Chapter 16
Towards the Implementation of the Circular Economic Model in Metropolitan Cities: The Case of Naples

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Abstract The general thesis of this contribution is that metropolitan cities—mostly port cities, also characterized most of the time by a relevant historical-architectural landscape—can reduce their agglomeration diseconomies if they adopt a ‘circular’ model of organization. The ‘territorialized’ model of circular economy is the ‘circular city’ model, which puts its centre with its suburbs, its historical centre with the port, and the consolidated city with the suburban territory in virtuous relationships. This chapter focuses on the multidimensional benefits of the circular economy and circular city model from an evaluation perspective, identifying an analytical list of indicators emerging from operational practice and the scientific literature. A multidimensional and multicriteria assessment method is used in the metropolitan city of Naples, Italy, to support the planning process for development of the port area from the perspective of the circular economy and circular city model. The originality of this assessment consists, on the one hand, in assuming evaluation criteria emerging from the strategy of the European Green Deal and, on the other hand, in focusing on the integration of the indicators proposed by the World Health Organization related to the Health Impact Assessment in a perspective that integrates environmental, economic and social impacts assessments.

Keywords Circular economy · Circular port city · Metropolitan cities · Multicriteria evaluation · Historic landscape · Cultural heritage

16.1 Introduction

The general thesis of this contribution is that metropolitan cities, mostly port cities characterized in Europe by a relevant historical-architectural heritage, can reduce their agglomeration multidimensional diseconomies if they adopt a ‘circular’ model...
of organization, starting with the way they organize the production of economic wealth and its redistribution.

The ‘territorialized’ circular economy model is the ‘circular city’ model (Circle Economy 2016a, b; Gemeente Rotterdam 2016; LWARB 2017; Mairie De Paris 2017; Forum World Economic 2018), able to put its centre with its suburbs; its historical centre, with the port that is often a real economic engine of the city, but also a source of negative external effects; and the consolidated city with the suburban and rural territory in virtuous relationships.

Port metropolitan cities represent a fertile entry point to the circular urban economy if they activate virtuous circular processes, starting from improvement of the connection between the port and the city, whose planning and management strategies are particularly complex and frequently conflicting, often with negative impacts for both.

The first hypotheses assumed here are those of the Intergovernmental Panel on Climate Change (IPCC) reports (IPCC 2014, 2019) on climate change and the (consequent) documents of the United Nations (Agenda 2030 for Sustainable Development (United Nations 2015) and the New Urban Agenda (United Nations 2016), as well as of the European Union and the European Commission (European Union 2016), about the adoption of the European Urban Agenda and the circular economy model.

In particular, in the literature there is a focus on the circular economy model and its territorial transposition into the circular city, and the different definitions and attributes of a circular city are considered. At the same time, systemic solutions in this direction are being tested practically in the international field.

The first part of this chapter focuses on the benefits of the circular economy and circular city model that the empirical evidence demonstrates in economic, environmental and social terms: reduction of climate-altering and polluting gases, and economies from synergies from which greater economic profits are obtained with additional employment. Moreover, this work identifies an analytical list of indicators emerging not only in the operational practice of the various circular cities, but also from the scientific literature.

The second part of this chapter is focused on the implementation framework of metropolitan cities in Italy in terms of approved, adapted, or elaborated strategic and territorial plans. In this context, the analysis of the Metropolitan City of Naples and its guidelines on the strategic plan are introduced. The attention then shifts to the analysis of the relations between the port (a real economic engine) and the historic city, identifying two reference preliminary projects related to the regeneration of a portion of the waterfront in the city of Naples, Italy.

The methodological process starts with the selection of suitable indicators taken from the scientific literature and operational practice of some port cities.

A multicriteria analysis was structured on the basis of multicriteria evaluation methods such as ANP (Saaty and Vargas 2013) and PROMETHEE (Corrente et al. 2014) and was applied to the evaluation of the two preliminary planning design hypotheses, identifying complementary effective actions towards the circular model.
The originality of this assessment consists on the one hand in having assumed evaluation criteria emerging from the strategy of the new Green Deal (European Commission 2019c) of the European Union, and on the other hand from integration with the indicators proposed by the World Health Organization (WHO) related to the Health Impact Assessment (HIA) (Fusco Girard and Nocca 2019), in a way that integrates environmental (EIA) (National Environmental Policy Act (NEPA) 1969), economic and social (SIA) impacts assessments.

In fact, the European Union Green Deal assumes the circular economy model as an essential factor to face the challenges and competition in the globalized economy, introducing a series of indications that take the form of evaluation criteria: waste minimization, reuse, recycling, material regeneration, use of renewable energy sources, promotion of second-hand markets, strengthening of green areas, etc.

The following sections analyse the general European framework for the circular economy and circular city implementation (Sect. 16.2); the systemic approach through the lens of the landscape and its implications (Sect. 16.3); the circular economy as a hybrid model of economic development (Sect. 16.4); and the role of cities as ‘laboratories’ for the implementation of the circular economy, exploring recent implementations in the metropolitan city and the port of Naples (Sect. 16.5). Based on the experience of Naples, the circular relationship between the city and the port infrastructure is investigated (Sect. 16.6), and the application of hybrid evaluation methods to assess different transformation hypotheses is presented (Sect. 16.7), with two preliminary projects for the waterfront of the metropolitan city of Naples (Sect. 16.8). Finally, conclusions are drafted to pave the way towards implementation of the circular city model also in other metropolitan cities (Sect. 16.9).

16.2 The General European Framework

The general framework represented by the European Union’s development strategy has been adopted. It can be summarized in the following points.

16.2.1 The European Green Deal

The European Green Deal (EGD) takes as its starting point the conclusions of the latest IPCC reports on global warming; the increasing pollution of air, water and soil; and the effects of climate change.

In anticipation of the forthcoming Action Plan for Air, Water and Soil, the Green Deal (European Commission 2016, 2019a) insists on the features that should connote action by all institutions in Europe towards zero emissions by 2050: the efficient use of natural resources; the ability to decouple economic growth from the production of climate-altering/pollutant gas, and the production of waste; the ability to conserve natural capital (today only 12% of the materials used come from
recycling, and the extraction of new materials accounts for almost 50% of climate-altering emissions), ecosystem health (EGD §2.1.6) and the health/well-being of the population; and the capacity to promote a development model that is not only ecologically compatible but also inclusive and socially just. The reference to the Pillar of Social Rights (European Commission 2017) is explicit.

The proposals range from the reconfiguration of energy policies to new infrastructure policies, from transport to construction, to the diffusion of new digital technologies.

More specifically, proposals are made in the various sectors.

In the construction sector, a new phase of recovery and renewal of the existing building stock is foreseen (EGD §2.1.4). It is necessary to update the implementation tools in order to overcome all factors blocking upgrading of the building stock, also with reference to new energy standards.

In the transport sector (EGD §2.1.5), it is foreseen that greenhouse emissions, which now account for 25% of total emissions, must be reduced by 90% by 2050, while at the same time promoting rail transport.

One very important point is that ‘the cost of transport must incorporate external effects on the environment and health’ (European Commission 2019c). In particular, it is hoped that technological innovations will be introduced in cities to reduce the climate-altering and polluting load on the sector.

In the energy infrastructure sector, smart grids and digital tools are promoted for continuous monitoring of air/water consumption and pollution. Decarbonization, an improvement in energy efficiency, use of renewable energies, capture of CO₂ and the introduction of hydrogen as an energy carrier are all stressed (EGD §2.2.3).

Finally, the European Green Deal calls for climate change adaptation measures and new business models that reflect the perspective of use rather than ownership of goods, together with the possibility of co-use, linking with the sharing economy business models. It opens many new opportunities for people, for entrepreneurs and for cities.

16.2.2 The European Environment and Air Quality Directive

The European Environment and Air Quality Directive (issued on 28 November 2019) (European Commission 2019b) further emphasizes that reduced air quality is a source of chronic diseases such as asthma, respiratory crises, cardiovascular crises, cancer, etc., resulting in around 400,000 premature deaths in the EU. This pollution is caused by elements such as SO₂, PM10, PM2.5, NO₂, CO, ozone, benzene and benzopyrene, which particularly affect urban/metropolitan areas where production, industrial activities, transport and more intense mobility are concentrated. Here, combustion for heating houses is at its highest due to the building density, and the microclimate is more compromised. It emerges that Italy is rated highest for levels of PM10, NO₂ and benzene, and is in second place in the EU for levels of SO₂ (European Commission 2019c). Road transport in the EU contributes
to the highest percentage of NO (39%), followed by energy (17%) and the commercial and residential sector (14%). The transport sector is the major source of PM10 and PM2.5, with 10–11% incidence.

Thus, the transport sector (infrastructure/mobility) appears to require immediate investments to improve the status quo, improving the well-being/health/quality of life of European citizens, as well as ecosystem health. ‘Air quality is essential for human health. It is also essential for environmental sustainability and to ensure social and economic benefits’ (European Commission 2019b). In other words, air quality is a global common good to be managed by all with the utmost care.

### 16.2.3 Health and Circular Economy

In 2019, the WHO published the second report on Assessing the Health Impacts of Circular Economy, exploring the relationship between health impacts and well-being in the circular economy model, proposing to incorporate the HIA, EIA, SIA and multicriteria assessments into urban planning and design/programming tools in order better to assess, control and manage transformations towards the necessary transition (WHO 2018, 2019).

In fact, in 2018, the WHO had already focused on the interdependencies between circular economy and health and social impacts, also based on European Environment Agency (EEA) monitoring. This monitoring revealed that air quality in European cities has been degrading over the years, especially through emissions from the transport, housing and industry/tertiary sectors. To highlight its percentage incidence, the cost of pollution in relation to GDP reaches about 6% if economic data are aggregated on the basis of monetization of morbidity.

### 16.2.4 The International Panel on Climate Change (IPCC) Reports

The starting point of the climate change issue is the IPCC reports. The IPCC established in 1988 on the basis of an agreement between two United Nations organizations (the United Nations Environment Programme (UNEP) and the World Meteorological Organization) proposed the first in 1990. The report recognized that emissions due to human activities have increased over time, leading to concentrations of CO₂, methane, nitrogen oxide, chlorofluorocarbons and other climate-altering gases, with a consequent rise in the average temperatures on Earth. The negative impacts of this global warming were concentrated in some coastal regions characterized by intense poverty. Subsequent reports have only confirmed the above with increasing concern.
In 2010, the NASA Earth Observatory highlighted this rapid global temperature increase and attributed it not to natural causes but to human activities. For example, the graph of air and ocean temperature between 1750 and 1950 showed a substantially constant trend, while it began to rise from 1950 onwards (IPCC 2014, Graph 3). Negative impacts on agriculture, coastal areas, urban/metropolitan concentrations, water resources, energy, migration processes, conflicts, health/morbidity and quality of life/well-being were clearly highlighted. Adaptation and mitigation measures were therefore explicit to reduce the risk associated with temperature rise in order to avoid irreversible processes (IPCC 2014, pp. 103–104).

The WHO has repeatedly stressed the risk posed by the combination of climate-changing gases and polluting emissions. For example, the WHO has repeatedly pointed out that about 7 million premature deaths are due to pollution outside the home (World Health Organization 2018a)—i.e. the urban environment, 80% due to cardiovascular complications and the remaining 20% to respiratory causes and cancer.

In its 2018 report, the WHO addressed in particular the problem of the relationship between health and the circular economy—i.e. between climate change/pollution and damage to human health.

The Countdown Report monitors the impacts of climate change and pollution on people’s health/well-being on the basis of 41 indicators. In other words, it highlights the responsibility of the human dimension/cause of climate change.

In fact, the 2017 report highlighted the risks of climate change for many diseases of viral and/or bacterial origin. The subsequent 2018 report monitored the above report with indicators 1.7 and 1.8, concluding that ‘climate change conditions are a critical cause in determining the spread and impact of many diseases’ (Watts et al. 2019). The 2019 report, confirming the above with further data, underlined that the economic cost of not taking timely action will lead ex-post to a much greater economic/financial effort without the restoration of ex-ante conditions.

From the annual loss of forestation, the increase in energy consumption, the multiplication of air transport, the increase in carbon monoxide, etc., it follows that there is a need to act with the highest priority in the energy sectors, with decarbonization of the local economy, the recovery of vast and natural areas in cities, and urban and organic agriculture.

16.2.5 Multidimensional Impacts of Port Cities: From Climate Change/Pollution to Economic and Social Impacts

The following Fig. 16.1 (Watts et al. 2019) provides the general framework adopted in this paper. It highlights the intense climate-changing and polluting impacts that cities, and in particular port metropolitan cities, have on the atmosphere, water and soil, and their mutual interdependencies. These impacts, due to their intensity, cause
damage primarily to human health and well-being, which in a human-centred perspective is a priority. This damage, together with the other effects, then turns into economic and financial costs, as well as social costs. For example, the transport sector is responsible for 23% of climate-altering gases; the industrial sector is responsible for 20% through energy industries, 12.6% through manufacturing industries, and 8.1% through industrial processes. Finally, the residential/services sector is responsible for 19.5% of these impacts (ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale 2018).

The circular economy model can reduce negative impacts, producing economic/financial, social and environmental benefits.

Local urban/metropolitan regeneration projects must be characterized by the ability to be instrumental in the pursuit or realization of the circular model. In particular, they should be able to reduce the economic, environmental and social costs mentioned above, thus improving cities’ conditions.

Figure 16.1 refers to the ex-ante conditions—i.e. without an intervention project. It shows the increase of some significant economic, social/human and environmental cost items. With a careful intervention project, many economic, environmental and social cost items can be reduced. They are the multidimensional benefits of a circular approach.
16.2.6 Human-Centred Development

The human-centric approach that is emerging in development strategies and in urban planning, especially after Covid-19, is introduced here. It gives a cultural and social ground to the European ‘Green’ Deal.

The human-centric city development approach reshapes the city project towards a project that links, generates and multiplies relationships and bonds in space and time between human beings, between people and spaces, and between people and nature (the Mother Earth). The latter is the specific characteristic of New Humanism compared to the traditional interpretation: the symbiosis between people and nature. In particular, it assumes the health of eco-systems as the condition of the health of human beings. Human-centred development and green development are interdependent, because the health of nature is a global common good.

Human-centred development assumes the dignity of the human being and therefore the implementation of human rights (health/well-being, work, housing, services, quality of life, etc.) in order to determine a flourishing capacity implementation, interpreted in a relational rather than an individualistic perspective. The humanistic approach interprets the new technical digital urban landscape not in terms of the traditional ‘smart city’ (advanced technologies, short horizon, rent as a development engine, etc.), but in terms of the capacity to orient all technological innovations towards the fulfilment of human needs.

The humanization process is linked to values, and thus to culture. Cultural built heritage is an expression of culture characterized by a human scale and by the beauty of squares, public spaces and landscapes. Beauty is a humanistic value because it satisfies specific individual needs and contributes to the well-being and health of human beings (Sacco and Teti 2017; Grossi et al. 2012). The beauty of places contributes to humanization processes in planning.

Cultural values such as cooperation, collaboration, coordination, etc. become more and more relevant if we want reduce social fragmentation, through a culture characterized by long-term, commons-oriented and civic dimension oriented.

Human-centred development assumes the key role of tangible, material, quantitative values together with intangible, qualitative, immaterial values, such as trust and cooperation as the engine of developments. The unifying perspective is that of human flourishing (Prendeville and Bocken 2017). It is linked to the capacity to orient all innovative technologies (IoT, AI, robotization, sensors, screens, new bio-materials, etc.) not towards surveillance and control, etc., but towards goals that reflect human dignity. Citizens, and not algorithms, should be put at the centre of development. Big data management through AI, for example, should be able to improve social inclusion, citizen responsibility, well-being level, etc. Human-centred innovations allow the achievement of human flourishing and human creative capacity as the main goal of development.

Human-centred development requires a key role of the (urban) community in terms of active citizenship, pro-active participation and self-organization.
Work is the key condition for implementing the human scale, the social inclusion, the community dynamic.

Commons and their management are an effective entry point for stimulating the community.

To implement a humanization strategy grounded on cooperation, trust and coordination of actions, it is necessary to introduce hybridization—between economic productivity and environmental productivity, between economic and social productivity, between ancient processes and new ones—into conventional economy processes.

Human-centred city development needs to be grounded on the principle of subsidiarity to making participative decisions as close as possible to the local level. A specific strategic plan for culture is required because culture is considered in this approach as the key resource for human scale development.

The human scale project is thus able to place people and culture at the centre of sustainable development (human sustainable development), making abandoned and neglected heritage places attractive to human beings and for talents and creative and innovative activities, accepting the challenge of heritage regeneration and embracing the new circular economy development paradigm to make people and places flourish through culture.

Many EU documents pay attention to the human challenge. For example, in the Action Plan for the Circular Economy (European Commission 2015), the social economy is evoked (§5) on the basis of the Madrid Declaration (23/5/2017) (European Parliament 2017). The social economy includes cooperatives, associations, social enterprises, ethical banks, foundations which concur on an inclusive economy grounded in the society. Another EU document is the European Pillar of Social Rights (European Commission 2017), also evoked in the European Green Deal (11/12/2019, at §2.1) and the New Industrial Strategy for Europe (European Commission 2020) (10/3/2020), which assumes the social rights for orienting the required transition towards the economy de-carbonization.

16.3 The Circular Economy as a Hybrid Model of Economic Development

The circular economy model is interpreted here as a hybrid model between nature’s economy and man’s economy, between economy and ecology, between competition and cooperation, and between market economy and social economy. This model is capable of taking into account instrumental values based on a utilitarian approach and intrinsic values based on a non-utilitarian approach (respect for ecological thresholds, reference to short but also long time periods, to material and immaterial values, etc.).

The ecological economy inspires the circular economy. In nature, every living organism not only consumes resources/energy, but in turn, being related to other
living organisms, contributes to nourishing their lives, providing a flow of services to them. It is characterized by a perfect metabolism, made perfect over millennia, that allows every by-product and all waste to be recycled.

Linking different programmes/logics requires a participatory evaluation of the pursuit of intrinsic values and the opportunity costs to achieve them.

Circular economy

- decouples the economic growth from resource consumption and negative environmental impacts (Ellen MacArthur Foundation 2015a) (Ellen MacArthur Foundation 2015b).
- offers a new perspective to generate values and profits, reduce production costs, natural resources consumption and greenhouse gas impacts, and generate new employment (European Commission 2014).
- is interested to produce services to be consumed instead of goods to be appropriated (through property rights, etc.) (Galalae et al. 2020).
- is interested to use values more than market values (Hansjürgens et al. 2017).
- reduces the trade-off between economic productivity and ecological conservation (and social goals) (Liu et al. 2020).
- is attentive to relationships between state and market, between public and private; it is attentive to the civic sector (third sector) between them (Evers 2005).
- is grounded on cooperation, collaboration, integration between multiple subjects and activities (European Commission 2018).
- is attentive to all interdependencies (UNESCO 2011). The attention is on the capacity to avoid underuse and waste of all kinds of capital: not only of natural capital and man-made capital, but also of human capital and social capital. These forms of capital are as important as the natural and man-made ones (Preston et al. 2019).

Waste is interpreted not only in terms of natural or man-made resources, but also in terms of human and social capital. The city is not only a great source of waste or discarded elements, but is often also the set for discarded people: unemployed, marginalized people, etc. The circular economy is focused to valorise the human being in terms of his capacity, intelligence, creativity and self-entrepreneurship. Employment is a key element.

16.4 The Systemic Approach Through the Lens of the Landscape and Its Implications

Many metropolitan cities in Europe offer a high-quality landscape. All metropolitan port cities in the Italian context are characterized by a specific cultural landscape (see Table 16.1).

The historic urban landscape (HUL) approach, as a unifying/holistic approach, incorporates the principles of the challenge to climate change. In other words, it can
Table 16.1 Italian metropolitan cities (2016)

| Localization | Metropolitan city | Municipalities (n) | Population (2014) | Density (pop/km²) | Port City | UNESCO WHS | Other significant CH |
|--------------|-------------------|--------------------|-------------------|------------------|-----------|------------|---------------------|
| North        | Bologna           | 56                 | 1,001,170         | 270              | *         | *          | *                   |
|              | Genova            | 67                 | 868,046           | 473              | *         | *          | *                   |
|              | Milano            | 134                | 3,176,180         | 2015             | *         | *          | *                   |
|              | Torino            | 315                | 2,297,917         | 337              | *         | *          | *                   |
|              | Venezia           | 44                 | 857,841           | 347              | *         | *          | *                   |
| Centre       | Firenze           | 42                 | 1,007,252         | 287              | *         | *          | *                   |
|              | Roma              | 121                | 4,231,244         | 789              | *         | *          | *                   |
| South        | Bari              | 41                 | 1,261,964         | 327              | *         | *          | *                   |
|              | Napoli            | 92                 | 3,127,390         | 2653             | *         | *          | *                   |
|              | Reggio Calabria   | 97                 | 559,759           | 174              | *         | *          | *                   |
| Islands      | Palermo           | 82                 | 1,275,598         | 255              | *         | *          | *                   |
|              | Messina           | 108                | 648,371           | 199              | *         | *          | *                   |
|              | Catania           | 58                 | 1,115,704         | 312              | *         | *          | *                   |
|              | Cagliari          | 16                 | 542,277           | 142              | *         | *          | *                   |
| Metropolitan cities |       | 1.273             | 21,970,713 (35% of total for Italy) | 446 | 65% | 70% | 100% |
| Total Italy  |                   | 8,046              | 60,476,650        | 47               |           |            |                     |
be argued that this approach is achieved through the circular economy model and vice versa.

In fact, the HUL recommendation recognizes first of all a close relationship between the design/planning of cultural heritage conservation and economic development (Nijkamp and Voogd 1990): heritage conservation and management should be included in the framework of economic development strategies (§VI, Comma), and in particular in the framework of sustainable development strategies (VII Comma, §10, §11).

The notion of sustainable development returns several times in the text (§24/b etc.), as does the economic strategy in which conservation activity should be included/integrated.

The HUL recommendation suggests a landscape-based approach to the conservation and management of cultural heritage (see HUL Recommendation Preamble). This landscape perspective is structurally unifying because multiple and multidimensional approaches converge in it: it integrates the social perspective with the environmental, economic, physical, cultural and juridical ones.

All current problems are incorporated into the landscape, from climate change to pollution, health, social marginalization, economic wealth production, poverty, etc. The landscape is a prism that allows us to adopt a human-centred perspective that is focused on the human dimension. There is no landscape if it is not perceived by a subject through its different senses. On the other hand, landscape is only the result of a series of choices made by each subject and the community. Landscape reflects the culture of a society—the way in which each person relates to others and to nature and the environment—and culture represents the human product, human creation par excellence.

The landscape is therefore configured as a vital, living resource, able to change continuously under the pressure of people’s needs, interests and hopes.

Indeed, in HUL, the economic model is not only that of sustainability. The UNESCO recommendation on HUL repeatedly suggests that the landscape should not be preserved, but rather carefully managed in its transformations (§12): that is, it has to be sustainable, taking into account cultural, social and economic values (§5). This means producing development that is not only sustainable but also human and social (§10, §18), attentive to people’s well-being and quality of life (§17, §18).

Throughout the text, the different values and attributes with which to evaluate the landscape in an integrated and comprehensive way emerge (§10): cultural and environmental values (§3, §21), intangible and visual values (§9), perceptive values (§13), social values (§24, §6), environmental values (§19), ancient values and contemporary values (§22).

Emphasizing the key role of creativity (§12), HUL calls for the integration of old and new. The notion of hybridization is evoked here, albeit implicitly. It is not a mere juxtaposition, but a reflection of complementarity, generating synergies and circularity; it is not only multifunctionality, but a juxtaposition of heterogeneous programmes, calculating rationality and relational rationality, cashflow control and creativity, analysis of economic/financial convenience and construction of sense/meaning.
It should also be noted that the issue of climate change is incorporated into the UNESCO recommendation (see Preamble, paragraph VIII and §19).

The circular economy model is not formally expressed, but many principles characterizing the circular economy model are nevertheless evoked. In §11, the need for productive and sustainable use of space resources is stressed. In §19, reference is made in particular to efficient use of the environmental resources represented by water and energy, while §2 calls for a strategic vision that goes beyond the short term: it stresses the importance of a long-term vision, which is typical of the circular economy.

Furthermore, §24/d stresses the need for self-financing—i.e. self-regeneration of financial resources in order to preserve the regenerated heritage over time. In addition, §22 stresses the need for ‘harmonious’ cooperation between different private and public actors. These are two typical characteristics of the circular economy model.

Finally, it should be noted that together with the notion of sustainable development (within which the conservation/management of heritage/landscape is placed) the notion of human development is mentioned in §12 and the notion of human and social development in §18. These are once again characteristics that are in perfect alignment with the circular economy model, careful to avoid waste and the under-utilization of different forms of capital, from natural to manufactured, human and social.

In conclusion, the HUL approach finds its implementation within the circular economy model, which is evoked even if indirectly.

The above has implications in terms of evaluation tools, which are increasingly required to ‘support decision-making processes’ (§24/b) both in design/planning and in change management. In §10, it is recognized that evaluation has to be integrated and comprehensive.

In Part IV, concerning tools, the need for evaluation tools is stressed (in §24/b) to ‘monitor and manage change in order to improve the quality of life and urban space’. It introduces an assessment of cultural (heritage impacts), social and environmental impacts to improve choices, also calling for new financial tools (§24/d). These are therefore integrated evaluation tools (Fusco Girard and Nijkamp 2005; Fusco and Nijkamp 1997). More precisely, they are hybrid evaluation tools that combine heterogeneous approaches and procedures.

16.5 Cities as ‘Laboratories’ for the Implementation of the Circular Economy: the Metropolitan City and the Port of Naples

Cities and networks of cities (small, medium and large) are the main protagonists in the new evolutionary dynamics. The territorial spatial dimension of the circular economy is represented by the circular city. The ‘ideal’ circular city is present in
many experiences that are already taking place in Europe and abroad (Circle Economy 2016a, b; Gemeente Rotterdam 2016; LWARB 2017; Mairie De Paris 2017). Some cities in Italy and in the South of Italy also seem today to be configured as ‘laboratories’ for the circular model: Salerno, under the Horizon 2020 CLIC project, Taranto as the city of hydrogen, Matera as a circular city for over 2000 years (Fusco Girard et al. 2019).

Sustainable development of the South of Italy strongly depends on the capacity to adopt circular development strategies, putting in relation of synergy, symbiosis and/or mutual interdependence, public, private and third sector investments; investments in logistics, culture/cultural heritage and tourism, in the agri-food sector, renewable energies, building sector, etc., improving the administrative procedures for the effective and efficient use of EU funds.

The metropolitan city of Naples comprises 92 municipalities, with a population of 3,117 million inhabitants (2015). By demographic size, it is second only to Rome and it is almost equivalent to Milan (see Table 16.1); 172,213 companies operate in the metropolitan city (ISTAT 2011).

The ports of the metropolitan city of Naples are those of Naples, Castellammare, Pozzuoli and Torre Annunziata.

The port of Naples shows a complex set of port activities with over 370 companies operating, employing more than 5200 employees and with a turnover of around 516 million euros.

Already in 2005, more than 20.8 million tons of goods were loaded and unloaded in the Neapolitan port system and more than 370,000 containers were handled.

In 2005, over 9 million passengers passed through the Neapolitan port system. In recent years, the Neapolitan port has confirmed a growth trend in the goods sector, too; thus, qualification as a Mediterranean logistics platform is looming.

Pleasure boating represents a sector with strong growth. In 2017, in the Gulf of Naples and the Amalfi Coast, direct expenditure linked to the movement of large yachts was estimated at over 30 million euros. The potentiality of large yachts is evident and is developing in all the ports of the AdSP (Port System Authority) of the Central Tyrrhenian Sea.

The main companies in the shipbuilding sector are Cantieri del Mediterraneo S.p.A., that occupies the area between Carmine dock and Calata Marinella and develops activities related to the transformation and repair of ships and pleasure boats with the management of three basins; and Palumbo S.p.A., that operates in three distinct areas: dock 28, dock 37 and dock 40. The distribution is due to the impossibility of using a single large concession area and the constant expansion of the company’s business.

The Megaride shipyards occupy dock 36. The Nuova Meccanica Navale has two operating sites: the Vigliena shipyard and Carmine dock.

The ‘Palumbo’ and ‘La Nuova Meccanica Navale’ also set up a company called Napoli DRY Docks srl (with an investment of 20 million euros) for the management of a common area at the Martello dock to be allocated for ship repairs, with a new floating dry dock.
In addition, in the port of Naples there are about 34 companies and/or individual businesses defined as naval mechanical workshops that operate in the sector of repair, transformation, plant engineering, engines, etc.

The port is a real engine in the metropolitan economy. But at the same time it is the source of many negative externalities. The impact caused by emissions from ships in transit has been estimated on the basis of different models that simulate the concentration and dispersion of PM10, NO2, SO2 and VOCs (Giovanni Libralato et al. 2020; de Luca and Fiori 2020).

16.6 Towards the Circular Relationship Between the City and the Port Infrastructure

Some hypotheses have been elaborated for the transformation of the status quo, and particularly one specific portion of it, from the perspective of the circular model. These hypotheses are not yet real projects but are preliminary planovolumetric reference schemes through which it was intended to open a circular relationship between the port and the city (Fusco Girard et al. 2020).

They have been elaborated on the basis of the results of studies (Figs. 16.2 and 16.3) at the Interdepartmental Research Centre on Urban Planning, Alberto Calza Bini, for the Urban integration of the expansion towards the east of the port of

Fig. 16.2 Preliminary planning hypothesis 1
Naples, and within the activities of the Master’s Degree Course Level II in Sustainable planning and design of port areas of the Department of Architecture of the University of Naples Federico II.

These proposals are the entry points for the transition to the systemic and circular model always evoked but not concretely implemented. As a matter of fact, the existing port business model is also careful to improve internal efficiency and competitiveness with respect to other port infrastructures: it is separate from the urban dynamic and its socioeconomic goals.

There is not a clear choice between the business models: port as an enterprise, the port as a hub in a logistic chain and the port as a waterfront.

On the one hand, the planovolumetric design scheme is configured as an innovative element of the waterfront, with its spaces capable of attractiveness for their spatial, visual-perceptual and cultural quality. On the other hand, it is proposed to guarantee reciprocal circularity—for example, with the transport system and local mobility. The recovery of the architectural and historical heritage configures the proposal as generating an attraction pole, almost a square, with public spaces offering specific quality services that are usable by both users of the port infrastructure and citizens.

At the same time, the design idea is connected to the logistic model as it involves moving the containers not with the trucks, but on rails. In this way, it is possible to avoid affecting the local traffic while reducing impacts on air pollution and on the emission of climate-changing gases, reaching locations in the Centre-North in a more ecological way. The assumption is to prepare rail transport thanks to nine daily
up and down trains. This is the maximum capacity proposed by the Port Authority and Trenitalia.

In this way, the urban attractive waterfront project is integrated with other logistics platforms in order to improve productivity.

### 16.7 Towards Hybrid Assessment Methods: The Assessment of Different Transformation Alternatives

Definitely, the above was premised to proceed with the development of a hybrid evaluation approach that is consistent with the circular model and capable of taking into account the human-centred perspective, already incorporated in many EC documents, and which finds its foundation in human rights: health, well-being, quality of life, work, housing, services, etc.

Health, as already noted, is a fundamental element of this approach. Health represents one of the Sustainable Development Goals—SDGs (n. 3), being a central element in the pursuit of sustainability in its three dimensions. People’s health must be integrated with the health of the ecosystem and the health of the economy. The approach in Fig. 16.1 suggested not only the assessment of financial, economic, social but also of all environmental items.

In particular, the Health Impact Assessment is the assessment tool proposed by the WHO to ‘assess the potential impacts on the population and their distribution on the various social groups, resulting from policies, programs and projects’ (World Health Organization 2018b). The HIA allows minimization of the negative effects on human health that can be a direct consequence of public policies or projects or plans, while the EIA and the CBA (cost-benefit analysis) evaluate only environmental and economic health (World Health Organization 2018b). The HIA has been proposed in Italy by a new Law 29/03/2019 (Ministry of Health). It requires a specific metric, both quantitative and qualitative which supports a participative approach.

The assessment of the health impact of emissions has been evaluated in particular for the pollutants PM2.5, NO2 and O3, deducing the risks. Assessments of annual emissions of NO, NO2, NOx, PM10 and PM2.5 caused by container traffic in the port of Naples have been elaborated, allowing an evaluation of ground concentrations and mortality risks associated with this form of pollution.

The thesis, as already pointed out, is that Italian metropolitan cities can find economic, environmental and social benefits if they adopt the circular model, in which health impacts are clearly highlighted.

The case study that is proposed does not refer to the entire metropolitan system, but only to a portion of the waterfront, which is in any case configured as a strategic ‘hinge’ between the port and the city (Cerreta et al. 2020, n.d.). It represents the entry point to implement further urban/metropolitan regeneration processes (Acierno et al. 2020). The multi-objective matrix of the most significant indicators is shown in
Tables 16.2, 16.3 and 16.4. They have been selected analysing indicators adopted in many port cities’ circular projects. The impacts have been identified through specific working groups, the quality of the air and emissions due to ships’ movement, and the quality of air coming from transport mobility, integrated with financial-economic analysis.

| Category                  | Indicator                                                                 |
|---------------------------|---------------------------------------------------------------------------|
| Air                       | Emissions of pollutants                                                   |
| Energy                    | Energy produced from renewable sources                                    |
|                           | Surface used for energy saving in buildings                               |
|                           | Annual energy savings                                                     |
|                           | Projects implemented to maximize energy efficiency                        |
| Waste                     | Differentiated urban waste                                               |
|                           | Municipal waste going to landfill                                        |
|                           | Start-ups active in the circular economy sector                           |
|                           | Plastic packaging recycling plants                                       |
| Water                     | Waterproofed surface                                                     |
|                           | Drinking water consumption                                               |
|                           | Precipitation absorbed by green roofs                                    |
| Well-being and quality of life | Pedestrian areas                                         |
|                           | Cycle paths                                                              |
|                           | Urban public green                                                       |
|                           | Health risk induced by air pollution                                     |

| Category                  | Indicator                                                                 |
|---------------------------|---------------------------------------------------------------------------|
| Cargo handling            | Container traffic in the port of Naples                                   |
|                           | Ro-Ro traffic in the port of Naples                                       |
|                           | Various goods traffic in the port of Naples—infused liquids               |
|                           | Various goods traffic in the port of Naples—solid bulk                    |
|                           | Various goods traffic in the port of Naples—GNL                           |
|                           | Exports                                                                   |
|                           | Imports                                                                   |
| Enterprises               | Innovative start-up companies—trade sector                                |
|                           | Innovative start-up companies—tourism sector                              |
|                           | Innovative start-up companies—services sector                             |
|                           | Incidence of innovative start-up companies—trade sector                   |
|                           | Incidence of innovative start-up companies—tourism sector                 |
|                           | Incidence of innovative start-up companies—services sector                |
| Pendolarism               | Daily mobility for study or work                                          |
|                           | Mobility outside the municipality for study or work                       |
| Real estate market        | Real estate price of buildings for residential use                        |
|                           | Real estate price of buildings for commercial use                         |

Tables 16.2, 16.3 and 16.4. They have been selected analysing indicators adopted in many port cities’ circular projects. The impacts have been identified through specific working groups, the quality of the air and emissions due to ships’ movement, and the quality of air coming from transport mobility, integrated with financial-economic analysis.
The values obtained from the financial analysis (which takes into account the cost of construction, management, maintenance and revenues) discounted at a rate of 5% allow deducting internal rates of return between 12 and 24%. These assessments are some of the ones incorporated in Fig. 16.1. They have been integrated into the multicriteria analysis with social and environmental impacts, identifying the preferred actions in activating circular processes.

Through the ANP method, the main impacts of different proposals have been identified. The PROMETHEE method helped to recognize actions consistent with the circular economy model (Fusco Girard et al. 2020).

### Table 16.4 Indicator matrix: selected socio-cultural indicators

| Category                        | Indicator                                                                 |
|---------------------------------|---------------------------------------------------------------------------|
| Demography                      | Natural balance                                                           |
|                                 | Migration balance                                                         |
|                                 | Change in population under 18 years of age                                 |
| Employment                      | Spare population turnover index                                            |
|                                 | Employment rate                                                           |
|                                 | Rate of non-participation in youth work (15–24 years)                      |
| Cultural and creative system    | Incidence of cultural and creative enterprises                             |
|                                 | Incidence of the number of employees in cultural and creative enterprises  |
|                                 | Tourist expenditure activated by the cultural and creative productive system |
|                                 | Wealth produced by the cultural and creative production system             |
|                                 | Incidence of cultural and creative non-profit organizations               |
| Social vitality                 | Incidence of volunteers in non-profit organizations                       |
|                                 | Innovative cultural associations                                          |
|                                 | Social reuse index of assets confiscated from mafias                     |
| Tourism and cultural heritage   | Hotel accommodation rate                                                  |
|                                 | Extra-hotel accommodation rate                                            |
|                                 | Tourism rate                                                              |
|                                 | Cultural activities and events                                             |
|                                 | Cultural demand index                                                     |
|                                 | Museums, monuments and archaeological sites                                |
|                                 | Museums, monuments and archaeological site visitors                       |
|                                 | Museums/institutes performing digitalization of goods and collections      |
|                                 | Museums/institutes belonging to a museum system to share resources and coordinate activities |
|                                 | Museums/institutes offering the possibility of a virtual visit via the internet |
|                                 | Evening and night-time opening museums/institutions                       |
|                                 | Museums/institutes collaborating with other cultural institutions in the territory |

The values obtained from the financial analysis (which takes into account the cost of construction, management, maintenance and revenues) discounted at a rate of 5% allow deducting internal rates of return between 12 and 24%. These assessments are some of the ones incorporated in Fig. 16.1. They have been integrated into the multicriteria analysis with social and environmental impacts, identifying the preferred actions in activating circular processes.

Through the ANP method, the main impacts of different proposals have been identified. The PROMETHEE method helped to recognize actions consistent with the circular economy model (Fusco Girard et al. 2020).
16.8 Characteristics of the Two Preliminary Projects for the Waterfront in Naples

The two preliminary planning hypotheses (Figs. 16.4 and 16.5) transform a ‘non-place’ into a place characterized by a capacity for attraction—i.e. an area characterized by a field of gravitational forces capable of resisting and opposing the many degraded/decaying areas in which a ‘repulsive capacity’ prevails.

Benefits are not only financial and economic, but also environmental and social. A particular first benefit is linked to human health.

The starting point is the recognition that in Naples, as in many other metropolitan cities, there is an under sizing of mobility on rail. Then there are high levels of polluting and climate-changing emissions.

The proposed projects highlight how a synergistic port/city relationship can achieve lower climate-changing and polluting impacts, with further benefits of an economic, ecological and social nature. In fact, the port is a fundamental economic engine for the metropolitan city of Naples, as well as in other metropolitan cities (see Table 16.1).

However, it also has strong negative impacts on the city. A study was carried out on the annual emissions of NO, NO2, NOX, PM10 and PM2.5 due to the transport of goods in container in the port of Naples (Fusco Girard et al. 2020; Libralato et al. 2020).

Fig. 16.4 Preliminary planning hypothesis 1: visualization
These data, appropriately processed, have been used as input for the CALPUFF dispersion model (www3.epa.gov) to estimate NO2, PM10 and PM2.5 concentrations in the urban area surrounding the port (Fusco Girard et al. 2020).

The results of the dispersion model were used in an assessment of the increased risk of mortality associated with air pollution in the urban port area.

With reference to the latest data available (2016) for the definition of weather conditions, it was found that moving the goods from road to rail transport (9 + 9 trains/day) would reduce deaths by two per 1000 for the 600 kTEU hypothesis and by three deaths per 1000 for the 1000 kTEU hypothesis, due to the reduction of nitrogen dioxide (there are no significant benefits related to the reduction of PM10 and PM2.5). Positive impacts are also achieved for the reduction of cardiovascular and respiratory system diseases.

The benefits in terms of reducing greenhouse gas impacts, which should be added to those due to pollution, have not been evaluated.

The net benefits (especially if one assumes the context/reference of the very recent EU documents) can significantly increase with the use of renewable energy sources, forms of energy efficiency, the use of bio-eco-compatible materials, the use of micro-electricity for mobility and transport, the multiplication of green areas, the introduction of digital technologies, etc.

The hybrid evaluation method is therefore a tool that integrates the different and multidimensional impacts (from environmental to social/human to economic) and helps identify those combinations of projects/actions characterized by the promotion...
of greater synergies, for their complementarities: therefore, capable of multiplying the net benefits implementing the human scale of the development strategy.

The two preliminary projects determine impacts whose final results are almost equivalent.

In order to make the city/port relationship a more virtuous one (or more circular), and in order to improve net positive impacts, further specific integrative characteristics of the transformation preliminary project are needed to be included. A participative process involving many stakeholders helped in this direction.

Also a new ‘circular business model’ has been recognized to be useful, for better reflecting economic, ecological and social values: a ‘triple layered business model’ (Joyce and Pasquin).

These characteristics can be recognized as included also in the list of the 17 SDGs of Agenda 2030.

In particular, they refer to the better pursuit of the objectives of the general European framework (see §3) and also of Agenda 2030 for the reduction in the quantity of climate-altering gases released into the atmosphere (SDGs 3, 7, 8, 11, 13); reduction in the amount of pollutant gases (SDGs 3, 11):

- Repair, reuse, maintenance and regeneration of materials and manufactured articles (SDGs 12).
- Waste collection (including from drainage, demolition, glass, plastic, iron, wood, etc.) (SDGs 11, 12).
- Water reuse/recycling (including from cruise ships, etc.) (SDGs 6, 12, 14).
- Reuse of heat produced (for residential purposes, etc.) (SDGs 8, 11).
- Multiplication of green spaces, green corridors, biomass, and green and blue infrastructure to contribute to the local microclimate (SDGs 11, 13).
- Mobility based on electricity (lorries, micro-electric, etc.) (SDGs 7, 11, 13).
- Use of digital technologies (including IoT, AI, etc.) to improve connection levels and synergies (SDGs 8, 9, 17).
- Location of innovative start-ups linked with port activities and services (SDGs 8, 9).
- Promotion of industrial ecology processes (SDGs 12, 7).
- Reduction of arrival/manoeuvre/departure times (just in time) through rational time programming to reduce CO2, etc. (SDGs 3, 12, 13).
- Implementation of the multi-helix model (SDGs 8, 9, 17).
- Moving from the production of goods to the production of insurance services, financial services, software, design, etc. (SDG 12).
- Use and production of renewable energy (SDGs 7).
- Energy efficiency of buildings (SDGs 7, 11).
- Use of bio-materials (SDG 12).
- Production of bio-gas (SDG 3).
- Valorisation of existing (and underused) share capital (SDGs 8).
- Reuse of cultural/landscape capital (SDGs 7, 11).
- Continuous monitoring and evaluation of impacts (SDGs 12, 17).
The New Industrial Strategy for a global competition, green and digital Europe mentions, inter alia, the use of hydrogen as an energy carrier to accelerate the decarbonization of the industrial system.

The European Strategic Research Innovation Agenda states that hydrogen is an essential component of decarbonization, as about two-thirds of CO2 emissions are produced by the steel, chemical and cement industries.

Obviously, the production of hydrogen requires the use of renewable energy sources to achieve the electrolytic process.

The application of hydrogen in the port infrastructure, with the use of fuel cells, is evoked not only for the construction of fixed equipment, but also for industrial vehicles, railway wagons, various plants, etc.

Good practices are being tested in many port cities around the world in this direction—for example, by transforming CO2 into CH4 using hydrogen produced from renewable sources (www.marseille-port.fr).

The above characteristic/initiatives reshape the previous planning alternatives and can help to identify a new more effective project solution. In particular, they can better contribute to employment and self-employment, as a key condition of the human-centred strategy (in coherence with the Social Pillar of European framework and European culture), avoiding any ‘human waste’ through the valorization of underused human capital.

16.9 Conclusions

The evaluation carried out with the ANP and PROMETHEE suggests to better improve the benefits compared to the status quo. Some impacts are quantified; others, in the absence of significant data, are only assessed in qualitative terms (Fusco Girard et al. 2020). However, this preliminary test suggests moving from the preliminary planning proposal to a more in-depth solution proposal in which the impacts of Fig. 16.1 in §2.5 are better identified.

In order to improve these benefits, some new actions have been identified for the transformation of the status quo, in addition to those resulting from the ‘Special economic zone’ recognized officially for Naples port area. New synergy economies can thus be developed, based on symbioses, with positive socio-economic impacts.

This evaluation approach can be tested on a larger scale and proposed again in other metropolitan cities.

The financing with EU funds is justified on the basis of what has already been stated about the Green Deal approved by the European Union. The effective fight against climate change is a key objective of Agenda 2030 and of the Pact of Amsterdam. But it is also a precondition for many other social objectives to be achieved. This is in fact a general interest that any political majority should adhere to, regardless of the dynamics linked to democratic change between political majorities and opposition.
In short, it is a commitment and not just an option for any local government. Cities and networks of cities (small, medium, large) are in fact the protagonists of the new evolutionary dynamics.

In reality, the fight against climate change is not a constraint, but an opportunity for cities of any size because it enables them to improve their overall productivity. New tools are required to support decision-making processes, sharing outcomes with the involved stakeholders (people, entrepreneurs, public institutions, etc.), stimulating the institutional culture of evaluations.

Finally, it is worth pointing out that the above appears to be all the more true in the South of Italy (Mezzogiorno), where it is necessary to invest according to a systemic rather than a sectorial approach, as all too often happens.

Sustainable development in the South strongly depends on the ability of cities to adopt not only adaptation and mitigation strategies with respect to the risk of climate change, but also circular development strategies, linking synergy, symbiosis and/or mutual interdependence between public, private and third sector investments: in logistics, culture/tourism and the agri-food sector, improving administrative procedures for better use of EU funds and overcoming purely bureaucratic constraints, since the focus is mainly on the results achieved.

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