased and produced results with extensive regulations on environmental protection and sustainability: this affected new economic theories and strategies. This also applies to the port sector (Acciaro et al., 2014). Therefore, development is important for circularity.

### **2.3 Port and develop Circularity**

The goal of sustainability can be pursued in many ways, and Circularity, specifically Circularity in port, is one of these: however, it is not a simple technical innovation but a wide-ranging process that involves many actors. The fact is that embracing this kind of novelty, on the one hand, sees the port as the protagonist of innovations and new economic approaches and, on the other, as a provider of solutions to reduce, minimize and eliminate some negative externalities.

We consider ports as places linked to trade by ship and as a huge crossroads of transport and industrial areas and, specifically, transport hubs for waste movement.

From the spatial point of view, the ports located near urban agglomerations have the characteristic of being suitable for the recycling of waste produced and, therefore, playing a leading role in the circular

transaction: what makes the port attractive for the development of Circularity? Their industrial/logistic function combined with the adjacent urban area or, in any case, nearby is the answer (Haezendonck and Van den Berghe, 2020). The circular economy is a closed cycle where materials will regain value after a product's life: this system does not stop with the port environment. The aim is to make the port a focal player that can interact with the wider surrounding region to guarantee a flow to and from the city (Deloitte - ESPO, 2021).

Circular activities are a multitude and range from simple start-ups focused on management, to new ad hoc infrastructures and new industrial centers, or old reconverted ones, for circular projects.

On the other hand, at various levels, the government administrations have also identified Circularity as an effective system for least reducing negative externalities and creating development opportunities (Haezendonck and Van den Berghe, 2020).

We have already had to quote Van Buren et al.: now it is interesting to create a hierarchy of Circularity. Usually, this concept is simplified by using the 9Rs, which are listed in a virtuous way.

- 1 Refuse (to use that material/product)
- 2 Reduce (use of the lesser quantity of products)
- 3 Reuse (second hand)
- 4 Repair
- 5 Renovate
- 6 Remanufacture (use pieces used to create new objects)
- 7 Reuse
- 8 Recycle (reuse but of material)
- 9 Recover energy (incinerate residue and create energy)

The concept of hierarchy lies in the fact that, as can be understood, energy recovery is the final solution to further extracting utility. Therefore, in the circular economy concept, Circularity is inversely proportional to the position; therefore, entering Circularity could mean "less circularity" in the Van Buren ranking, while lower levels on the scale are synonymous with greater maturity and depth in innovation.

Looking at the port hubs, we could say that the first step for this circular transaction starts exactly with the activities of recycling, reuse of materials, and reuse of energy. Inside the port, energy



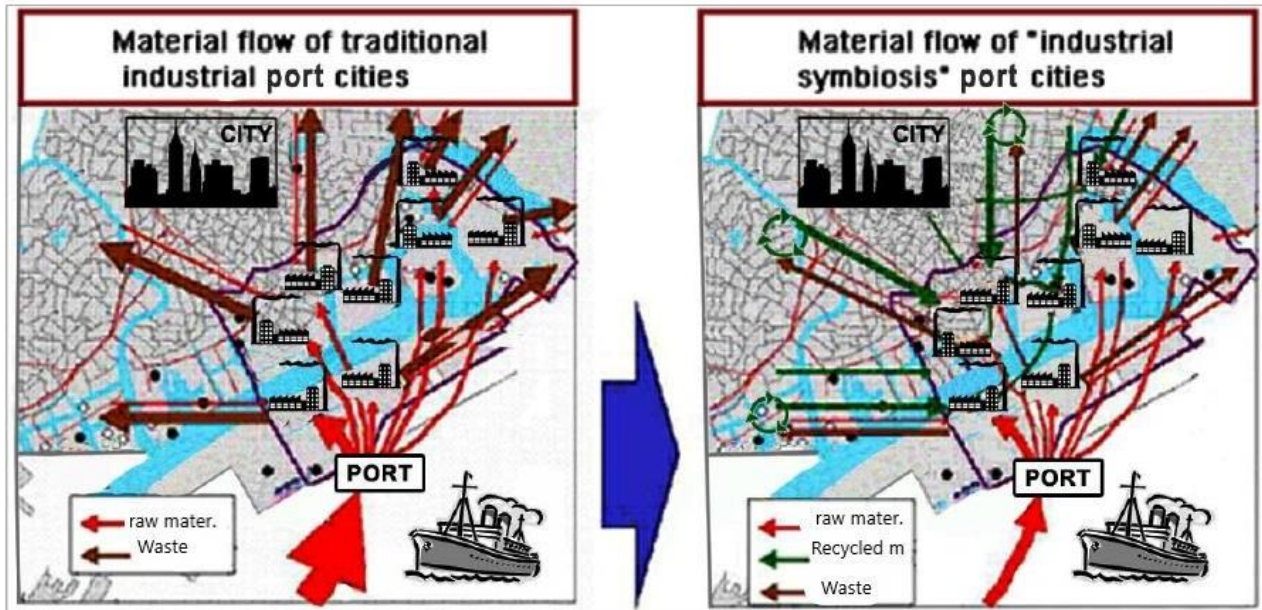
consumption is a constant topic on the agenda, and in this sense, Circularity can compensate for the use of fossil fuels. As we have had the opportunity to deepen these concepts, they are seen positively also from a working perspective, and this is a great plus (Van Buren et al., 2016)

Based on what has been seen, therefore, the port that embraces the circular concept should be structured in such a way as to go beyond simple recycling and energy recovery (which in any case can be seen as starting points). The more the various "R" is articulated, the more the port proves to have reached a certain degree of circular maturity.

However, the maturity in the development of the circular economy is an important challenge for the port complex because the port is a central hub in the supply chain of a multitude of activities. Therefore the Circularity in the port also depends on that of the other sectors and how much the port itself can push its clients and all the players involved (from companies to shippers etc.) in the conversion to Circularity ( Haezendonck and Van den Berghe, 2020). However, most European ports are focused on the two elements of Circularity mentioned above (energy recovery and recycling). Therefore, they have not yet managed to develop the fundamental element of creating new value (www.alvec.it, 2018).

The maximum development of the circular economy applied to the port size is achieved when the port enters into synergy on several levels: these synergies can be

- 1.1** Industrial, for which the CE is mainly expressed in the concept of energy recovery
- 1.2** Urban, where the dimension of recycling is highlighted
- 1.3** Territorial, where relations with the hinterland allow the full affirmation of Circularity and the creation of value and new goods and flows



*Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the "Historic Urban Landscape" Approach. Luigi Fusco Girard, 2013*

The port then becomes a central player: it provides the spaces and systems to develop the circular know-how. This type of territorial synergy with the hinterland is the overcoming of the double dimension of the CE; Energy (renewable) and recycling (from used materials).

Today, to complete the sustainable conversion, we cannot ignore this concept of territorial synergy, called industrial.

This concept has become central in our definition of circularity. The pivot of this industrial synergy is the port: the port-city can and must develop specific relationships with the surrounding environments by including large parts of the circular supply chain. The new flows may be even more limited, and redesign the connections with the port in a more local/regional perspective. Still, the goal is the creation of new logistics and new added value (Haezendonck and Van den Berghe, 2020).

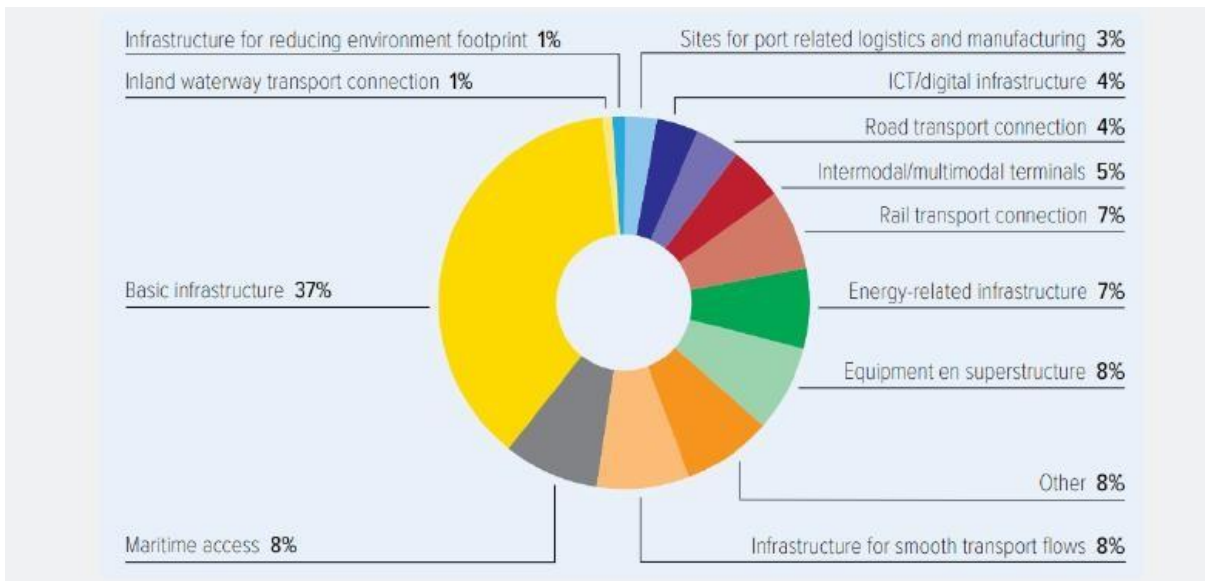
The circular model is becoming attractive to many European cities, both necessary and an opportunity. The most virtuous cities are already experimenting with spatial development and transformation projects through the centrality of the evolved environment to be reusable: therefore, the production of energy, food, new renewable systems, multimodality, etc., are at the center of this rebirth (Ellen MacArthur Foundation, 2017).

From a circular point of view, the current energy model (one of the pillars) is under pressure. We have said that fossil fuels are the primary source of income for numerous ports, and the trend is now towards alternative sources: port authorities can take advantage of this and prepare the cluster for new types of energy sources (for example, for ports that can exploit the wind, offshore platforms). This also applies to new types of goods, which port authorities can encourage, through infrastructure investments (redeveloping new spaces, i.e.) and new circular synergies (Deloitte - ESPO, 2021). In the global landscape, it is precisely the port city that offers numerous conveniences to make circularity come true. The interconnection and symbiosis with the various players and systems become central: industry, logistics, tourism, urban system, etc.: to this, we add the development of technologies that support policies and decisions. As a crossroads of traffic, the port becomes the perfect laboratory for developing the circular economy. The success of this model is a composition of multiple competing factors (Gravagnuolo, Angrisano, and Fusco Girard, 2019).

## **2.4 Circularity: Impact of new technologies in the port sector and consequences**

The possibility that the circular economy uses the latest digital technologies is real: IT and AI play a predominant and central role in the transition towards circularity. The advent of new technologies will help for this profound change, as will the widespread dissemination of data: this will allow the authorities to work and develop the available resources more efficiently. Improving communication channels will help transparency in port activities: moreover, technology has already imposed a revolution linked to e-commerce. Also, in this sense, the port plays a vital role because the good still flows through it before being delivered (Chauhan, Parida, and Dhir, 2021). Port Authorities direct investments to reconfigure the port ecosystem: sustainable solutions are extensive, and we will see them in more detail. The role of the port as a center of innovation pushes it towards solutions of significant impact, naturally depending on the type of port. Sustainable investments for circularity concern three main pillars that we will see more in, two of which are already widely feasible with ease: energy grids and recycling.

The ESPO Port investment focus (2018) outlines the various investment categories in this regard.



Deloitte.it

Circularity in ports means explain Ports system: seaports handle huge volumes of raw materials, intermediate products, and final products; given this, the whole supply as we know it will be profoundly changed. The port must now be understood more and more as a hub of meetings, where the productive industries, those that deal with recycling materials and a passage point for all these types of flows, come together. They become a virtual node for the import/export of waste materials and therefore are an extremely important and ideal point for the affirmation of the circular economy. In the definition that we tried to give in the introductory part of the paper, circularity includes the use of renewable energy sources. Therefore, the transaction toward the circular economy sees a fundamental element in this pillar. However, it is not only an economy based on renewable energy (excluding electricity and alternative fuels for transport): we support the concept of transaction towards the use (and reuse) of resources that the concept of circularity allows renewing as material for new products (Sornn-Friese, Poulsen, Nowinska, and de Langen, 2021).

The new energy capacities will mainly consist of the energies already mentioned: depending on the orography of the area, it will be more solar, wind, marine, or non-fossil. The transaction will imply the closure of existing fossil power plants for ports. In much of Europe, this process is taking place: in Northern Europe, for example, it is part of a plan to return to the parameters of the Paris agreement; in England, it is planned to phase out fossil power plants by 2025 (Sornn-Friese, Poulsen, Nowinska and de Langen, 2021). The circular port will have considerable potential to become a clean energy generator. This transaction cannot be undertaken by the port authority independently. Still, the various initiatives will have to be agreed upon with the large energy companies: ports can exploit this situation and facilitate its development. The seaport is the perfect place for offshore wind energy storage, for

example, and ports affected by this phenomenon. It is an unlimited opportunity for industrial and urban networks, requiring large amounts of energy. Any approach to green energy (which is a pillar of the circular economy) will involve significant infrastructure investments (from the adaptation of the docks to the expansion of the electricity grid) (Katsaprakakis, 2016). The great demand for energy is also because European ports are among the largest in the world regarding chemicals, steel, iron, refineries, metals, etc. Due to the limits imposed and addressed in the last part of the paper, more actions have been taken to limit the emissions of these industrial clusters. In the form of the production of clean electricity and electrification, the circular economy becomes an essential element to enhance the diffusion capacity of this type of electricity: Each port sector has a given type of reference energy (oil for combustion, gas for heating, etc.). Moving on to circularity, it will also be necessary to be more flexible in this energy supply/demand, and therefore this type of coupling will integrate various energy systems. (Deloitte - ESPO, 2021).

## **2.5 Circularity and Supply Chain**

One element to consider when talking about ports and the circular economy is the geography of supply chains. These can be global but regional, national, or local: shipping, intended as maritime transport, is included in global supply chains. If we talk about goods, we can mention two cases; for paper, for example, areas of origin and place of production are international, but glass, on the other hand, it's often regional/national. Specific attention is needed to this dynamic to identify the concept of circularity in ports. The transformation took place after the war with the consecration of the economic system that characterizes our era: starting from the 1950s, many supply chains (means of transport, toys, textiles, etc.) shifted from linear local to linear global. This trend culminated in the 1990s with the enormous growth of global trade: today, the transaction involves a further step, starting from linearity and circularity. The linear model is no longer sustainable; we need to change. ( Sornn-Friese, Poulsen, Nowinska and de Langen, 2021 ). The strategy in place is to create synergies and have an advantageous position in the market: collaboration can be vertical or horizontal: from the horizontal point of view, we have synergies between ports or terminals that, driven by the needs, including sustainability, try to be more efficient through collaboration.

On the other hand, when it comes to vertical integration, we try to connect the entire supply chain more closely by collaborating more intimately with the various suppliers and, in general, with the hinterland. Therefore, vertical integration will be visible with the full development of circularity, and more vertical integration helps strengthen and make circularity more closed (Hansen and Revellio, 2020).

As we have already had to argue, circularity should not deal with, and does not deal with, only products: by circularity, we also mean organizational and operational aspects. Therefore, reconfiguring all production elements and creating new specific ones for the Circular Economy will be crucial. Therefore, the connection with non-industrial players, such as government, city institutions, and city organizations, is valued (Haezendonck and Van den Berghe, 2020).

The transition towards the Circular Economy in the port is a long and non-linear process, which involves many players and does not have its ideal completion. However, we have seen that it is considered "finished" when one goes beyond the concept of energy and recycling and approaches the creation of value using new flows of goods. Depending on the number of actors involved (intraport, port city, and territorial level), the complexity of the organization of the circularity will vary (Raimbault, 2019).

This change can affect the geography of supply chains. If we think of materials and raw materials, both scrap and scrap steel refer to globalized supply chains in which exchanges occur at a supra-national level. Moreover, it is not only the type of good we examine that influences the supply chain but also among the individual companies that sell similar products: in textiles, the part of the material that is recycled is very varied and also depends on the market we decide to consider. These are markets in which the linear share is still very high compared to others, and these differences help us define the position of the various goods and how ports can interface with the various realities. Circular and global supply chains consist of many different products: for example, they are predominantly linear and global products such as toys, electronics, and fuels (Sornn-Friese, Poulsen, Nowinska and de Langen, 2021).

Conversely, agricultural products have been, overall, more circular, even if it cannot be said that these products are linked to a circularity concept: due to globalization and trade liberalization, many agricultural chains are becoming completely global (imagine a product such as cocoa for example). Everything is in constant motion; steel, for example, historically global, can also be seen as circular, and glass, which is often reused locally. In general, it can be said that the challenge is to look with much more attention to the concept of circularity and efficiency. The share of this type of economy is increasing, and changes in the business model accompany this: companies are shifting towards selling a service rather than just selling an asset. The producer is also made responsible for that part that goes beyond the end of the product itself (end of life). The costs of waste collection and treatment are lowered, and the companies involved create value thanks to circularity increase. The conversion towards circularity affects not only the industry but also the organization of the supply

chain, consequently also the ports their management and their space organization (Sornn-Friese, Poulsen, Nowinska and de Langen, 2021).

## **2.6 Potential effect of Circularity on Ports**

The circular economy has two main effects on ports: on the one hand, it affects the volumes handled, and on the other, it acts as an attraction for new logistic and industrial activities. It all depends on the type of commodity or raw material that we consider, however, we can assert that with the increase in circularity, the volumes of raw materials that are now handled by the ports will decrease. There are products that by nature and characteristics have an easy predisposition to circularity: let's think, for example, of demolition waste in the construction sector. In this case, the cement can be turned into sand and re-introduced into the circulation again to produce new, also reducing the CO2 emissions that characterize production starting from plaster. Furthermore, CDWs (Constructions and demolitions waste) also consist of other materials such as bricks, wood, plastic, solvents, etc., all of which are potentially interesting from a circular point of view (Sornn-Friese, Poulsen, Nowinska and de Langen, 2021).

Other materials such as steel (steel scrap) are suitable and are already currently connected to circularity: the same applies to wastewater, both maritime and non-marine, which can be a source of fertilizers and/or gas or metals. Cars and tires are other products that can generate high volumes of recycling commodities, as are electric cars whose market is on the rise and will become fundamental in the coming decades. Similar is also the consumer electronics sector, from where precious materials and rare earths can be extracted to re-enter the industry. Furthermore, plastics, textiles, paper and glass are goods that have long been the protagonists of the circular vision: today, with the lowering of costs and the development of new technologies, they can be recycled repeatedly without losing the qualitative characteristics ( Sornn-Friese, Poulsen, Nowinska and de Langen, 2021 ).

Moreover, the energy sector has been classified as essential for increasing and developing the circular economy. Recent studies have focused precisely on the optimization of the energy sector and have framed cities as ecosystems where waste is disposed of and becomes input for other subsystems ( MacArthur Foundation, 2015.). Stewart et al. exactly hypothesizes the electric city as the point of arrival of a certain type of circularity (Stewart, Kennedy, Facchini and Mele, 2017).

As mentioned, the transition towards circularity will mean a decrease in throughput capacity: this transition, however, will also bring with it new opportunities for ports. The port will have to undergo a transformation not only with respect to the type of goods and products that will be handled but also from the architectural structural point of view: the location of the factories that will manage the flow of volumes of these "new" goods will be an important element. From the industrial and logistic

clusters already present, new ones could be born in order to develop the so-called "eco-industrial" parks: it is a question of perceiving the opportunity and adapting the geography of the port to the best of the needs of circularity (J. Goddin, 2020).

In Europe, those at the forefront are in the North area (Belgium and the Netherlands): in fact, in these countries the goal in the long term is to complete transition to circularity and the industrial development of the port is influenced by this dynamic. This circumstance will be typical of the port of the future where companies, producers and port authorities will focus on sector-by-sector circular agreements. We can once again believe that the transition to the Circular Economy may apparently be a threat to ports, with a view to reducing volumes: but also because it reduces the range of supply chains, from global or mainly global to regional. In reality, the transition to a Circular Economy offers the opportunity to magnetize countless industrial and logistic activities: public and private investments are already numerous also because the port is preparing to become central in storage, assembly, and production. A further element to consider is how the Circular Economy will be able to reshuffle the various power relationships between ports from the point of view of their competitiveness: new development areas will emerge and ports that today have certain volumes and a type of role, if they move in time, will be able to attract Circular activities by increasing their numbers and their importance (presumably to the advantage of port clusters linked to fossil fuels) (Sornn-Friese, Poulsen, Nowinska and de Langen, 2021). Speaking of competitiveness, new opportunities and changes in the type of port, in terms of what actually goes on in a given port, we said that circularity is an opportunity to also change the balance of power between ports as we know it today. We know that there are countless factors that influence competition between ports; the most important is undoubtedly the location, followed by the products and the hinterland. Consequently, the type of goods handled and

handled by the port is also relevant because, as it is easy to imagine, some types of products require complex structures that not all are able to offer (De Langen, 2007).

## **2.7 Port Profile: new metropolitan economy**

To approach circularity and be able to understand the strengths of a port system, a port profile is needed. Giving a definition of this type provides a design of the main activities present in the port or connected to it: the throughput alone tells us little because, as far as circularity is concerned, there are many factors to be taken into consideration, even if not physically close to the port (S.Vermulen, 2016).

Trying to insert circularity in the urban environment means changing the economy in a rather radical way: in this sense the rethinking must not only pass through the direction strictly linked to the



business. We must try to build a system that attracts investments but also refers to "external" elements such as cultural heritage, landscape, common goods, local awareness, etc.

The port and the adjacent urban conglomerate have a dependent relationship on each other. Communities receive negative externalities but at the same time enjoy the advantages deriving from port activities (work, infrastructures, etc.). In an elementary way, the city offers labor, and the port reciprocates with employment: the city also allows a constant flow of demand for raw materials and at times provides raw materials to be recycled, which in the sense that interests our paper, means push for circularity. The city/port connection (and in turn hinterland) is fundamental for the development of the Circular Economy. This new economy will include private actors who will have to be attracted and supported by the port authority (Deloitte - ESPO, 2021).

The urban economy must act as a fertilizer for circular processes (and the famous 9 Rs - reduce, recover, reuse, recycle, regenerate, renewables etc.) and urban planning should act as a doping for circular processes by facilitating and promoting a certain type of industrial economy, with exchanges and flows between the port area and the hinterland. This new model has a dual "regenerative" purpose of the port / city / hinterland axis: it aims both at enhancing the synergies between the port system and the metropolitan part from a functional point of view to circularity. At the same time, in the long run, it benefits natural ecosystems and the well-being of populations (Wijkman A., Skånberg K., 2015). Below we will pass to the explanation of the methods that are, can be or have been used in the study of the discipline object of this paper.

## **2.8 Framework of strategic plan**

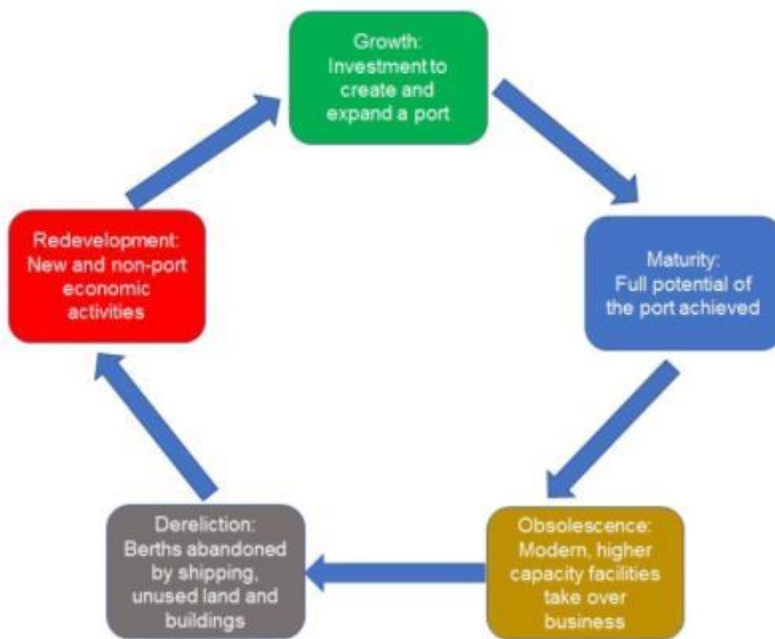
Structuring the transaction towards a circular economy within the port is not an easy task. Several factors and steps need to be considered. This is because Circularity by definition has its own form while inside a port it must have a very specific development, regarding how it can be triggered, how it enters into relationship with the actors present and with the surrounding stakeholders (Carpenter et al., 2018 )

The circular economy can help ports to remain competitive, helping the innovative path and redevelopment. Starting from afar, we can define the life cycle of a port in five phases:

- .Growth - expansion of the port facility
- .Maturity - the potential is reached
- .Obsolescence - modernity takes over

.Abandonment - the risk that a port will lose its commercial weight and move towards the loss of its economic weight

.Requalification - where new economic realities are encouraged

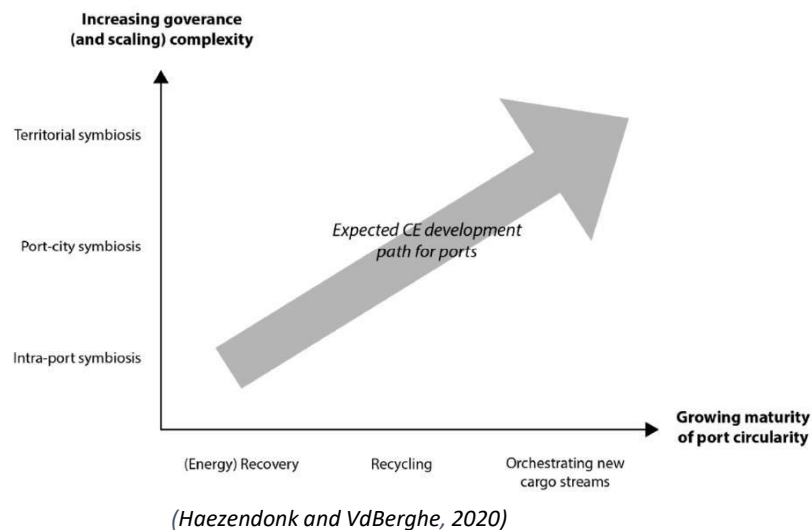


*(Carpenter et al., 2018)*

In the case of circularity, we find ourselves in point number 5: the adaptation of the port to new economic changes. This is the fundamental element for the development of port circularity. (Carpenter et al., 2018). The three elements for the affirmation of the circular economy in a port are: reduction of pollution through energy recovery - optimization of the value that has been created through a subsequent phase (the recovery of resources and materials in a closed circuit) - manage new flows and relationships between the players that make up the circularity chain (Haezendonck and Van den Berghe, 2020).

Within this superstructure, the various dynamics are combined according to the port of reference and the territorial reality: it is the port authorities that must be the main drivers of this type of change (Carpenter et al., 2018)

With these levels of maturity there is a tendency to draw a picture of what are the dynamics that characterize the development of circularity within the port. This type of transaction does not have to be immediate and disruptive: for the framework, two guidelines must be considered. On the one hand the innovations, on the other hand, how these innovations are optimal for the port being analyzed. Therefore, the level of advancement of the port circular economy will be combined with the type of symbiosis of the port (Haezendonck and Van den Berghe, 2020).



The greater the level of symbiosis of the port, the more complex it becomes to organize the transaction, but the closer one gets to the concept of a complete circular economy (Haezendonck and Van den Berghe, 2020).

This framework is useful to better analyze the reality of the Genoese port and understand if and how the port authority is developing the transaction towards circularity.

## **2.9 Framework in the Genoese reality**

What we have examined so far leads us to ask ourselves what we will find by subjecting the port of Genoa to the study on circularity.

We have seen what the key elements are and what should be the framework of a port in which the circular economy is fully developed. It is a question of creating synergies, through the various activities in which the port is engaged. The port of Genoa must therefore have solid connections with the industrial areas present in the hinterland, to favor the connection with other production sites.

The port authority will have to reflect on how to use the spaces, on how to rationalize the existing ones and how to create new ones: the proximity to the urban part of the city is certainly a positive feature for the circularity.

We have mentioned the 9Rs, the more these will be articulated in the future design and the more the port will reach its circular maturity: we will see if a multi-level synergy has been created between the local urban area and the territory: we will see at what point are the synergies reached so far and what plans for the future.

We will analyze at what evolutionary stage is the part relating to technology and artificial intelligence, which we know to be an important pivot. Analyzing the increasingly widespread dissemination of data has become a key element for efficiency.

We have seen how important the horizontal synergy (with other ports) and vertical (with the hinterland) is important from the point of view of the supply chain. It will be important to investigate the level of this type of interactions in Genoa.

Therefore, if we want to know the evolutionary point of the theoretical framework for circularity in Genoa, we will consider how the various power relationships between ports and players will be reshuffled. We talked about "redevelopment" understood as a new phase in which emerging economic realities are encouraged.

In closing, what we will try to understand is at what point is the level of symbiosis, in light of which pillar has been developed - or is intended to develop in the near future - between energy recovery, recycling and new economic flows (territorial symbiosis).

### **3.0 Methodology**

This paragraph helps to understand the main criteria, trying to answer the research question. We have already introduced this paper's objectives, mainly to allow the reader to comprehend what the circular economy is and the differences and similarities with the energy transition and sustainability. Describe how this circular economy applies to the port galaxy and how it is almost a natural culmination of the port's role in the future. The goal of the used tools is to explain if and how this circular economic model has been made current for the port of Genoa: whether this has been done most appropriately and what are the margins for improvement, or where it would be reasonable to act and invest more.

Since this paper aims to explain the situation of circularity in the Genoese port system and if there is a planning structure for this economic model, it is necessary to realize what the prospects are.

A quick overview of the chosen method will be given to have a complete view of the subject.

Recent studies have shown that case studies have become among the most popular study and research systems ever: this result is due to several factors, but mainly the case study has the advantage of fostering innovative and modern theoretical insights and practices. Furthermore, this research system makes it easier to explain and analyze study phenomena that are the subject of academic scientific investigations (Piekkari, Welch e Paavilainen, 2009).

#### **3.1 Data Collection**

The collection of the information elaborated in the text was completed in different phases: the overview of the concept of circularity was made by drawing information from the most authoritative sources available today. For the study of the circularity itself, and in the light of its applicability to the port dimension, fairly recent studies have been investigated, both of an academic/scientific nature and coming from industrial or consultancy realities (for example, Deloitte). This information was then used to contextualize the reality of the port of Genoa. Next, this phenomenon was analyzed in its entirety by drawing on the information contained in the annual reports published by the port authority: the goal was to investigate whether the port of Genoa is potentially suitable for the development of circularity and at what level it is such circularity. Finally, the interviews had the main objective of assessing whether the potential authority is effectively and actively moving in the direction of the circular economy and what margins for development there maybe for the future.

#### **3.2 Case Study**

Case studies are a research system that has spread quite widely in the last few decades, becoming one of the most usable and reliable research sources. The advantage of the case studies lies in the ease they can create and give life to new theories and insights (Welch et al., 2011). This system has not

been without criticism: the risk is that the dominant opinions could compromise the context, which is a cornerstone in the case studies. Furthermore other criticisms that have been leveled against it, including the fact that practical knowledge must necessarily be accompanied by theoretical knowledge and is a more useful system for creating hypotheses rather than generating theories: therefore it would be inappropriate for the development of scientifically based assumptions (Flyvbjerg, 2006). Those involved in research on these issues are trying to reconcile the link between these two elements as much as possible (Welch et al., 2011).

The traditionally used methods to theorize the case studies are at least three:

Some support a method that believes that the supreme purpose of case studies is the possibility of obtaining innovative theories starting only from empirical data. Those who hold this idea want to develop observations that can then be applied in many different contexts. This interpretation is the classic one that starts from a specific element to arrive at generality (Welch et al., 2011).

Another approach is that which believes that case studies can be used to discover and give life to new scientific assumptions and for verification. Since these are experiments done in nature, the case studies according to this theory have a high degree of truthfulness and validity.

A more particular theory is that which maintains that there is also randomness in explaining phenomena. There is a tendency to reject the regularity in the choice of a model, adding something unpredictable and unexpected that is in antithesis to what was initially hypothesized.

The three methods are corrective of the biases seen above even if obviously our case study has an intrinsic limit in the fact that it is structured on the basis of the port of Genoa only. In our case, the approach to the case study was classic, trying to start from certain elements, analyzing their roots and evolution over the decades, and then applying it to the specific reality that we wanted to analyze. Furthermore, it must be added that if the problem of referring only to one reality can be identified in the limited scope of the results, on the other hand we will have an approach that will allow us to go very deeply into the reality of the Genoese port, and this is certainly a positive element for this type of method, because we will be able to guarantee realistic conclusions.

### **3.3 Interviews**

This thesis bases the research method on qualitative interviews; This type of interview is characterized by questions asked on a particular topic to an interviewee: this individual has completed

freedom to answer as he sees fit according to his knowledge and convictions. In doing so, they can propose answers that reflect their point of sight. This type of strategy allows to obtain excellent results and to capture as much as possible how the interviewee understands the arguments and possible solutions (Bryman, 2012).

In recent years, remote interviews have taken over, both for technological advances and for external issues (in our case the pandemic). The disadvantages of a type of remote interview concern in particular the type of result that is sought. If the interviewer needs to know the attitude, even physical, and the reactions of the interviewee, then the remote method may be inadequate. In our case this type of approach was not necessary, and the technology made it possible to obtain long-distance interviews that are very comprehensive in terms of content (Opdenakker, 2006).

The system used provides a classic scheme in which the subject who asks the questions uses a series of closed-ended queries that have been previously designed to adhere to the direction of the investigation. The interview will be carried out by reading the questions exactly as they were structured.

To have a satisfactory final result, various actors were chosen, including technicians from the port authority, representatives of the governmental public administration, and professionals in the circularity sector.

The past-present and future point of view of those who actively manage the port and who has to do with developing the business plan and managing the investments were fundamental. The same can be said for government representatives; the pushes towards the circular direction must pass through national policies. Finally, the technical point of view of industry representatives was useful to have a direct overview of which sectors are more inclined to develop circularity in the port of Genoa.

### **3.4 Results explanation:**

We conducted the interviews via telephone or zoom, between September and October 2021, due to the restrictions due to the pandemic. As a result, some of the interviewees were not on national soil.

The semi-structured interview is that type of interview in which the subjects to whom the questions are addressed will have to answer pre-determined questions and are usually the typical system with which a qualitative research paper is constructed.

All subjects received the same questions, and the main objective was to understand how and when the development of circularity in the port was possible. The number of interviewees is not high, but this has to do with a strategy that has preferred quality over quantity: in fact, all subjects hold top

positions, and their point of view is rather authoritative. Unfortunately, it was impossible to have evidence because the interviewees were previously asked if the conversations could be recorded. The answer was negative, just as they preferred to remain anonymous.

The interview makes it easier to understand the phenomena, as, during the dialogue, the collection of information is in-depth. But, above all, the interview itself allows you to go under the surface: the communication increases the knowledge of the interviewee and interviewer because it is easy to exchange points of view (Mcleod, 2014).

It is certainly a cost-effective and, in itself, quick method.

Moreover, it provides interviewers flexibility and anonymity, ensuring the utmost sincerity.

Regarding the limits, there is a risk of lack of details because questions are closed and set very specific limits.

As already specified, the number of interviewees was reduced: it could be negative, but on the other side, this allowed us to obtain similar results among the interviewees: a sign of a univocal idea on the future development of the port circularity in Genoa.

The interviewees gave their vision of the problem in the light of the position held and their business.

The questions asked were roughly the same. They were subjects belonging to different spheres but whose purposes in the port galaxy were very close.

The interview is conducted only once, and the aim is to obtain the answers most completely and exhaustively possible: the questions in the semi-structured interview include a central question - What is the development of circularity in the port of Genoa - followed by associated questions, linked to the central one (Jamshed, 2014).

### **3.4 The model: Qualitative**

The qualitative research we have chosen for our paper has, by definition, its foundation in the collection of observable information through classifications and labels. Not in numerical form. The data is usually recorded using a diary, questionnaire, interviews, or unstructured observations. These are the most common and well-known tools used in the qualitative field.

Qualitative data are mainly descriptive data, making their use more difficult and, consequently, their processing will be more complex. However, qualitative research is useful in single case studies and describes a certain event or behavior. In essence, it is a question of expressing the qualities of a specific object of investigation in the form of textual information.



### ***Subjectivity of the results:***

The information collected is then analyzed in an interpretative, subjective way, even if there are tools that make it possible to reach accurate and reliable results (Fiore, 2021).

#### **- *Benefits***

In general, qualitative research is less structured than quantitative research, which allows us to identify a series of nuances of a specific behavior or event that could not be understood differently: this leads to considerably enriching the observed data, building very detailed and rich theories.

#### **- *Disadvantages***

The limits of this methodology may be the extreme individuality and subjectivity with which data is collected. For this reason, in certain circumstances, it cannot be easy to replicate the process that leads to the generalization of the data.

In the following chapter, we developed the described method into practice, trying to describe the reality in the port of Genoa.

The reasons that led to want to analyze the Genoese port system through the methodology described are many. First of all, the general problem of sustainability is a current and particularly present issue. The circular economy as introduced in the initial part of the paper is an economic theory that lends itself perfectly to port realities and that generates a notable series of transformations and modifications not only in the port itself - of Genoa in our case - but also in all the realities, economic and otherwise, that orbit around it. The port as a nodal point of the new economic relationships that will be created and the center of the new synergies. The fact that the port of Genoa was chosen is no coincidence. First of all it is the main Italian port, for movements, historically and for the number of shipping lines and container handling and various goods. In northern Italy - as we will see - it plays an important role and allows you to connect the northern Italian industrial area with the rest of the economic world. Mediterranean and oriental. Furthermore, as the first Italian port they make it a perfect starting example for testing circularity, the goal is in fact to understand how the analyzed theory can be applied and to what extent this has been done so far. The empirical analysis of the situation together with the literature made it possible to structure a basic idea, which was then the subject of discussion in the interview phase. The interviews helped to put what has been said into practice and effectively structure the state of development of circularity in the port of Genoa, understanding its progress and critical issues.

## **4. Case Study: Port of Genoa**

### **4.1 Introduction and general information**

The Port of Genoa consists of a Port System consisting of 4 connected sub-ports. Genoa, Prà, Savona, Vado.

The Genoese port system is a rather complex system where a myriad of industrial, civil, and transport activities are present and interact, with heavy implications from an economic and environmental point of view. As we have stated, the port dimension requires an integrated approach that considers the needs existing up to now and especially the future ones, in the light of the radical economic-energy changes taking place. According to the guidelines of the Environmental Energy Planning strategy, the port of the future is determined to create a sustainable, resilient, and low-emission port system. All this, to guarantee a better quality of life without losing competitiveness and traffic: among the strategic lines, we can mention investments in alternative energy carriers (hydrogen and LNG), improve the energy efficiency of means of plants and processes, increase the use of sources renewable energy all using the latest technologies. We will try to understand the port authority's approach to the circular economy (DEASP, Genoa 2020)

The port of Genoa has ancient roots since Roman times: It is with the Middle Ages, with the maritime republics, and with the birth of trade by sea in the modern sense that Genoa is configured with the physiognomy it has preserved until our days ([www.portsofgenoa.com](http://www.portsofgenoa.com), 2021). The area extends along a narrow strip of land dominated by the Apennine Mountain, a range that forms a wall between the Po Valley - the economically richest area in Italy - and the sea. This morphology determines important differences along with the entire port territory: the lack of space, a recurring problem, has led to the creation of space on the sea. It is precisely towards the sea that the port has expanded over the centuries, and even today, the most recent development plans look in this direction (PEAP, Genoa 2012). From a circular point of view, spatiality is an important element in Genoa; it will be essential to understand where to obtain the spaces necessary for the circular conversion of the volumes traded.

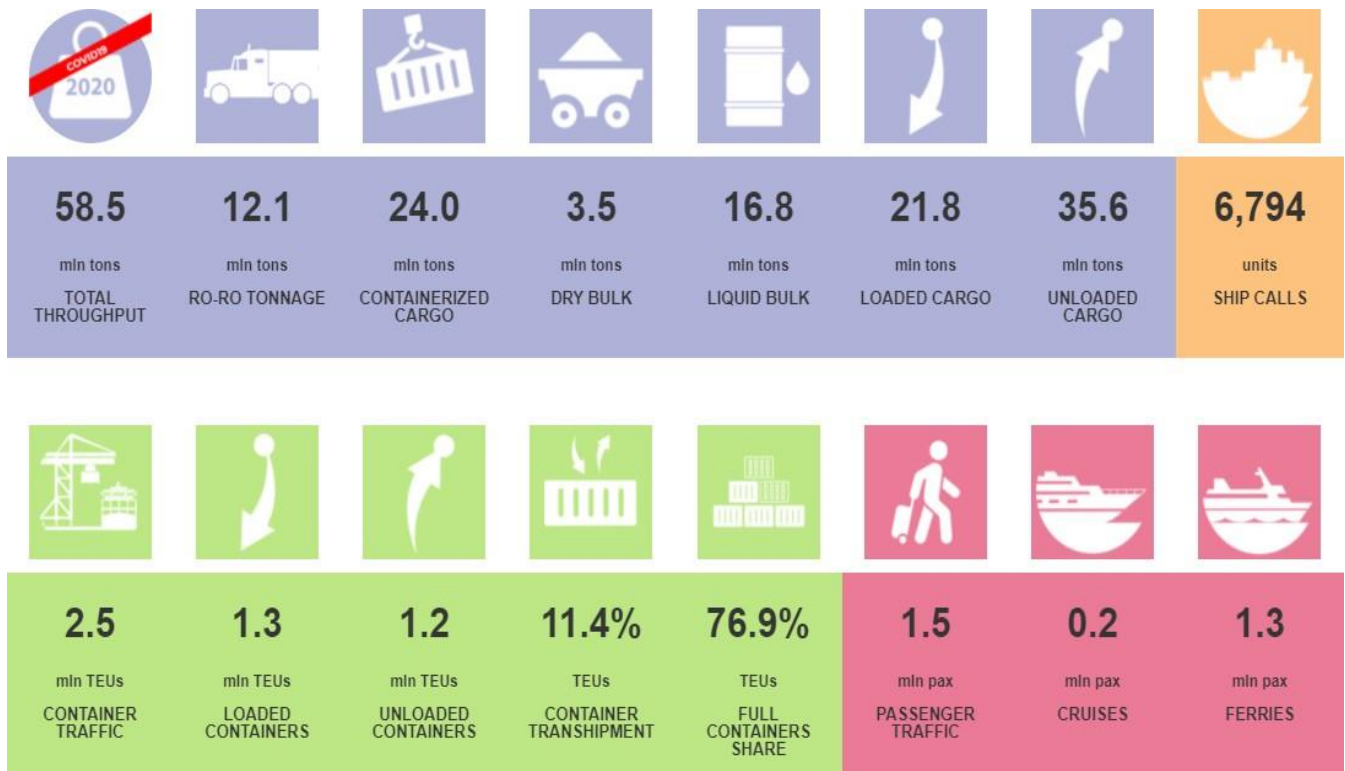
It was from 1875 that the uninterrupted process of development that will continue to the present day began: the first phase lasted until the early 1900s when the Suez Canal opened, and the first railway connections with Northern Italy were created. Then, during the Fascist era, the number of docks and basins and multipurpose areas was implemented: starting from the 1960s, the port of Voltri was built, the passenger hub, and then in 2000, the last step that designed the shape of the port as we see it today, the starting point of what will be the Port System of the western Ligurian Sea, determined to play a top player role in the challenge of the energy and economic transaction towards sustainability ([www.portsofgenoa.com](http://www.portsofgenoa.com), 2021).

The surface of the Port System is a total of almost 7,000,000 square meters, on which more than 30 terminal operators are operating, handling any goods and goods. The port of Genoa alone, on the other hand, extends for more than 22km along the coast and covers almost 6,000,000 square meters on which 25 terminals operate that manage many trades, from containers to metals passing through perishable products, forestry, bulk, petroleum products and also passenger cruises. In addition, there are naturally all those services relating to the repair and maintenance of vessels, their preparation, and computerization. In chronological order, the latest development of the port is that of the Voltri-Prà area, built in the 90s and dedicated exclusively to container traffic (DEASP, Genoa 2020).



Due to the global pandemic, 2020 and part of 2021 was a difficult year for port activities, with important implications for maritime traffic of goods and especially passengers globally.

About 7000 vessels arrived in Genoa (-20% on an annual basis), and freight traffic amounted to 58.5 million tons (-14.2%) with 2.5 million TEU (-6.5%). But, as imaginable, the cruise sector has been hit hard: the suspension of all passenger activities has reduced the flow of tourists by 90%, and the traffic of ferries to and from the islands has halved ([www.portsofgenoa.com](http://www.portsofgenoa.com), 2021).



(Portsofgenoa.com)

The Port System is also composed of the Savona-Vado port: Historically an outlet for the Savoy Kingdom (City of Turin), the port developed at the end of the 19th century thanks to railway connections and the establishment of shipyards and industrial sites. In the twentieth century, it was enlarged and equipped to handle coal, and during the post-war period, its strategic role was recognized. Since 1990 the two basins have been developed, merchant and cruise activities are enhanced for Savona, while in Vado, an infrastructural expansion plan has been launched with the creation of an ad hoc Terminal. The port, which has an area of more than 350,000 square meters, specializes in the unloading of petroleum products and fruit trading and is one of the most important terminals in the Mediterranean for fruit: starting from 2019, the Vado Gateway has become 100% active and is a state-of-the-art semi-automatic terminal with fully automated stacking Yard (www.portsofgenoa.com, 2021).

The port of Savona has a smaller surface area than Genoa, equal to almost half a million square meters: the oldest docks are close to the city center. Over the years, they have been converted for tourist activities, both pleasure boating and cruises (MSC, Costa Cruises mainly). 2000. The terminals for general goods, bulk, and Ro-Ro are located far from the city center (www.portsofgenoa.com, 2021).



The Genoese port area is the first Italian port system for volumes handled, productivity, and economic value: all of this gives an idea of the central importance they play for national and European trade.

The strategic geographical position, the favorable weather and sea conditions, and the absence of tides put Genoa at the center of a series of international and Mediterranean connections: the port can accommodate any latest generation vessel, creating connections with more than 450 ports. Greedily. From the circular point of view, it is clear that the potential is considered in absolute terms (www.portsofgenoa.com, 2021). In the next chapters we will deal with the results obtained by triangulating the theoretical and methodological information with the Genoese port reality.

#### **4.2 Circularity in the Port of Genova: towards the port of the future – Results/discussion of results**

We want to investigate in what terms the port system is prepared for the transition towards circularity: We were able to investigate previously that the pillars of circularity are three energy recovery, recycling, and the creation of new value.

We also know that depending on the type of port, the approach to sustainability occurs differently, both for logistical-oro-graphic reasons and for reasons of opportunity: a large seaport or a large port hub will have different characteristics and circularity from an inland port or port clusters (Haezendonck and Van den Berghe, 2020). The Genoese system is a rather complex one, in which

countless activities take place and interact with considerable impacts and opportunities from an energy and environmental point of view. What we will try to understand are the current state and future strategies. Therefore, planning and development: how environmental and circular choices will shape the future port. A sustainable port at the center of a broader plan, a nodal point in the supply chain.

We had the opportunity to consult various sources produced by the Port Authority: The Environmental Energy Planning Document defined the strategic guidelines and objectives. Sustainability is the keyword of this document. As we have had the opportunity to investigate, sustainability is linked to circularity. For certain areas, the two things overlap, but, by definition, the Circular Economy has its dynamics.

The document, and this is important for the concept we are investigating, considers a broader context in which the port is identified as a nodal point: in this sense, it plays an active role in guiding, supporting, and coordinating private and public entities - near and far - who are involved in the supply chain.

The port authority is active in the first pillar of circularity which, we recall, is the energy one and is the one where ports have the easiest concentration.

Starting from the European regulation EU 2018/1999, all member states have given life to national plans for energy and climate. We find the guidelines for circularity in the Genoese port within this plan. Concerning the energy problem, connected with sustainability and circularity, Genoa has oriented itself over the years and has minimized its dependence on the most polluting fossil fuels: the two large coal plants in the port area were decommissioned.

The first important power plant in the port area was built at the end of the 1920s: Genoa was a city in great expansion in those years. In 1925 it was completed, with one of the largest territorial expansions conducted in Italy in that period, to favor the development of industrial and port activities. In this context, it is necessary to strengthen the energy supply with the construction of a large coal-fired power plant. In choosing the location close to the sea for the construction of the new plant, the desire to celebrate technological innovation and facilitate the plant's operations contributed. The coal necessary for the power plant operation was supplied by sea by ships and barges from which it was transported to the top of the roof, where the Bunker was located. The plant remained operational until 2016 and was definitively closed in 2017, adapting to the city's development and industrial activities with increasing supply volumes and adjustments to current regulations (Politini, 2018).



Between the late 1800s and early 1900s, the expansion of production activities transformed Vado Ligure (part of the Genoa port authority) from a coastal village to one of the municipalities with the highest industrial concentration in Europe. Thanks to the port and the strategic position, many important international industries opened their factories here. In this context of constant growth, between the sixties and seventies, Enel built the thermoelectric plant in Vado Ligure ( Tirreno Power - Centrale di Vado Ligure, 2018). We were in 1970, but in the 90s, the coal-fired groups were put into operation. The power plant has changed over time considering the environmental problems. In 2007, two coal-fired units were replaced by two turbos gas-powered exclusively by natural gas and a traditional steam turbine. In 2016 Tirreno Power closed the entire coal-fired part of the plant. Two natural gas groups remain in operation today (a mixture of methane with other gaseous substances) (IрпиMedia, 2021).

#### **4.3 Circularity Pillars in the port area**

We have defined "urban" synergy as one of the three pillars of circularity: the one that has to do with recycling materials. Genoa is active, as established in the waste management plan drawn up by the Port Authority.

For the port of Genoa, waste recovery is applied to all vessels that dock annually (over 7,000 in the last year). The recovery service is totally in the hands of private companies, in free competition. The Port Authority has not identified a single monopoly manager but has opted for the free market, identifying only a maximum tariff ceiling. The companies involved are 10 in Genoa, and it is important for circularity that they deal with waste that can create added value once it has been circulated: we saw in the previous part that there is waste that lends itself to circularity, such as wood, plastic, aluminum, batteries, solvents, CdW, etc.

In the case of the Genoese port system, we can highlight the plastic and bilge waters (water coming from the cleaning and washing of the bilges), which must be disposed of specifically by law, and cannot be discharged into the sea. To the waste management plan, the new ecological platform, which had been hypothesized, has not yet been built and the spaces used are those of the companies involved.

The same things apply to Savona - Vado whose services are attributable to those described above: The recovery of recyclable waste ranges from glass, aluminum, waste oils, batteries, paper and cardboard, tetra Pak, etc., and are performed by three main companies.

Compared to Genoa, there is an ecological platform built in 2012 to improve the collection of this waste. It is an important structure for the circularity and considering the importance of allocating specific spaces to the transaction towards this economy (Piano Gestione Rifiuti, 2019).

Speaking of kind of investments and financing, the total foreseen for the interventions for the diffusion of solar panels and wave energy production systems are as follows:

Intervention	Cost
Installation of photovoltaic systems	14.300.000 Euro
Wave energy experimentation	15.000.000 Euro
<b>Total Cost</b>	<b>29.300.000 Euro</b>

More In details:

Name of the project or initiative?	When was it started?	Who started it?	Who is currently actively involved?	How much?	Strategic goal Energy recovery/recycling hub/new supply chains matchmaker	Referring to 10Rs	Do they play an initiating or other role in this?	Intraport, port-city, or port-territorial ?
Installation of photovoltaic systems	Start 2020 End 2022	Concession holders, ENEL, GSE	PA and private companies	14.3 M Euro	Energy Recovery	Recover	PA is the main developer	Intraport

- Photovoltaic Systems (table above)

General Description: The construction of systems on building surfaces within the port boundaries of Genoa and Savona is envisaged, and the relevant useful surfaces have been identified.



- Wave energy experimentation (table below)

General description: Machine partially submerged by water that thanks to the wave motion and oscillatory motion produces an air flow that activates a turbine that generates electricity.

CE initiatives	Date	Initiator	Actors involved	Cost	Strategic domain	CE business model?	involvement of the port authority	Level of "symbiosis"?
Name of the project or initiative?	When was it started?	Who started it?	Who is currently actively involved?	How much?	Strategic goal Energy recovery/recycling hub/new supply chains matchmaker	Referring to 10Rs	Do they play an initiating or other role in this?	Intraport, port-city, or port-territorial ?
Installation of photovoltaic systems	Start 2020 End 2022	Concession holders, ENEL, GSE	PA and private companies	14.3 M Euro	Energy Recovery	Recover	PA is the main developer	Intraport

The investment for the installation of solar panels to produce energy is the basis of the 9R rule seen during the first part of the paper. The investment is important, and the prospects seem to be good, both in Genoa Pra and in Savona Vado, therefore for the whole Port System. The timing ranges from 2 months for the smaller parts to 12 months for the larger ones. The subjects will be the port authority, government bodies, and private companies (Enel) (DEASP, Genoa 2020).

About obtaining energy from wave motion, it is instead a preliminary investment: this is because several aspects make the design of such equipment more complex. The most suitable type for the

specifications of the Mediterranean Sea are those with "oscillating water" (Oscillating Water Column), also known as OWC.

They will be installed along a portion of the outermost dam, specifically along with the eastern airport and VTE quays. It will also take six months to install the 1: 1 prototype and 36 months for the first block to go into production.

This purchase will involve the Port Authority, government and university research, and Italian navy entities (DEASP, Genoa 2020).

What mentioned above show how the transition towards the circularity does not necessarily have to occur in a disruptive way, but gradually: For the port of Genoa, the latest report indicates the short period as the one in which to introduce photovoltaic energy systems and experiment with those to recover energy from motion way. In the medium-long term, the strategy is to supply energy on a large scale thanks to the investments made and to take the path of green hydrogen.

Therefore, we can define the industrial synergy of the port of Genoa as the implementation of technologies that will allow for solar energy from wave motion and, secondly, consequently, green hydrogen. This is the typical hydrogen made thanks to the circular approach (DEASP, Genoa 2020). While as regards the recovery of waste, the Genoese reality is already decidedly more structured, at least at an organizational level. With the interviews in the next part, we will see if on a practical level things are positive or not.

#### 4.4 Detailed results of Interviews: results

The subjects interviewed were 5, coming from both the port authority and the municipal administration; one, on the other hand, is a technical person directly responsible for managing one of the companies that deal with the collection, storage, and recirculation of waste.

Subjects	N1	N2	N3	N4	N5
Date (2021)	28 <sup>th</sup> of September	30 <sup>th</sup> of September	1 <sup>st</sup> of October	4 <sup>th</sup> of October	4 <sup>th</sup> of October
Role	Port Authority	Port Authority	Municipality	Municipality	Professional/industry
Interview via	Zoom	Zoom	Zoom	Zoom	Zoom/In Person

We wanted to have a theoretical/technical vision. However, as has already been clear from what has been said so far, the port of Genoa has launched programs that fully enter into the concept of circularity: this was also unequivocally confirmed by the interviewees.

We could see a certain "fil rouge" in the answers from the interviewees, almost as if there was general clarity on the current situation. And in the same way, it was also clear what future interventions should be.

The starting point was to analyze at what point we can define Genoa on circularity: the answers obtained have followed what we have stated in the previous part.

The city has been moving on the general theme of sustainability for several years, and only recently has it decided to focus on a more circular concept. As often happens with the Circular Economy in port, the first investments always concern the first two pillars, which are also the most immediate and the easiest.

The interviewees confirmed that energy and recycling have been included in sustainable development documents and that they are, therefore, the fuse that triggers the economic transition towards circularity.

They talked about sustainability because there are many projects in this sense (electrification of docks, diffusion of LED lights, etc.) but what we can define strictly connected with our analysis are two, the diffusion of solar panels for energy purposes and the exploitation of motion wave to get energy.

It was asked whether the construction of offshore platforms was also planned (technology appeared in an old environmental energy plan of 2010), but no specific answers were provided.

It must be said that circularity is a consequence of sustainability in our case. Paris 2050 has imposed compliance with certain parameters, and in this sense, the Port Authority is moving.

The interviewees stressed that the interventions implemented primarily reduce pollution, emissions, and dependence on fossil fuels.

The electrification of the docks is a clear example of this, as also the solar panels and the electricity obtained from the wave motion. One interviewee spoke of significant savings: halving of CO<sub>2</sub> in Ton/Y, elimination of NO<sub>x</sub> and Pm.

It was confirmed that the energy sector is the one in the direction in which the Port Authority and politics have moved more decisively, with investments already scheduled and defined and with the

involvement of external private and public actors: large national companies (Enel/Eni for example), university research institutes and also other ministries (that of defense).

The writer then asked the respondent what had been done or planned regarding the second pillar of circularity, recycling.

In this sense, we have received the most satisfactory answers from the technician of an important Genoese company that deals with collecting waste and its recycling.

The premise is that this pillar, although existing, is in a rather embryonic state compared to what we were able to deepen during the literature review part.

Normally at the national level for this kind of service, the PA resorts to a contract and identifies a company authorized to collect the waste: in Genoa, the PA has established maximum service rates that cannot be exceeded. Then there is bargaining between the operator and the shipowner: competition between the various companies present within the port of Genoa is guaranteed.

Therefore, a management plan has been made so that the refusal of ships is withdrawn as quickly as possible so as not to slow down maritime operations. From a technical point of view, Companies deal with different types of waste: glass, paper, wood, plastic, aluminum, etc.

Most waste is processed enough to be landfilled and possibly sent to other Italian regions, where it becomes fuel for incinerators.

Currently, only plastic and aluminum are given (and not sold) to external consortia involved in somehow putting these materials back on the market.

The only material that can be fully included in circularity is the bilge waters. However, thanks to specific investments authorized by the PA, some Genoese companies can process these waters and extract between 6.000 and 10.000 tons of oils a year, which are treated and re-sold into the market again to have their initial function. This process is regularly carried out in port and generates business.

#### **4.5 Detailed results of Interviews: discussion of results.**

The results of the interviews were interesting and helped in a clear way to have an ideal vision of the development of circularity in the port of Genoa. Furthermore, they served us to understand how well it will be to plan to improve this new economy for the future.

The plan for Genoa, confirmed by our interviewees, starts from the need to reduce negative externalities - noise and pollution from CO<sub>2</sub> and gas - and can be interpreted in a circular key.

In particular, solar energy and wave energy are also excellent systems for the circular concept of Energy Recovery. In this sense, the interviewees, without any difference, confirmed that these investments also go in this direction.

The interviewees expressed, without exception, how the port of Genoa moved late on the issue of circularity: apart from the last example, there are no government plans, at all levels, that allow us to talk about the third pillar of circularity: the creation of value and a new flow of goods.

The responses pointed out that some movement could be seen from an energetic point of view. But, unfortunately there is not much about recycling, especially since most of it is recovered the big limit is the lack of connection with the recycling market and with existing companies in the hinterland, outside of the port area. Regarding the reuse of waste materials, the interviewees underlined that there is no real road map and in the eyes of those who responded, it seems to be an unstructured and poorly organized process.

As already pointed out we receive the confirmation that there is a lack of infrastructure. In Liguria, there is no circularity chain; there are no startups or companies directly involved in this new economy. So far, the things done are the prerogative of private companies that have decided to invest independently in a sector. Still, there is no political direction or support from the administrations. To push the circularity to grow and develop fully in the second pillar and then in the third, there must be a supply chain behind it: no private individual would autonomously make millionaire investments without having the guarantees of a return. From a strictly economic point of view, the circular supply chain must be a profitable business: it was pointed out that if the circularity in Genoa did not have competitive costs, or profits high enough to cover the costs, it would be a failure because it would be cheaper to dispose of in landfills or through some other system (and considering the Italian situation, even if not legal).

For all the subjects interviewed, both from the PA part and the public administration, we're unable to provide certain dates or figures on when this kind of road map will be considered.

We tried to understand three steps that should be the right direction for the complete development of circularity in the Genoese port system: the answers were quite unambiguous, a sign that the problem has been framed and, at least on paper, the solutions go in the same direction.

The first pre-condition for a circular economy in Genoa concerns spaces: from the morphological point of view, the city, and the port, have always had a problem with spaces. For this reason, port development (as we have also seen in previous chapters) has been oriented towards the sea over the centuries and in recent decades. Stealing space from the sea was the strategy of the PA in an area

strongly conditioned by the presence of hills and mountains that make territorial and infrastructural development difficult. In this sense, understanding where to invest, where to lease the infrastructures of the circular supply chain, and connect them to the road, motorway, and railway network is of primary importance. We are talking about pre-condition: in the absence of well-defined, well-connected, and well-served spaces, there can be no circularity in this port.

The second element, which involves businesses and investments more, has to do with the de-bureaucratization of practices: everything related to obtaining authorization and financing must be streamlined and simplified. This is a pathological problem of the Italian administration at all levels. Genoa also teaches those private individuals have moved as far as possible; without help from the competent authorities in simplifying all the necessary procedures, it becomes difficult to implement circularity.

Finally, a correct and decisive political will is needed: as has been done for the sustainability issue, with investments in the direction of decarbonization and energy recovery. The same must be done to close the circle and complete the circularity. In the light of the interviews, the political direction is fundamental because it sets goals, unlocks funding, allows personal planning, and includes new players. Similarly, correct planning serves to "counter" those committees (strong in Liguria) that oppose implementing projects and infrastructures. Convincing these subjects of the goodness of the projects and the returns in the environmental, economic, and occupational fields is, once again, fundamental for the proper development of circularity in the port of Genoa.

#### **4.6 Framework in the Genoese reality considering our results.**

We can claim that for the port of Genoa the framework cannot be defined as complete. Considering the tripartite division, industrial - urban - territorial and the graph of the development of circularity in the port, we can say that there is still a long way to go.

What emerges by triangulating the part of literature with the part of method and empirical analysis is that the Genoese situation is lagging behind. Movements in the direction of circularity have been made, but indirectly. Industrial and urban synergies (intra port symbiosis - port city symbiosis) seem to have been addressed and at least partially achieved. From an industrial point of view, in fact, the port authority moved in agreement with the central government administration. Some ministries have financed the works that aim at decarbonisation and a shift towards cleaner energies.

The urban synergy (port-city symbiosis) will be the next one, in the sense that there is planning for the development of recycling. The main problem is that the port authority did not undertake to define

a strategic plan on how to re-enter the waste that is collected by the various companies active in the port, into circulation. The regulation concerns only the withdrawal of the material itself but not its recycling. This leaves private individuals with this task, and the results in terms of performance are very low.

What is missing from a regulatory point of view is for the port authority to address the problem and outline specific programs to develop 100% urban synergy.

To do this, it emerged from both the reading of the Waste Management Plan and the DEASP that adequate spaces for the storage of materials to be recycled were not provided - except for the case of Savona part of Port of Genoa. This phase is always managed by private individuals in areas of their property. An element to be implemented should be that of spaces, which are currently lacking. Places within the port area in which to store the materials ready to be transferred to the companies that will have the task of reinserting them in the production cycle.

Another element totally absent is the digitization. We mentioned the importance of IT and artificial intelligences in the development of the circular economy. For the development framework of the port of Genoa there is no mention of this type of implementation. Above all from the point of view of financing programs for digital startups, which could substantially favor the full fulfillment of circularity. This too is a task that belongs to the port authority and of which there is no trace in the various programs analyzed, but which would be fundamental.

There is no connection whatsoever between the port entities that deal with the recovery of recycled materials and outsiders (companies) interested in purchasing such goods. This element has repercussions on the full evolution of urban synergy and mostly on the transition to total circularity, (or the territorial synergy) where it is precisely the connections with the hinterland that create new value, new goods and new flows.

For territorial synergy (Territorial Symbiosis) greater political planning would be needed in the direction of creating connections between companies / players active in the hinterland and the port of Genoa. In the light of what has been seen in the literature, the port will need these new flows in full circularity, and the various players will need the role of the port. Genoa seems to be motionless in this respect: it accuses the typical slowness of the local / port public administration but also the lack of support from the central government. Above all, the infrastructural point of view is lacking, connections with the northern and rich part of Italy are insufficient, both by road and rail.

Circular maturity cannot be achieved without a complete industrial and urban phase. For the territorial phase, the port of Genoa is still far from taking a real direction. Although space and infrastructure

problems are the main physical obstacles; the biggest problem is the lack of support and political direction from local and national authorities.

## **5. Conclusions**

From a strategic point of view and bearing in mind what was defined in the literature review, the Port Authority of the Port of Genoa acted: sustainability, energy transaction, and recycling were addressed. What seems to be missing is an overall vision. We can talk about CE about the first two pillars, namely energy recovery, and recycling. However, with one difference, from an energy point of view, it is easy to find future planning and the direction taken in the various reports. Recycling – may be the most significant. For the future modification of the Strategic Framework of the port arrangement of general interest have frame a drawing of things to come situation of the ports, where the public job engaged with the port area is built up, without neglecting to focus on the way that a definitive objective is clearly the organizations and individuals that make up the financial texture that is served. However - the port has moved in a rather disordered and, above all, not "direct" way. Leaving the initiative in the hands of private individuals, who have done what they could: there is no precise direction and good policies.

Strategic planning should consider implementing the two pillars and then accordingly take the related steps to implement the third pillar and thus complete the circularity.

We are facing serious delays: even as a result of what we have understood from the managers involved in the interviews, planning must start from an embryonic level. The development of circularity will require space and additional costs if these spaces are found on the sea rather than on land. After that, it should be easier to invest in this sector and finally implement a clear political direction. The port authority is the last link; it receives funds from the central government: the political will must also be expressed in the upper echelons at the national level. The hope is that this will happen and that the direction is towards change and this new business. Bearing in mind Paris 2050, the address now seems to have been traced; the trait is the delay with which the Italian country system moves, and it is a peculiarity that the writer defines as "cultural." However, keeping these difficulties in mind, the development of Circularity in Genoa cannot ignore a well-defined political direction. The strategic



plan would have already started with the first two pillars. Still, considerable effort is needed to complete the circularity and include the third, creating a flow of new goods and new value.

This third and last step seems to be still far away, not having been developed even at an embryonic level: the conceptual level is missing even before the practical one. However, once the political and bureaucratic conditions are in place to complete this change, the spaces and connections with existing infrastructures will be identified: we can then talk about real planning in the short, medium, and long term.

For the moment, there is only something that has to do with energy recovery in the short, medium, and long term. But, at the same time, there are prerequisites for recycling that need to be better organized and supported by the PA.

Spaces - de bureaucracy and investments are the necessary triad for the development of a circular strategic planning in the future of the port of Genoa.

## **Notes**

For the interviews, the writer provided a document in which the key concepts were summarized: we wrote a short introduction to frame the problem and make it easier for the interviewees to identify the answers. After that, we have listed the questions.

The interviewees asked to remain anonymous, but we can say that they were five professionals titled subjects belonging to both the port authority, the municipality, and companies active in waste treatment.

Furthermore, in several cases, the interviewees did not answer some questions, focusing on the topics in which they were, due to their position, more experienced. The interviews did not take place in a question-and-answer context, but with a wide-ranging discursive modality, and in the end, they were summarized in the most significant elements.

The questionnaire has been based on mixing theoretical assumptions and key points on Circularity and Genoese reality, with Its specific development shape.

The document with the questions was the following:

"The port metropolitan areas are a set of many subsets: from the natural to the residential one, passing through the productive/industrial/logistic one, to the energy one and ending with the cultural/social

one. Ports are crucial crossing points for exchanging goods and products, and consequently, waste. In this sense, the port will be the protagonist of a huge change in light of sustainability: port areas will be increasingly identified as important waste transit hubs. The circular economy is a closed cycle where materials regain value after a product's life: this system does not stop at the port environment. The goal is to make the port a focal player capable of interacting with the wider surrounding area to guarantee a flow to and from the city.

Looking at ports, the first two steps of circularity are always recycling and energy recovery (using green sources). The third step, to talk about completed circularity, is the one in which relations with the hinterland allow the creation of new value and new goods and flows.

In light of this, the meaning of the research question: is to understand what the best planning for the port of Genoa on the Circular Economy theme could be. What is there today, if there is already something today and what is there for the future.

- How did Genoa work for the economic transaction toward the Circular Economy? How is it working?
- Starting from what has been done so far, how could it develop in a better way for the next few years?
- Is the inclusion of the energy transaction already underway in a circular context envisaged?
- How the morphological context can negatively / positively influence the Circularity in Genoa (the need to find spaces)
- Is there a project to move towards a complete circular economy and, therefore, viable business, or is it just pollution reduction and energy sustainability for the moment?
- Does circularity start from simple startups up to infrastructures and industrial centers. Do both the port authority and the PA already have earmarked funds? How much are they?
- In Genoa, we have plans for energy recovery and recycling but not for the third pillar of the EC, i.e., new flows of goods deriving from circular activities. Is it conceivable for the future, considering the volume of trade and investments?
- Investments in recycling and reuse are obsolete. Have significant investments been made, or are they planned?

- In the DEASP, we talk about solar, wave motion, and green hydrogen in the future, is offshore wind power planned?
- Trying to divide the theme into two parts, one more theoretical and one more technical; how do you think circularity will evolve in a context such as the Italian and Genoese one, and then - more in detail - which sectors will be most developed/funded? "

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