
Politecnico di Torino

Master's degree programme in

**Territorial, Urban, Environmental and Landscape Planning**

**Curriculum: Planning for the Global Urban Agenda**

# Master Thesis

## Ecological Transition of Cities: Identification of good practices that can be applied to the Metropolitan City of Turin

**Supervisor**

Prof. Patrizia Lombardi

**Co-supervisors**

Arch. Chiara Genta

Arch. Sara Torabi Moghadam

**Candidate**

Noemi Minghella

Academic Year 2020/2021

December 2021

| | |
|---|---|
| **Degree** | MSc Territorial, Urban, Environmental and Landscape Planning<br>Curriculum: Planning for the Global Urban Agenda<br>MASTER'S DEGREE THESIS |
| **Title** | Ecological Transition of cities: Identification of good practices that can be applied to the Metropolitan City of Turin |
| **Author** | Noemi Minghella |
| **University** | Politecnico di Torino |
| **Supervisor** | Prof. Dr. Patrizia Lombardi<br>Vice Rector of Politecnico di Torino<br>Full Professor<br>DIST - Interuniversity Department of Urban and Regional Studies and Planning<br>Effective member of School of Planning and Design |
| **Co – Supervisors** | Dr. Arch. Chiara Genta<br>PhD Fellow<br>DIST - Interuniversity Department of Urban and Regional Studies and Planning<br><br>Dr. Arch. Sara Torabi Moghadam<br>Research Assistant<br>DIST - Interuniversity Department of Urban and Regional Studies and Planning |
| **Research period** | March 2021 – December 2021 |

To all those who believe in me
and you who support me from
up there, with the aim of always
making you proud of me

## Acknowledgment

A first thanks to my Supervisor Prof. Dr. Patrizia Lombardi who allowed me to be part of her working group and to develop a theme in which I have a great interest and which I hope to be able to further explore in the future.

Thanks to Dr. Chiara Genta and Dr. Sara Torabi Moghadam who helped me develop my thesis from the beginning by guiding and advising me.

A special thanks goes to my family, my parents and my sister Cinzia who, despite the two difficult years that I had to face, have always supported and encouraged me, in everything.

Thanks to Davide who is always by my side and who has endured and absorbed all my anxieties and worries, sending me calm, helping me not to be afraid and always pushing me to pursue my goal.

Thanks to my best friend Elisa, who has been with me for many years and supports me, sometimes from afar, but who I always feel close to.

Thanks to my colleagues Souhila and Donatella who have shared this long university career with me, among anxieties, deliveries, anger but also a lot of satisfactions; without you it wouldn't have been the same.

Thanks also to all the people who in some way contributed to this thesis and to my entire university career, my new or old relatives and friends.

And finally thanks to you Zia, you can't be here today, this cursed Covid that has upset our existence has taken you away too soon, but I'm sure that from up there you support me and cheer me on today, hoping that you are always proud of your granddaughter.

This thesis is dedicated to you, who from up there support and protect me, as you always have.

# Index

## Preface

The research process that led to the realization of this thesis was started in March 2021 with the desire to deepen a theme that I believe is extremely important for those who, like me, have completed their study path in an area in evolution: urban planning.

In fact, I believe that it is essential to know and study the processes underway in different territorial realities, Italian or foreign in order to be able to outline new urban planning tools to build the city of tomorrow.

The research path carried out allowed me to analyse plans and documents of many European and Italian cities, giving me the possibility of "turning my gaze" towards very heterogeneous realities and strongly distant from Turin, a case study on which in these years of university I could work in different fields. In any case, even if distant and different, the cities of the world have the same goal: to achieve climate neutrality to mitigate the effects of climate change.

The research process stimulated me to pay more and more attention to policies to reduce greenhouse gas emissions, one of the possible tools with which cities can mitigate and adapt to the effects of climate change which are becoming more frequent and violent than ever before.

## Abstract – EN

Climate change and its effects are every day more and more visible before our eyes; they are no longer distant phenomena that we hardly hear about, their effects influence everyday life and it is necessary to implement measures that lead to climate neutrality, therefore to the zeroing of emissions of greenhouse gases into the atmosphere, which represent the main cause of them. The high presence of $CO_2$ in the atmosphere causes a global increase in the temperature of the earth and seas with disastrous consequences on marine and terrestrial ecosystems as well as for the global population. Cities, as places that host the largest percentage of global population with an increasing trend, are the entity that can provide effective ecological transition policies, in order to guarantee the reduction and subsequent zeroing of greenhouse gas emissions from anthropogenic activities that find space within the cities themselves. Cities are in fact among the major producers of greenhouse gases in the atmosphere, the major energy and natural resources consumers.

Therefore the thesis aims to define and study the ecological transition of cities and, thanks to the research process implemented, to define best practices that could be implemented in the Metropolitan City of Turin.

The research thesis investigated which new sustainable development models have been developed by the various European cities following the adoption of the Agenda 2030 and, through screening and filtering processes, it was possible to identify which Italian and European case studies to analyse to define which good practices and actions each territorial reality has implemented or envisaged in the strategic plans and in the climate and energy neutrality plans. It was also decided to limit the field of investigation to three main sectors which represent the most relevant areas of intervention for the ecological transition from an environmental point of view. The selected sectors are: the environmental, energy and mobility sectors. The critical analysis to determine good practices was also carried out thanks to a Swot analysis and a Stakeholders analysis in order to identify the lines of action and the actors involved.

Finally, by comparing the good practices identified in the case studies with those provided by the Metropolitan Strategic Plan – Turin Augmented Metropolis, approved in February 2021, some new possible actions for the Turin area are identified and validated through short interviews with key actors of the sectors on which the analysis was focused, as mentioned above.



**Key words:** Transition, Agenda 2030, Sustainable Development, Adaptation, Transformation, Mitigation.

## Abstract – ITA

Il cambiamento climatico e i suoi effetti sono ogni giorno sempre più visibili davanti ai nostri occhi; non sono più fenomeni lontani di cui difficilmente si sente parlare, i loro effetti influenzano la vita quotidiana ed è necessario attuare misure che portino alla neutralità climatica, quindi all'azzeramento delle emissioni di gas serra in atmosfera, che ne rappresentano la causa principale. L'elevata presenza di $CO_2$ nell'atmosfera provoca un aumento globale della temperatura della terra e dei mari con conseguenze disastrose sugli ecosistemi marini e terrestri oltre che sulla popolazione mondiale. Le città, in quanto luoghi che ospitano la più alta percentuale della popolazione mondiale, sono l'entità in grado di fornire efficaci politiche di transizione ecologica, al fine di garantire la riduzione e il successivo azzeramento delle emissioni di gas serra delle attività antropiche che trovano spazio all'interno delle città stesse. Le città sono infatti tra i maggiori produttori di gas climalteranti nell'atmosfera, i maggiori consumatori di energia e risorse naturali.

Pertanto la tesi mira a definire e studiare la transizione ecologica delle città e, grazie al processo di ricerca implementato, a definire le migliori pratiche che potrebbero essere implementate nella Città Metropolitana di Torino.

La tesi di ricerca ha indagato quali nuovi modelli di sviluppo sostenibile sono stati sviluppati dalle diverse città europee a seguito dell'adozione dell'Agenda 2030 e, attraverso processi di screening e filtering, è stato possibile individuare quali casi studio italiani ed europei analizzare per definire quali buone pratiche e azioni che ciascuna realtà territoriale ha attuato o previsto nei piani strategici e nei piani di neutralità climatica ed energetica. Si è inoltre deciso di limitare il campo di indagine a tre settori principali che rappresentano le aree di intervento più rilevanti per la transizione ecologica da un punto di vista ambientale. I settori selezionati sono: l'ambiente, l'energia e la mobilità. L'analisi critica per la determinazione delle buone pratiche è stata svolta anche grazie ad una analisi Swot e ad una analisi Stakeholders al fine di individuare le linee di azione e gli attori coinvolti.

Infine, confrontando le buone pratiche individuate nei casi studio con quelle previste dal Piano Strategico Metropolitano – Torino Metropoli Aumentata, approvato a febbraio 2021, vengono individuate alcune nuove possibili azioni per il territorio torinese e validate attraverso brevi interviste con attori chiave dei settori sui quali si è focalizzata l'analisi, come sopra citato.



**Parole Chiave:** Transizione, Agenda 2030, Sviluppo Sostenibile, Adattamento, Trasformazione, Mitigazione.

## List of Acronyms

**ASviS**: Alleanza Italiana per lo Sviluppo Sostenibile (Italian Alliance for Sustainable Development)

**CMMI**: Città Metropolitana di Milano (Metropolitan City of Milan)

**CMTO**: Città Metropolitana di Torino (Metropolitan City of Turin)

**FEEM**: Fondazione Eni Enrico Mattei (Eni Enrico Mattei Foundation)

**GDP:** Gross Domestic Product

**HLPF**: High Level Political Forum on Sustainable Development

**LPT**: Local Public Transport

**MC**: Metropolitan City

**NBS**: Nature Base Solutions

**OECD**: Organisation for Economic Co-operation and Development

**PAES**: Piano di Azione per l'Energia Sostenibile (Action Plan for Sustainable Energy)

**PNRR**: Piano Nazionale di Ripresa e Resilienza [Italia] (National Recovery and Resilience Plan)

**PSM**: Piano Strategico Metropolitano (Metropolitan Strategic Plan)

**PUMS**: Piano Urbano della Mobilità Sostenibile (Urban Sustainable Mobility Plan)

**SDGs**: Sustainable Development Goals

**SDSN**: Sustainable Development Solutions Network

**SNSvS**: Strategia Nazionale per lo Sviluppo Sostenibile [Italia] (National Strategy for Sustainable Development) [Italy]

**VLR**: Voluntary Local Review

# List of Figures

## List of Tables

# CHAPTER 1: INTRODUCTION

## 1.1 Background

"There is no world of yesterday to return to, but a world of tomorrow to be born quickly"

[PNRR Italy] (Consiglio dei Ministri, 2021)

There is a globally defined transition process, by definition "a transition from one way of being or life to another, from a condition or situation to a new and different one" as the Treccani encyclopaedia defines it (Treccani, n.d.).

In particular, a process defined by scholars as Ecological Transition that concerns all territorial realities and defined as "the basis of the new model of Italian and European development. Intervening to reduce polluting emissions, prevent and counter the instability of the territory, minimize the impact of production activities on the environment is necessary to improve the quality of life and environmental safety, as well as to leave a more green and a more sustainable economy for future generations" as reported into the PNRR of Italy, the *Piano Nazionale di Ripresa e Resilienza* (National Recovery and Resilience Plan) of Italy, in the edition approved on 13 July 2021 by the European Commission (Consiglio dei Ministri and Italia domani, 2021).

The need to implement an ecological transition process derives from the awareness that the current development model is no longer sustainable and from the need to limit the effects of climate change caused by excessive emissions of greenhouse gases into the atmosphere and in particular of $CO_2$ (World Commission on Environment and Development and United Nations, 1987).

During the UN Summit on Sustainable Development on 25 September 2015 in New York, the *Agenda 2030* was presented which promotes a new development model; it contains the 17 sustainable development goals which, thanks to their achievement, following a territorialization process, can guarantee the equitable development of humanity in line with the resources that the planet offers (United Nations, 2015).

In December 2015, the Paris Agreement was also adopted during the Paris Climate Conference, in the Conference of Parties (COP21), and it is the first universally recognized and binding agreement on climate change. Many states, including the European Union, took part in the agreement which establishes a global framework to promote sustainable development and avoid or limit climate change, possible only if the increase in the earth's temperature, defined as global warming, it remains limited to 1.5°C or well below 2°C.

The Agreement provides, in addition to the determination of mitigation measures, also to establish measures and tools for adaptation to climate change to increase the adaptability of the various countries to the negative effects of climate change (United Nations and Unfccc, 2015).

Subsequently, to ensure complete implementation of the Paris Agreement, the Katowice Climate Package was adopted during COP24, held in 2018 in Katowice, Poland, which essentially summarizes again the rules of the Paris Agreement stipulated three years earlier, as reported in the *Relazione del Ministero della Transizione Ecologica sullo stato di attuazione degli impegni per la riduzione delle emissioni di gas ad effetto serra* (Ministero dell'Economia e delle Finanze, 2021).

The 26th Conference of the Parties took place in Glasgow between the end of October and mid-November 2021. It has four main objectives that derive in part from the previous United Nations Conferences on Climate Change:

1. Zero emissions by 2050 and limit the rise in temperatures to 1.5°C;
2. Safeguarding communities and natural habitats through adaptation policies;
3. Obtain and mobilize funding;
4. Collaborate.

The United Nations Framework Convention on Climate Change, UNFCCC, at the end of COP 26 reported the 4 main achievements of the Summit even if there are still many missing points of agreement (United Nations Environment Programme (UNEP), n.d.). First of all, for the first time, adaptation to climate change is considered as important as the reduction of GHG emissions; then, of fundamental importance is the need to help developing countries economically in order to guarantee them the same level of innovation in the fight against climate change; furthermore, the need to reduce greenhouse gas emissions appeared to be of considerable importance, also due to its urgency. Finally, thanks to the finalization of the guidelines, it will be possible to fully implement the Paris Agreement signed in 2015 (UNFCCC, 2021).

The 17 Sustainable Development Goals which are included in the Agenda 2030 and shape the new model of development promoted, were partly to be achieved by 2020, most of them by 2030. And it is precisely to this mid-term and then after 2050 that Italian and European cities refer to achieve complete neutrality in terms of emissions and thus implement a complete ecological transition as the Green Deal foresees (Ministero dell'Economia e delle Finanze, 2021) and (European Commission, 2019).

Furthermore, it is necessary that the sustainable development goals, defined at a global level, are declined in the underlying levels, from the global to the local through intermediate supra-local levels.

This also allows for greater participation and involvement of local actors so that they can feel an integral part of the change that must be implemented as it is individuals and small communities, in concert with the large ones, who are the protagonists and managers of the transition.

To eliminate emissions and achieve climate neutrality by 2050, it is necessary to speed up the decarbonization process, reduce the deforestation process, encourage the transition to electric vehicles and develop incentive policies for investing in renewable sources.

Instead, in order to safeguard and protect communities and natural habitats, it is necessary to restore ecosystems and design more resilient infrastructures and homes, capable of adapting and resisting the effects of climate change.

To ensure the achievement of the above objectives it is necessary that the necessary funds be invested to guarantee the possible realization of this transformation and it is essential to develop a process of collaboration between different entities that can contribute in different ways to the transition process towards the achievement of climate neutrality.

In the Italian context, the *Agende Metropolitane per lo Sviluppo Sostenibile* (Metropolitan Agendas for Sustainable Development) are the tool with which individual cities commit themselves and plan the ecological transition in the major sectors. Thanks to participatory creation and a bottom-up approach, they represent the most suitable tool for implementing the *Strategia Nazionale di Sviluppo Sostenibile* (National Sustainable Development Strategy) approved by Italy in implementation of the Agenda 2030.

The sectors involved are the most varied; this heterogeneity is also caused by the strong diversity of the individual territorial realities, the context and the effective possibility of change. The change starts, in fact, from the people who live in the cities, the population has in fact been involved in the implementation of strategic plans aimed at the ecological transition so that they were built in the best way and therefore feasible.

Cities are the main protagonist; cities then prove to be the driving force behind this important transition. They are in fact the place where most of the world population lives and there is an increasing depopulation of rural areas to move to cities.

They are also the source of most of the greenhouse gas emissions that derive from various sectors: transport, buildings, public lighting, public buildings, etc.

However, it is the cities themselves that can act as a stage for the implementation of all good practices towards the ecological transition in the various sectors responsible for emissions.

## 1.2 Problems

All the cities examined in this thesis have implemented in recent years and especially after the adoption of the Agenda 2030 and after the Paris Agreement, measures and models that can allow them to implement the transition and in particular to reduce $CO_2$ emissions in atmosphere thanks also to a reduction in the overall demand for energy or thanks to the production of energy no longer derived from highly polluting and scarcely available fossil sources.

Therefore, three main models of sustainable development can be outlined; firstly the 5P model (People, Planet, Prosperity, Peace and Partnership) which is the model indicated in the Agenda 2030 in 2015. It highlights the heterogeneity of sustainable development as not only the environment is taken into consideration but also areas closely linked to the social sphere. On the other hand, it is the same concept of sustainable development that makes the social, economic and environmental spheres coexist within it. Then there are the same Sustainable Development Goals which concern not only environmental but also social, economic and cultural issues.

This thesis will examine in particular the environmental issues to which the second development model is strongly linked, towards which some cities in northern Europe are moving, which is that of the Circular Economy which guarantees less waste and in particular a smaller amount of energy needed to produce and then dispose of.

State-of-the-art European capitals such as Amsterdam and Paris have already drawn up plans strongly centred on this model to implement the ecological transition without neglecting the 5P model as well. Turin itself, in the very recent *Piano Strategico Metropolitano – Torino Metropoli Aumentata* (Metropolitan Strategic Plan - Turin Augmented Metropolis), inserts circularity among the characteristics that the Piedmontese chief town must assume, which has already seen several transformations in its territory in recent decades, closely linked to changes in the social and economic sphere.

Finally, taking into consideration another interpretation of sustainable development policies, the model of the Doughnut economy is considered more realistic, in which the planetary boundaries are combined with the circular economy model; in fact they represent the limits beyond which development in line with the possibilities of the planet is no longer possible.

In this way, therefore, the problem on which this thesis takes shape is determined; it is to determine which model is the most effective and what are the measures implemented by the various European and Italian cities in the field of ecological transition that can be replicated in order to act as a driving force for others, and in particular which ones measures can be applied to the Metropolitan City of Turin that are not already foreseen, to complete the transition process.

## 1.3 Research questions

The goal of the thesis is therefore to analyse the selected case studies, to define which is the most effective model towards the ecological transition of cities and which good practices towards the ecological transition can be replicated in different territorial contexts.

Therefore, the research question that first emerges is: What are the good practices implemented by other European and Italian territorial realities that are more avant-garde towards the ecological transition of cities? Which can be replicated in the context of the metropolitan city of Turin towards the ecological transition?

## 1.4 Goal of the Thesis

The objective of the research thesis, which was structured through a methodological framework divided into two main phases, is to define a framework for the analysis of the applied models and to extrapolate which factors are linked to specific territorial realities through the analysis of case studies, policies and good practices that have been implemented in other territorial realities to achieve the ecological transition, thanks to a work of analysis and critical reading of the plans drawn up by each reality following the adoption of the Agenda 2030 and the Paris Agreement and to define which good practices can be applied in the Metropolitan city of Turin to ensure an optimal ecological transition in addition to those already foreseen.

The first phase of the applied methodology aims to identify the case studies and plans to be analysed; instead, the second phase aims to determine the good practices for the ecological transition envisaged by each case study.

The thesis analysed five European cities and five metropolitan cities in central-northern Italy. Tools such as Swot Analysis were used to determine good practices, a Stakeholders Analysis to identify the actors involved and those to be involved and interviews to key roles to validate the results obtained.

## 1.5 Thesis Structure

The thesis is composed of five chapters in which the phenomenon of ecological transition is analysed in the various case studies, the analysis of the scientific literature on the subject was also carried out and which is then used to conduct the research process, the fundamental part of the thesis.

In particular, the introduction provides a first mention of the issue of ecological transition closely related to the process of territorialisation of the Sustainable Development Goals adopted in 2015 with the Agenda 2030 and after the Paris Agreement; in the next chapter a literature review is reported which allows, thanks to the study of the existing literature, to have a clear idea of the European and Italian panorama in which the ecological transition and the case studies will then be analysed.

The third and fourth chapters of the thesis are dedicated to the description of the methodology used to conduct this research thesis. Chapter three covers the research process undertaken to identify case studies. The chapter is therefore composed of the methodological framework in which the screening and filtering process are described to identify the case studies and the plans that will be analysed and the results obtained.

In the fourth chapter, within the methodological framework, the process carried out for the determination of good practices applicable in Turin was reported. To determine them, a critical analysis, a swot analysis and a stakeholders analysis were carried out. The results were also reported in the second part of the chapter.

Furthermore, validation has also been included in the results of this chapter, carried out through interviews to key roles, in order to determine the results of the research, in particular to determine the effective implementation of the good practices identified for the Metropolitan City of Turin.

Finally, in the last chapter of the thesis, the fifth chapter, the conclusions to which this work has led are reported, as well as the main results, key findings, limits and future developments.

The structure of the research thesis conducted is summarized in the following scheme which shows a schematic representation of the structure of the thesis divided into chapters (Figure 1).

## Identification of Good Practices in cities towards Ecological Transition

### BACKGROUND - PROBLEMS

The global development model is no longer sustainable: with the 2030 Agenda in 2015 a new **model of sustainable development** is proposed: the 5P Model, which together with the Circular and Doughnut Economy model represent the possibility of guaranteeing sustainable development for cities, key places to implement good practices towards the ecological transition to achieve **climate neutrality**.

CHAPTERS IN WHICH THE TOPIC IS DISCUSSED

Chapter 1
Chapter 2

### RESEARCH QUESTIONS

What are the **good practices** implemented by other Italian and European territorial realities towards the ecological transition of cities?
Which can be replicated in the context of the metropolitan city of Turin towards the **ecological transition**?

### THESIS SOLUTIONS

**Critical analysis** of the good practices reported in the respective plans from the different case studies identified thanks to a **screening** and **filtering** process;
**Swot** and **Stakeholders** analyses to select the good practices not present in *Piano Strategico Metropolitano 21-23 - Torino Metropoli Aumentata* clustered in three main sectors: **Environment, Energy and Mobility**.
**Validation** thanks to interviews with key roles who are experts in the three sectors.

CHAPTERS IN WHICH THE TOPIC IS DISCUSSED

Chapter 3
Chapter 4
Chapter 5

*Figure 1 - Schematic summary of the research process. Source: Author, 2021*

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Ecological Transition: Definition

Starting from the 1970s, the concept of transition in the context of sustainable and environmental development was used to emphasize the need for the "transition from a growth model to a global equilibrium" (Meadows, 1972), highlighting for the first time the ecological and global risks generated by excessive growth demographic, economic and uncontrolled exploitation of natural resources as reported in the ETRES report, the Educational and Training Resources for Environment and Sustainability, in the essay on the ecological transition (ETRES, 2017).

In general, transitions in various sectors are just some of the types of change, more or less sudden and drastic, that an economic, political, social or environmental system can go through. Transition can be defined as a "continuous process of social change, by means of which the structure of society changes in a fundamental way" as is still reported in the ETRES report (ETRES, 2017).

It is not easy to give a single definition to the ecological transition process, not to be confused with sustainable development. The goal of the ecological transition is to make sustainable development possible; the latter, on the other hand, promotes development as a growth that the planet can lead in the long term, without compromising the life and growth of future generations.

The concept of ecological transition was only spread in 2008 by Rob Hopkins, an English activist and writer specializing in environmental issues. It can be defined as the transition from a current production and consumption model to a more ecological one and can be declined in different sectors (Hopkins, 2008).

French ministry of ecological and solidarity transition gives a definition of the ecological transition: it is defined as "an evolution towards a new economic and social model, a model of lasting development that innovates our ways of consuming, producing, working, living together to respond to the great environmental challenges, those of climate change, the scarcity of resources, the accelerated loss of biodiversity and the multiplication of environmental risks" (Ministry of the Environment, Energy and the Sea, 2014), as reported again in the essay by ETRES (ETRES, 2017).

"Our battle for global sustainability will be won or lost in the cities", with these words the former United Nations Secretary Ban Ki-moon in New York in 2012 underlined the fundamental role of cities that represent the fundamental places to realize the projects and

actions necessary to assist in achieving the SDGs envisaged by the Agenda 2030, as reported in the ASviS Report *I territori e gli obiettivi di sviluppo sostenibile* (Territories and sustainable development goals) (ASVIS Italia, 2020).

However, cities, more or less large or populous, are at the centre of the necessary transformations to achieve the SDGs and that are also the place where the world population, for decades now, has been concentrated, lives and will continue to increase.

"Cities are at the heart of today's economic, environmental and social challenges. More than 70% of EU citizens live in urban areas while about 85% of the EU's GDP is generated in cities. These urban areas are the engines of the European economy and act as catalysts for innovative sustainable solutions promoting the transition to a low-carbon and resilient society. However, they are also places where problems, such as unemployment, segregation, poverty and pollution are at their most severe" as reported by the European commission in the *European Handbook for SDG Voluntary Local Reviews* published by European Commission (Siragusa et al., 2020).

Cities are configured as major attractors in different geographical areas of population, education and leisure (URBAN@IT, 2021) and are responsible of the 70% of global GHG emissions (City of Paris, 2018).

They occupy 3% of the total terrestrial surface but are responsible for the emission of very high quantities of greenhouse gases (Barbera et al., 2021). Paul Crutzen in 2000 coined the term "Anthropocene" (Crutzen, 2005) to define the geological era we are living in, in which anthropogenic activities affect the atmosphere and alter its balance. In fact, the limits of the global ecosystem have been exceeded and the resources made available by the planet have been exhausted. It is therefore necessary to develop a scenario defined as "Post-Carbon city" or a new development model in line with the possibilities of the planet and to guarantee a green future for the next generations (Barbera et al., 2021). Many European cities have already prepared new tools to ensure a reduction in emissions and a greater capacity to adapt to climate change, in line with the principles promoted by the Agenda 2030 and the Paris Agreement.

The cities will be the mirror of the change that we want to implement and the starting point of every modification; it is in the cities that alliances and coalitions between the various actors responsible for the transition take place and it is the cities themselves, or metropolitan cities if we intend the Italian case, that become direct interlocutors with governments and implement the sustainability policies provided for by the Agenda 2030.

It is important to underline that, despite being the target analysed by the thesis, it is not only the big cities that can and must make a difference on this issue, but it is also necessary to apply it in local communities, in internal territories and in small urban realities.

### 2.1.1 Agenda 2030 and SDGs

Ecological Transition is made possible also through the territorialisation of the Sustainable Development Goals contained within the United Nations Agenda 2030 for Sustainable Development approved during the UN Summit on Sustainable Development held in New York on 25 September 2015 (United Nations, 2015) and from the adoption of the Paris Agreement which aims to limit emissions of greenhouse gases into the atmosphere in order not to raise the earth's temperature (United Nations and Unfccc, 2015). In this framework the European Green Deal, presented by the European Commission in 2019, aims to make Europe the first zero-emission continent by mid-century by implementing, among others, a process of decarbonisation (European Commission, 2019).

For the implementation of the Agenda 2030 a strong collaboration is necessary in all territories, from local to global scale, which are divided into very different and heterogeneous shapes and dimensions but which thanks to this diversity and uniqueness make it possible to implement the principles of development sustainable with various shades. This practice is of fundamental importance so that an engaging and concrete basis can be created that makes sure that the individual behaviour towards sustainability can be perceived as fundamental and essential.

The Agenda 2030 for Sustainable Development has been signed by 193 UN Member States and is presented as an action program for people, the planet and prosperity and incorporates the SDGs which are divided into 17 objectives, 169 targets and 232 indicators. The SDGs allow the transition from a purely sectoral to a multi-sectoral, almost holistic approach which is also reflected in the typology of new plans that cities approve to implement the ecological transition. The Sustainable Development Goals are also strongly connected and interconnected with each other; this makes the overall vision of environmental policies much more homogeneous.

SDGs are the evolution of the MDGs (Millennium Development Goals) but differ in that these applied only to developing countries while the SDGs provide for worldwide application.

They represent 17 Sustainable Development Goals to be achieved, some by 2020, most by 2030. The Agenda 2030 aims to end poverty, protect the planet and ensure prosperity for all. The SDGs are the political tool that can be used by cities, regions, countries to achieve

the objectives set by the Agenda. Furthermore, they are the potential means to "reshape sustainable development policies from scratch" as reported in the OECD report *A territorial approach to the Sustainable Development Goals* published in February 2020 (OECD, 2020a).

In general, the SDGs represent the tool to implement new development models that guarantee growth for current and new generations by promoting a bottom-up and participatory approach.

With a view to and with the intention of modifying an environmental, socio-economic development system which, before the adoption of the Agenda 2030, had proved no longer sustainable, many cities and territorial realities, more or less large, following the signature of the Agenda, they defined which new development models could be implemented.

The Agenda 2030 reports the 5P model as a model of global development, which takes into account not only environmental issues, but also aims to promote a new model that is inclusive, participatory and in line with the principles of sustainable development and the same sustainable development objectives that the Agenda contains. The models of sustainable development can act as tools to achieve ecological transition. In order to make the territorialization process of the SDGs towards the ecological transition effective and concrete, it is necessary to introduce a bottom-up process that envisages the involvement of civil society and a participatory process in the construction of objectives.

The importance of the localization process is underlined by the UN Development Group 2014, 6-7 reported in the *European Handbook for SDG Voluntary Local Reviews* published by European Commission (Siragusa et al., 2020) which states that "Localization refers to the process of defining, implementing and monitoring strategies at the local level for achieving global, national and subnational sustainable development goals and targets. This involves concrete mechanisms, tools, innovations, platforms and processes to effectively translate the development agenda into results at the local level. The concept should therefore be understood holistically, beyond the institutions of local governments, to include all local actors through a territorial approach that includes civil society, traditional leaders, religious organizations, academia, the private sector and others".

To allow an objective evaluation of the results that are being obtained with the measures already applied and foreseen, it is useful to think about quantifying the results so as to allow a measurement of achievement. To do this, the *Voluntary National Reviews* and the VLRs, acronym for *Voluntary Local Reviews*, have been drawn up on a global level which, respectively, at a global and local level highlight the strengths and challenges underway in the territorialization process of the SDGs and allows cities to assess their achievement of

the SDGs and their contribution to the Agenda 2030. In implementing the transformation towards sustainable development, some European territorial realities and all those analysed in this thesis have formulated new plans, on a local scale and beyond, based on the SDGs.


*Figure 2 - Sustainable Development Goals. Source: sggs.un.org*

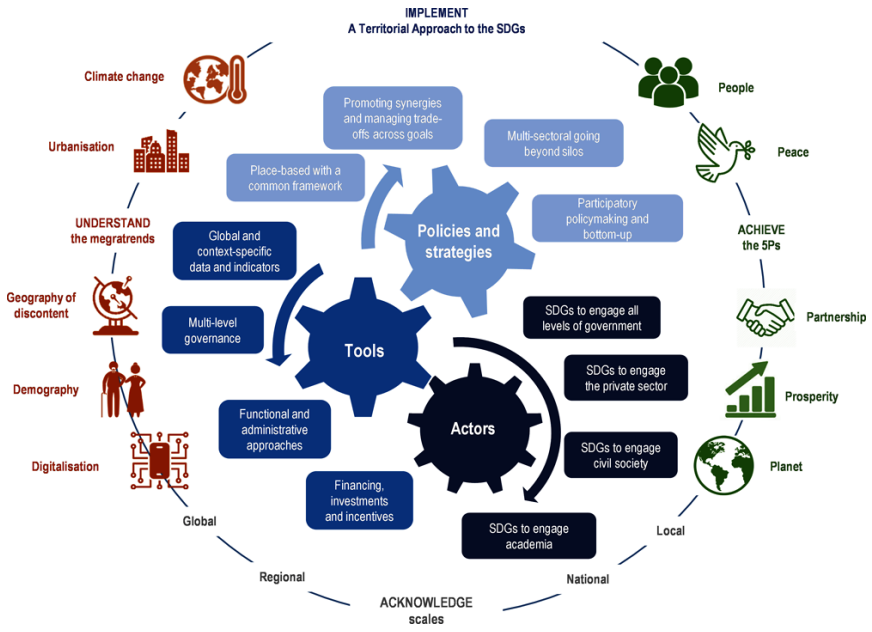



*Figure 3 - Analytical Framework for a territorial approach to SDGs. Source:*(OECD, 2020a)

In the previous diagram, Figure 3, it is possible to note how important the local dimension of ecological transition policies and sustainable development models is; it is in fact of fundamental importance to take into account the needs and the different conformations that the territories may present to ensure a correct and strong involvement of the actors, the use of adequate tools and the development of suitable policies and strategies.

## 2.2 Ecological Transition in cities: EU Level

The milestones in the construction of Urban Agendas at Italian, European and Global level are:

| DATE | EVENT |
|---|---|
| 25/09/2015 | UN Assembly approves the Agenda 2030 for Sustainable Development |
| 30/05/2016 | EU member states sign the Amsterdam Pact, which defines the principles of the EU Urban Agenda |
| 20/10/2016 | The UN Habitat III conference adopts the New Urban Agenda in Quito |
| 08/06/2017 | The Mayors of the metropolitan cities sign the Bologna Charter |
| 02/10/2017 | The Council of Ministers of Italy approves the National Strategy for Sustainable Development |

*Table 1 - Milestones events in the construction of Urban Agenda. Source: Author, 2021*

Some cities in the world, even among those that the thesis did not consider, revisit or adapt existing strategies and plans in order to implement the SDGs towards sustainable development; others, such as Kitakyushu, a city in southern Japan, have chosen to develop strategic plans based on the SDGs from scratch in order to build consensus and a shared vision of the future of the city.

Denmark, in addition to Copenhagen, its capital, has used the SDGs as an implementation link for territorial policies; Southern Denmark also incorporated the SDGs into the new regional development strategy focusing on six strategic pathways and eleven sustainable development goals.

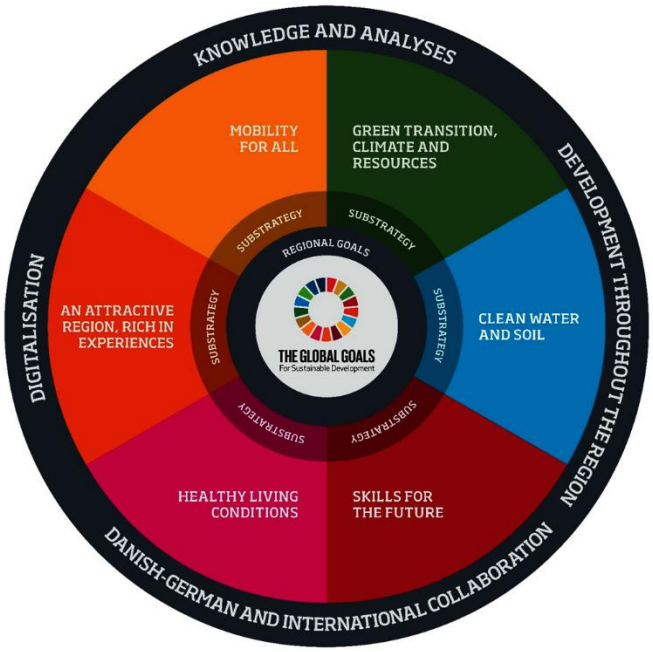



*Figure 4 - Diagram of the link between the regional development strategy (Southern Denmark) and the SDGs. Source:*(OECD, 2020a)

The ecological transition represents today and above all in the future the basis of the new economic and social model of development on a global scale, in line with the Agenda 2030 for Sustainable Development of the United Nations. In order to start the transition and transformation process, it will be necessary to "drastically reduce emissions of greenhouse gases in line with the objectives of the Paris Agreement and the European Green Deal; it is also necessary to improve energy efficiency and the use of raw materials in production chains, civil settlements and public buildings and the quality of the air in urban centres and inland and marine waters" as reported in the *PNRR, Piano Nazionale di Ripresa e Resilienza* (National Plan of Recovery and Resilience) proposed and approved by the Italian government in order to actively take part in the European NextGenerationEU project (Consiglio dei Ministri, 2021).

At the basis of the definition and approval of the Agenda 2030 is the concept of sustainable development that was used for the first time in the *Brundtland report* in 1987 (World Commission on Environment and Development and United Nations, 1987). The Agenda 2030 is the answer to the no longer sustainable model that was outlined in the Environmental field but also Economic and Social. In fact, the definition of a sustainable development model means a development capable of ensuring the satisfaction of the needs of the present generation without compromising the development possibilities of future generations, as reported in the *Our Common Future Report* known as *Bruntland Report* approved by United Nations (World Commission on Environment and Development and United Nations, 1987).

Combining the concept of transition and that of sustainability, very similar to the definition of ecological transition, OECD, in the report published in November 2020 *Managing environmental and energy transitions for regions and cities* provides a precise definition of "sustainability transitions" which "recognizes that global environmental challenges such as climate change or the environmental impacts of materials use are rooted in prevailing modes of production and consumption. Deep innovations and profound changes to the dominant structures, practices, technologies, policies, lifestyles, etc. are needed. This perspective is linked to the Sustainable Development Goals, which also encompass human well-being needs. Local and regional governments play an instrumental role in the environmental and energy transition given their important role in local transition domains (e.g. buildings), their levels of public investment, and closer connection to citizens" (OECD, 2020b).

As already pointed out earlier in this thesis, the cities of the world, even among those that the thesis has not analysed in detail, adapt existing strategies and plans with the aim of implementing the SDGs towards sustainable development; among those chosen, however, the Autonomous Community of Euskadi, Spain has developed and approved the *Euskadi Basque Country Agenda 2030* to transform the Spanish government program with a view to sustainable development and SDGs. The goal is also to ensure strong coordination between the different levels of government and actors involved.

In general, world governments are using and incorporating the SDGs into their present-thinking but future-oriented visions to re-design plans, actions and goals. All the SDGs are interconnected so the greater attention to some does not affect the others. The achievement of these objectives is measured on the basis of various indicators which change according to which SDGs refer; an interactive platform called “Localizing Sustainable Development Goals” was also created to facilitate the measurement of the distance to the achievement of the objectives, which for many cities are still a long way off. It is measured periodically through the Voluntary National Review presented to the HLPF.

There are many interpretations of the correlations between SDGs and the models that develop, also taking into account the planetary boundaries defined globally. One of these is the wedding cake model developed by the Stockholm Resilience Centre in which the SDGs are considered fundamental for all other objectives. Viken County, in Sweden, took inspiration from this model to reflect on the relationship between socio-economic development and planetary boundaries (OECD, 2020a).

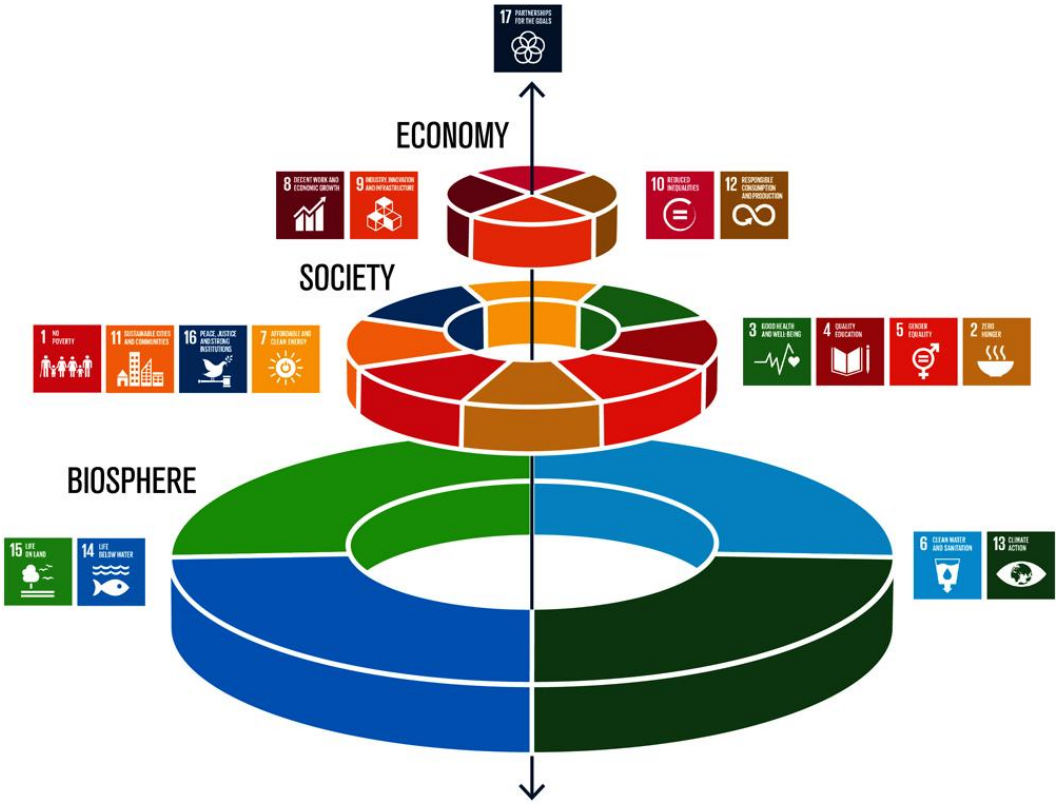



*Figure 5 - The "wedding cake" of the Stockholm Resilience Centre SDGs. Source:*(OECD, 2020a)

In general, whatever the precise idea of a model of sustainable development put into practice by each territorial reality, it is essential to take into consideration the key role of citizenship which turns out to be, after all, the real executor of socio-economic and environmental changes with the aim to create a civic spirit for action.

Among the models that the different cities can implement to achieve the ecological transition and sustainable development, it is possible to distinguish three: the 5P model, the Circular economy model and the Doughnut economy model.

### 2.2.1 Model 5P – People, Planet, Prosperity, Peace and Partnership

Model 5P, together with the others described below, represent the development models that cities can use to implement the ecological transition process.

The Agenda 2030 approved in 2015 "is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom" as reported in the document of Agenda 2030 drawn up on the approval (United Nations, 2015).

The Agenda proposed the 5P model as the main tool to reach the sustainable development; in order to construct a sustainable development model according to the 5P model, it is first of all necessary that the subjects involved have an active role in it in order to formulate the strategy. In general a participatory approach is needed.

The 5P model was also used for the development of the National Strategy for Sustainable Development in Italy consists of strategic objectives that take into account the five global P's: each area determines objectives and targets to be achieved.

- **People**: fight poverty and social exclusion and promote health and well-being to guarantee the conditions for the development of human capital
- **Planet:** guaranteeing sustainable management of natural resources, counteracting the loss of biodiversity and protecting environmental and cultural assets
- **Prosperity**: affirming sustainable models of production and consumption, guaranteeing quality employment and training
- **Peace**: promoting a non-violent and inclusive society, without forms of discrimination, fighting illegality
- **Partnership**: to intervene in the various areas in an integrated manner


*Figure 6 - Model 5P. Source: sdg.gdrc.org*

In general, also from the analyses carried out for this thesis, this model has been adopted in all Italian metropolitan cities, following the approval of the *Strategia Nazionale di Sviluppo Sostenibile* (National Sustainable Development Strategy), SNSvS, and in many of the European cities being analysed alongside other realities which are also paying a lot of attention and are heading towards the Circular economy model of which Amsterdam is the leader.

In Italy, for the SnSvS to be implemented, it is necessary that the Strategic Plans and the Metropolitan Agendas drawn up by the individual territorial bodies must define the objectives and actions.

In fact, the Metropolitan Cities and the Ministry collaborate to define strategic tools capable of achieving the objectives set for sustainable development. This collaboration finds practical application in the Metropolitan Agendas for Sustainable Development which are aimed at implementing the Agenda 2030 and the national and regional sustainability strategies.

In fact, the Agendas prove useful for increasing attention to sustainable development in the Metropolitan Strategic Plans drawn up by the Metropolitan cities established since 2014; to also promote sustainable development actions and finally to increase attention on the importance of social activation on these issues in order to raise awareness of collective awareness.

### 2.2.2 Circular & Doughnut Economy

Circular economy, it is with this adjective that the model that has been put into practice for some years by the cities of Northern Europe, such as Amsterdam, is described in order to drastically reduce $CO_2$ emissions into the environment thanks to saving, reuse and recycling policies avoiding the production of waste and, thanks to high quality productions, making it possible to preserve increasingly rare raw materials. The circular economy, thanks to this particular attention to the production cycle, guarantees a significant reduction of $CO_2$ emitted both in the production and waste disposal phases; Amsterdam wants to become a completely circular city by 2050. At the basis of the circular economy or doughnut economy there is a strong principle that it is essential to live and build a way of life within the limits imposed by our planet, making better use of what exists. Amsterdam foresees interventions to obtain circularity in five macro-sectors which are:

- Food and Organic waste streams
- Consumer goods
- Built environment
- Manufacturing industry
- Plastics

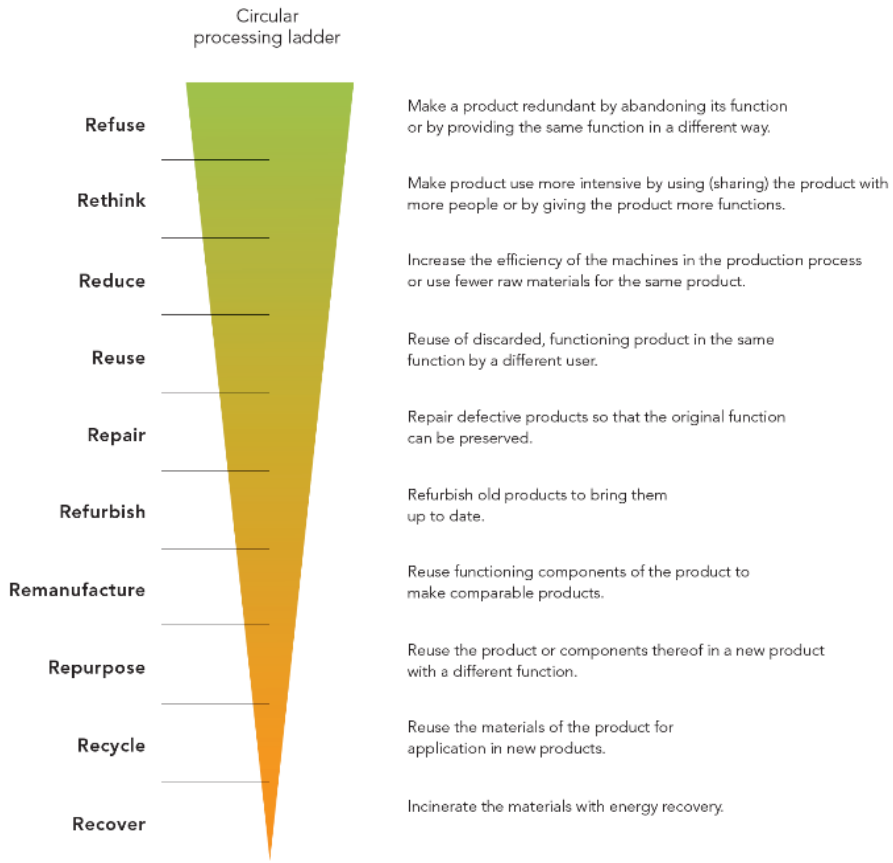



*Figure 7 - Circular economy explanatory scheme. Source:*(City of Amsterdam, 2020b)

The circular economy is often illustrated as a doughnut, a model that has theorized and developed Kate Raworth, a British economist at the University of Oxford and Cambridge (Raworth, 2017). In this model, which takes shape from that of the circular economy, it strongly takes into consideration the limits of our planet which, if exceeded, generate serious problems for ecosystems and the entire planet and materialize in the form of climate change, loss of biodiversity or lack of fresh water as well as ocean acidification. The "edges" from which not to go over form the outer limit of the doughnut. The circular economy or even more the doughnut economy demonstrate how social, environmental or cultural issues are interconnected. Amsterdam has been working for years towards the circular economy model, the doughnut economy will be able to form a safe, fair and sustainable society.

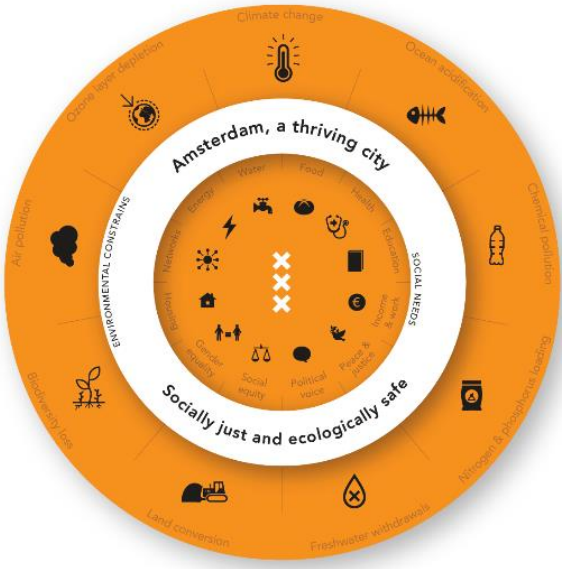



*Figure 8 - Doughnut economy Scheme in Amsterdam.*
*Source:(City of Amsterdam, 2020b)*

The doughnut model takes into account the nine planetary boundaries theorized by scientists to identify the systems that support the Earth. In order for humanity to have stable and favourable living conditions it must live within these borders; in fact, within this doughnut that is created between the social foundation or social needs and the ecological "ceiling" is where the needs of humanity can be satisfied (The safe and just space for humanity), as can be seen in the figure below (Figure 9).

By monitoring the levels of exceeding the social and planetary boundaries, unfortunately, in the figure below (Figure 10) it is easy to observe how humanity has already crossed the limits in four sectors that are:

- Climate change
- Biodiversity loss
- Land conversion
- Nitrogen and phosphorus loading.

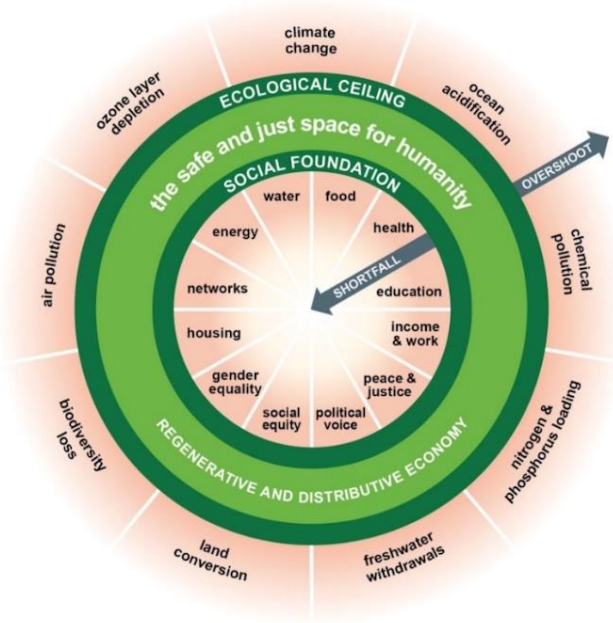



*Figure 9 - Representation of the Doughnut Model: The social and planetary boundaries. Source:(Doughnut Economics Action Lab (DEAL), 2020)*

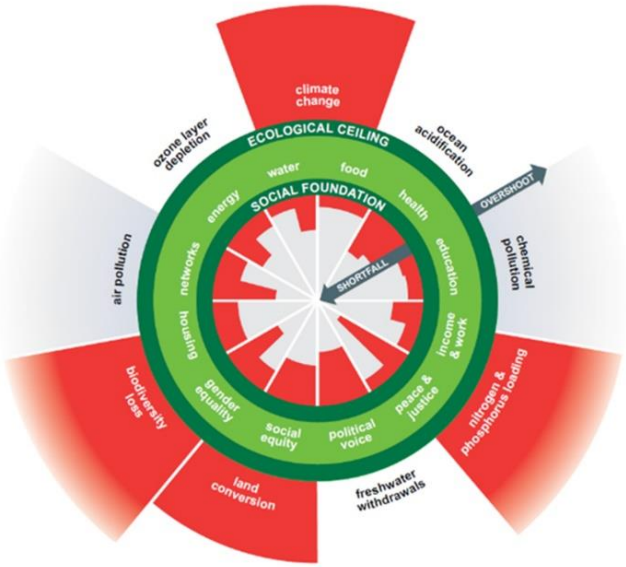



*Figure 10 - The transgression of the social and planetary boundaries. Source:(Doughnut Economics Action Lab (DEAL), 2020)*

The city of Amsterdam plans to become circular by 2050 at the latest and has already approved several action programs to achieve this.

It also plans to decrease greenhouse gas emissions by 95% by 2050 and the sectors on which the city of Amsterdam has chosen to focus are buildings, transport, industry, port and electricity. For each of these macro-sectors it has defined objectives and described actions to be taken.

### 2.2.3 Economic tools

Among the economic instruments introduced at European level to support the ecological transition process that affects many sectors, there is firstly the European Green Deal and then Horizon Eu.

#### 2.2.3.1 European Green Deal and Horizon Eu

The European Green Deal is a set of policy initiatives proposed in 2019 by the European Commission to achieve climate neutrality in Europe by 2050 (European Commission, 2019).

With its presentation, the European Commission is committed to making the European Union climate neutral by 2050 and fostering an ecological transition fairer and more inclusive.

The European Green Deal includes an action plan aimed at:

- promote the efficient use of resources by moving to a clean and circular economy
- restore biodiversity and reduce pollution

The Green Deal provides that in 2050 we will no longer generate greenhouse gas emissions, that economic growth is not associated with the use of unsustainable resources and that no person and no place are neglected, key objectives of the Agenda 2030.

The Green Deal consists of eight main areas for achieving the ecological transition that also ensures economic and social growth. They are: making the climate targets for 2030 and 2050 more ambitious, ensuring the supply of clean, cheap and safe energy, mobilizing industry for a clean and circular economy, improving the existing building stock from the point of view of energy and resources, increase the transition towards sustainable and intelligent mobility, plan a green and healthy food system, ensure the restoration of ecosystems and biodiversity and the elimination of pollution by toxic substances (Senato della Repubblica, 2021).

The European Green Deal aims to "ensure the world a growth that preserves the health, sustainability and prosperity of the planet with a series of social, environmental, economic and political measures" as reported in the *Piano per la transizione ecologica* (Plan for the ecological transition) (Senato della Repubblica, 2021).

Among the strategic instruments developed by European Union there is Horizon Europe that is one of the key tools of the European Union to guide and speed up Europe's recovery, preparedness and resilience. Thanks to Horizon Europe and its strategic plan, Europe will in fact lead the ongoing transformation process.

This first strategic plan of Horizon Europe defines the strategic guidelines for investment in research and innovation in the time frame from 2021 to 2024 and allows to stay in line with the political priorities of the Commission with a focus on a neutral climate and the Green Europe, fit for the digital age, where the economy works for people.

Horizon Europe will address the two transitions towards a green and digital recovery, ambitious but fundamental goals, to support green and digital transformations.

This climate transition requires substantial efforts in research and innovation in the field of clean technologies and social transitions. In fact, they will determine the speed with which this transition can take place, directly influencing the impacts and collateral benefits, such as better air quality, healthy soils and oceans, food and nutrition security, increased employment, social inclusion, sustainable management of resources and reduction of dependence on fossil fuels, objectives that are perfectly traceable to those set upstream with the approval of the Agenda 2030 in 2015.

Horizon Europe will act as a synergistic force between EU funding programs by acting as a link between all planned and funded actions.

The strategic guidelines for EU research and innovation for the period 2021-2024 are reported in the Strategic Plan 2021-2024 (European Commission. Directorate-General for Research and Innovation., 2021) are:

- Promote open strategic autonomy by guiding the development of enabling and emerging technologies to drive digital and green transitions through human-centred technologies and innovations;
- Restoration of ecosystems and biodiversity in Europe and sustainable management of natural resources to ensure safety in the food sector and a clean and healthy environment;
- Make Europe the first sustainable circular, climate-neutral and digital-enabled economy through the transformation of its mobility, energy, construction and production systems;
- Create a more resilient, inclusive and democratic European society, ready to tackle disasters, managing inequalities and delivering high quality health care and so that all citizens can act in green and digital transitions.

Action policies to ensure the transition that they are concentrated in five sectors: Health, Culture, Creativity and inclusive society, Civil security for society, Digital, Industry and Space, Climate, Energy and Mobility as reported by the Strategic Plan 2021-2024 (European Commission. Directorate-General for Research and Innovation., 2021).

## 2.3 Ecological Transition in cities: Italian Level

Italy, like many European countries and the world, has implemented the Paris Agreement, the Agenda 2030 and has defined the planning tools with which to structure the national decarbonization process: they are the *Piano Nazionale per l'Energia e per il Clima* (National Energy Plan and Climate) (PNIEC) (MISE et al., 2019) which plans to implement a new energy policy that is totally sustainable from an environmental, social and economic point of view by 2030 and the *Strategia Nazionale di lungo periodo sulla riduzione delle emissioni dei gas a effetto serra* (long-term National Strategy on the reduction of greenhouse gas emissions) (MATTM et al., 2021) which, thanks to analysis of the various sectors responsible for greenhouse gas emissions, proposes more or less innovative solutions to guarantee a drastic reduction by the middle of the century.

In order to implement the decarbonization process, therefore the elimination of greenhouse gas emissions deriving from fossil sources, it is first of all necessary to reduce the energy demand by about 40% compared to today, as foreseen by the *Strategia Nazionale di lungo periodo sulla riduzione delle emissioni dei gas a effetto serra* (long-term National Strategy on the reduction of greenhouse gas emissions) (MATTM et al., 2021); to do this, major redevelopment of existing buildings and a decrease in the use of private mobility will be required in the face of an increase in the use of public transport; it will also be essential to produce the necessary energy through the use of renewable sources and the development of a circular economy.

In the following diagrams it is possible to see the difference in the decarbonization scenario in 2050 of the Italian energy balance. In fact, the almost total absence of non-renewable sources is evident in the second model.

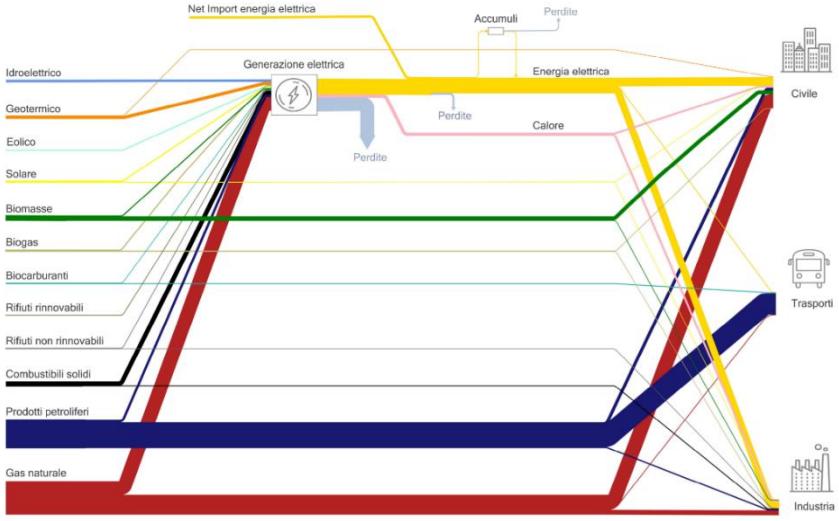



*Figure 11 - Italian energy balance 2018. Data source: Eurostat. Source:(MATTM et al., 2021)*

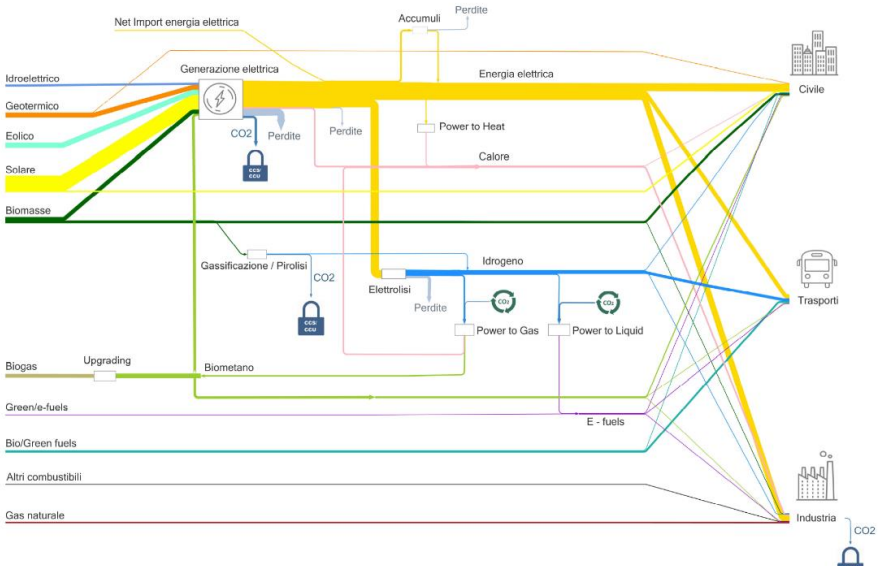



*Figure 12 - Italian energy balance 2050 - Decarbonization scenario. Data source: RSE. Source:(MATTM et al., 2021)*

There are therefore three sectors and macro-categories involved in the national decarbonization process:

- Reduction of energy needs deriving from private mobility and the civil sector
- Generalized use of renewable resources achievable through a mix of them connected to the electrification of plants previously fuelled with fossil fuels
- Use of $CO_2$ absorption systems thanks to the form of capture and storage.

In addition, in August 2021 the *Proposta di Piano per la transizione ecologica* (Proposed Plan for the ecological transition) (Senato della Repubblica, 2021) that Italy has envisaged to meet the objectives set by the European Union through the approval of the Green Deal was presented to the Senate of the Republic; with this plan, and therefore with the decrease and zeroing of greenhouse gas emissions into the atmosphere, we want to try to achieve the goals set in 2015 with the Paris Agreement to limit the rise in global temperature. The Plan for the ecological transition provides for numerous measures to achieve zero emissions by 2050 including:

- Decarbonization
- Sustainable mobility
- Improvement of air quality
- The fight against land consumption and hydrogeological instability

- The restoration and strengthening of biodiversity
- The protection and development of the sea
- The promotion of the circular economy, the bioeconomy and sustainable agriculture.

The ecological transition to which Italy, as well as other countries of the world is called, can only be implemented if:

- A collective will to collaborate and to modify behaviour and actions will be achieved by all the actors involved, from individual citizens, to businesses, up to the public sphere;
- The innovation guaranteed by scientific research will be pursued together with the use of new technologies with less impact and more effective;
- The regulatory simplification will allow a lightening of bureaucratic processes, leaving room for real transformation works.

The ecological transition will be achievable only through a long-term strategy that guarantees an overall vision and in which the transformation of the development model represents a shared goal at all levels.

The *Piano di Transizione Ecologica* (Ecological Transition Plan) (PTE) (Senato della Repubblica, 2021) has been studied and structured in synergy with the *Piano Nazionale di Ripresa e Resilienza* (Consiglio dei Ministri and Italia domani, 2021) (National Recovery and Resilience Plan) and coordinates environmental policies to ensure Italy's transformation towards achieving the objectives set by the Agenda 2030 and the Green Deal European. It is precisely the PNRR that represents the beginning of the process towards the ecological transition. In fact, future generations, in addition to those already present, will suffer the greatest effects of excessive emissions of greenhouse gases into the atmosphere; these gases in fact remain in the air for a long time before disappearing.

Energy and climate, in general, are strongly interconnected: in fact more than 80% of GHGs emissions derive from the energy field. In recent decades, Europe has already completed a decrease in dependence on fossil fuels; thanks to the policies of abandoning these, however, the demand for electricity will drastically increase (Lombardi and Gruenig, 2016). The best solution to increase the energy mix on renewable sources to make a good percentage of total energy consumption.

### 2.3.1 Agenda 2030 in Italy with L56/2014

In implementation of the national and European decarbonisation policy and in order to determine a new development model that favours it, in almost all European cities the 5P model has been the most adopted; among the cities that have chosen to implement this model there are all the Italian metropolitan cities as Italy has adopted the Agenda 2030 and implemented it through the *Strategia Nazionale di Sviluppo Sostenibile* (National Sustainable Development Strategy), SNSvS, approved on 2 October 2017 which inherits the four cardinal principles: integration, universality, inclusion and transformation (Ministero dell'Ambiente, 2017).

In Italy, the *Strategia Nazionale di Sviluppo Sostenibile* 2017-2030 (National Sustainable Development Strategy), represents the main tool in order to create a new circular economic model, with low $CO_2$ emissions, resilient to climate and global changes.

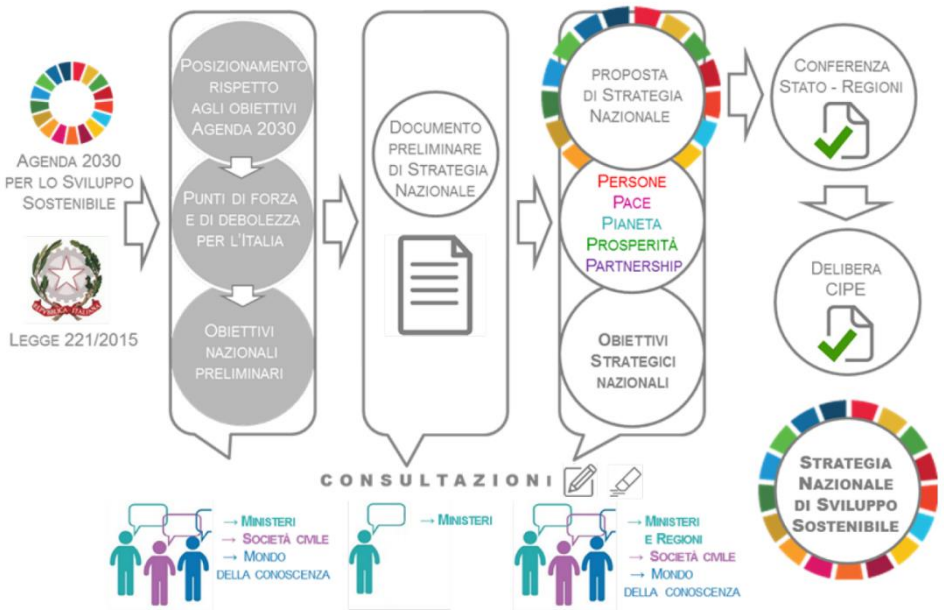



*Figure 13 - Outline of the definition of the National Sustainable Development Strategy. Source:(Ministero dell'Ambiente, 2017)*

On the model of the Agenda 2030, it is structured in five areas from which the acronym 5P derives and they are: People, Planet, Prosperity, Peace and Partnership.

The Sustainable Development Goals, included in the Agenda 2030, have been approved and have been set for the countries of the world, but they need to be territorialized in order to really witness what the Minister of Ecological Transition Roberto Cingolani defines as a "G-Local transformation, or a global reflection on a local scale".

It is in fact on a local scale that the Italian metropolitan cities, established with Law 56 of 2014, are implementing the major measures in the field of ecological transition.

The metropolitan cities, established in the reorganization of the provinces and local authorities, represent the protagonist; cities are in fact the cause and can be the solution to many of the problems associated with excessive emissions of greenhouse gases, responsible for the worst transformation of the last twenty years: climate change.

The implementation tool for the territorialisation of the SDGs is the *Piano Strategico Metropolitano* (Metropolitan Strategic Plan), PSM (MSP), which was approved by six of the ten Metropolitan cities established in 2014. In particular, by the Metropolitan City of Bologna, Florence, Genoa, Milan, Turin and Venice. The thesis will examine five of the six plans created and approved starting from 2016 following the adoption of the Agenda 2030 in Italy which also allowed the birth of ASviS, an acronym for the Alleanza Italiana per lo Sviluppo Sostenibile (Italian Alliance for Sustainable Development) in February 2016 and the approval in October 2017 of the *Strategia Nazionale per lo Sviluppo Sostenibile* (National Strategy for Sustainable Development), SNSvS, (Ministero dell'Ambiente, 2017) which applies and territorialises the 5P sustainable development model in Italy divided into five thematic areas (People, Planet, Prosperity, Peace and Partnership) already envisaged and developed globally by the UN Agenda 2030.

All metropolitan cities, with the aim of publishing and approving their *PSM* (MSP) and subsequent updates, start with a plan process, subsequently publish the guidelines or intermediate documents, structure and implement a participatory process, fundamental in the construction of a functional Metropolitan Strategic Plan suitable for the context inserted. These first *PS* (SPs) are followed by more recent updates.

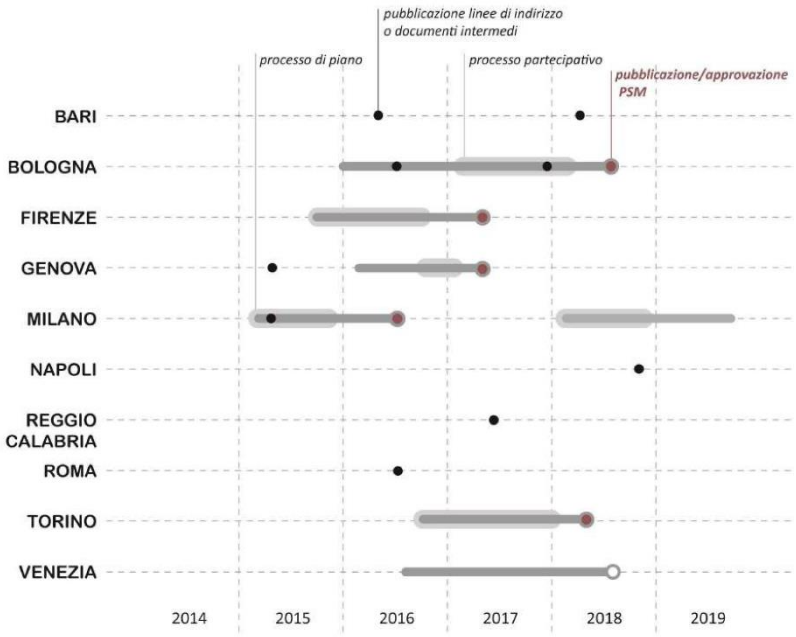



*Figure 14 - Chronology of the implementation of Metropolitan Strategic Plans in Italy. Source: (CM Milano, 2019)*

In general, however, some characteristics common to the Strategic Plans drawn up so far can be observed: they are structured with an initial context analysis, followed by a regulatory framework, followed by the plan process and the general vision expressed as "approach, orientations, vision, strategies" and then report the themes, strategies, objectives and actions and finally detail the operations and monitoring of the plan.

As far as the actors involved are concerned, they are varied as being a Metropolitan plan, all the municipalities that are administratively part of the new Ente Città Metropolitana (Metropolitan City Body) established by law 56 of 2014 are involved. A bottom-up approach is also fundamental for the realization of the PSM (MSP) with the involvement of the population through questionnaires, interviews, territorial tables, focus groups, metropolitan tables and open conferences.

The issues mainly addressed and on which the PSM is based are those present in the Agenda 2030 for Sustainable Development and in particular: work, development, innovation, social inclusion, welfare, communities, environment, natural resources and landscape, mobility and sustainable energy.

The *SNSvS* (National Sustainable Development Strategy) provides for the adoption of Agende Metropolitane (Metropolitan Agendas) for sustainable development; to date all of them have equipped themselves with the Strategic Plan but only the city of Bologna has already drawn up the *Agenda Metropolitana per lo Sviluppo Sostenibile* (Metropolitan Agenda for Sustainable Development).

In general, the tools for planning sustainability in Italy are (URBAN@IT, 2021):

- Agende Metropolitane (Metropolitan Agendas) for sustainable development that are drawn up thanks to funding from the Ministry of the Environment provided for in the SnSvS (National Strategy for Sustainable Development);
- The Piani Strategici Metropolitani (Metropolitan Strategic Plans) provided for by law 56 of 2014 (del Rio) and on a voluntary basis the strategic plans of the municipalities;
- All urban planning and sectoral planning tools dedicated to a specific area such as that of sustainable mobility of different types and integrated;
- The Agende Urbane (Urban Agendas) of the municipalities for the implementation of the regional operational plans of cohesion policy.

The Metropolitan Agendas take shape following the *Carta di Bologna per l'Ambiente* (Bologna Charter for the Environment), (CM BO et al., 2017) document signed by the Mayors of Metropolitan Cities in June 2017 which provides for the achievement of the objectives set out in the UN Agenda 2030 involving all dimensions of sustainability. The general objective is to integrate the different forms of sustainability, increase the level of involvement of civil society and promote pilot actions for sustainable development.

The topics on which the Metropolitan Mayors have drawn up this document, on the occasion of the G7 Environment are:

1. Sustainable use of land and solutions based on natural processes
2. Circular economy
3. Adaptation to climate change and risk reduction
4. Energy transition
5. Air quality
6. Water quality
7. Ecosystems, urban greenery and biodiversity protection
8. Sustainable mobility

### 2.3.2 Economic tools

Among the economic instruments to guarantee the ecological transition of Italian metropolitan cities, following the European Green Deal, the Next Generation Eu plan was introduced, which provides that each country, through the presentation of a strategic plan convincing, functional and enforceable, awards funds to be used for the realization of what is foreseen. The plan drawn up to obtain the European financing plan is the *Piano Nazionale di Ripresa e Resilienza* (National Recovery and Resilience Plan) approved by the European Commission on 13 July 2021.

#### 2.3.2.1 Next Generation EU and PNRR

NextGenerationEU is not just a plan for recovery, it is the plan put in place to achieve the objectives set by the European Green Deal. The goal is to create a greener, resilient and digital Europe (European Commission, n.d.).

NextGenerationEu is structured by three main topics:

- Green Transition
- Digital transformation and innovation
- Heath and fight to poverty

Over 50% of the amount will support modernization, for example through:

- research and innovation, implemented with the Horizon Europe program
- fair climate and digital transitions
- preparation, recovery and resilience

The package of actions towards this great opportunity will also finance:

- modernization of traditional policies, to maximize their contribution to the Union's priorities
- the fight against climate change for which will be used the 30% of the European founds
- the protection of biodiversity and gender equality

NextGenerationEU is the great opportunity for the Italian development of this decade, which evokes Italy in a collective and urgent effort. The tool to carry out this national effort is the National Recovery and Resilience Plan approved by each country to get a more sustainable and inclusive country, with a more advanced and dynamic economy. Also Italy approved its *Piano Nazionale di Ripresa e Resilienza* (PNRR) that has been proposed to the European Commission in order to be approved; it has been approved on 13 July 2021 (Consiglio dei Ministri and Italia domani, 2021).

The country's relaunch action outlined in the Plan is guided by policy objectives and interventions related to the three strategic axes shared at European level: digitization and innovation, ecological transition and social inclusion.

With the approval of the *Piano Nazionale di Ripresa e Resilienza*, (National Recovery and Resilience Plan) on July 2021, Italy becomes the protagonist of the European Green Deal.

The *Piano Nazionale di Ripresa e Resilienza* of Italy, PNRR, is divided into 6 Missions, which in turn group 16 Components that are functional to achieve the economic and social objectives defined in the Government's strategy.

The Components are divided into 48 Lines of intervention for homogeneous and coherent projects. The six Missions of the PNRR represent structural "thematic" areas of intervention that are:

1. Digitization, innovation, competitiveness and culture;
2. Green revolution and ecological transition;
3. Infrastructures for sustainable mobility;
4. Education and research;
5. Inclusion and cohesion;
6. Health.

Mission number 1 is made up of three components and aims to modernize the country by putting into practice the digital revolution in public administration but also in justice and in the industrial sector. Tourism and culture, driving forces of the Italian system, also need to be modernized.

Mission 2, strongly linked to the theme of this thesis, is instead structured in four components and aims to see the ecological transition realized in line with the objectives of the European Green Deal. The four components of the mission are:

- Circular economy and sustainable agriculture
- Renewable energy, hydrogen, grid and sustainable mobility
- Energy efficiency and building renovation
- Protection of the territory and of the water resource.

Mission 3, which is also connected to the thesis, is divided into 2 components and aims at the creation of a modern, digital and sustainable infrastructure system, which therefore guarantees zero emissions of climate-changing gases. Mission 3 consists of:

- Investments in the railway network
- Intermodality and integrated logistics

Mission 4 is made up of two components and focuses on future generations. Indeed, it aims to revive growth, social inclusion and productivity in line with major environmental challenges, such as climate change.

Mission 5 is made up of three components and mainly concerns social issues of great importance such as the fight against gender discrimination and the improvement of the quality of work, especially for women.

Finally, Mission 6 is composed of two components and has the objective of improving the health care system in the area so that the pressure on the hospitals decreases but is instead spread over all the health centres of the territory and to modernize the technological equipment and diagnostics of the National Health System.

# CHAPTER 3: CASE STUDIES SELECTION

In this chapter, the research process focuses on determining the case studies and the plan of each case study that will be analysed. The research process implemented is shown in the diagram below (Figure 15).

In this phase of the research, it was decided to determine the case studies that would have been the subject of analysis through a screening operation in order to select those that have a decisive value in the ecological transition. Paragraph 3.1 will describe the method for identifying the case studies and the plans to be analysed, while the results of the two steps will be reported in paragraph 3.2.

## 3.1 Methodological Framework

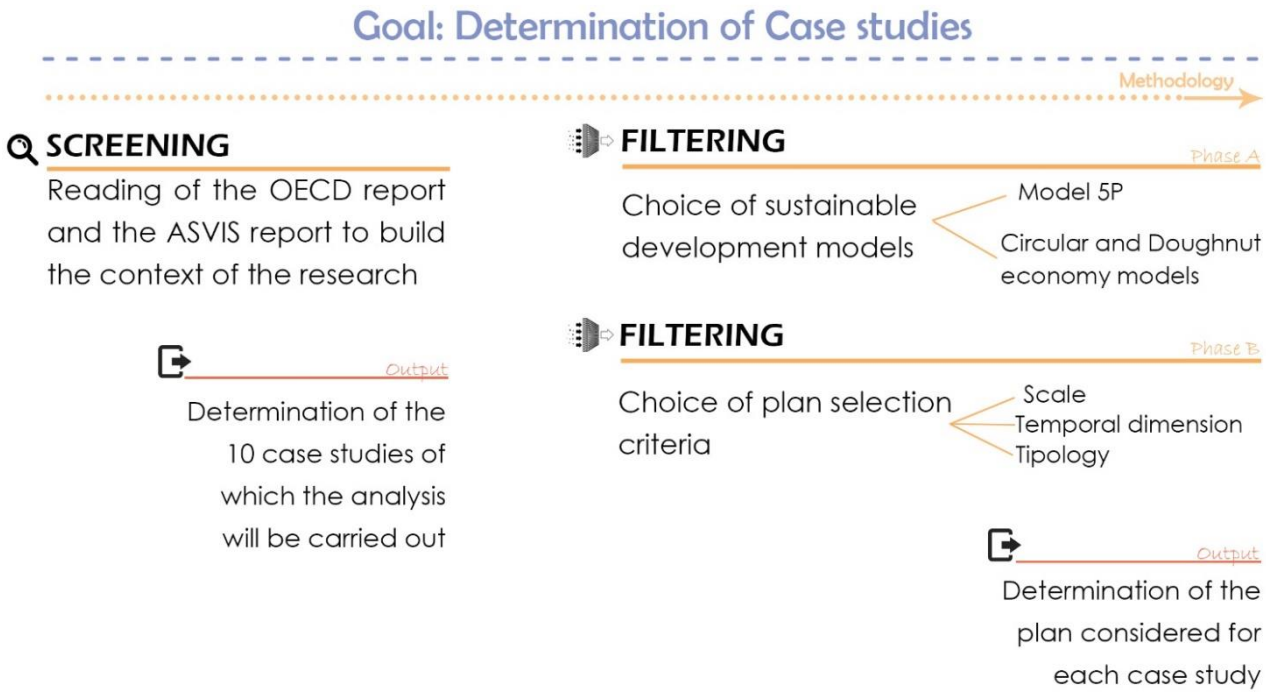



*Figure 15 - Case study selection process. Source: Author, 2021*

The research process that led to the realization of this thesis took shape from an initial screening process that resulted in the reading of some documents whose focus is the sustainable development goals and in particular the importance of their territorialization in Italian and European cities to see the ecological transition materialized. It is in the city, responsible for a large part of greenhouse gas emissions, where it can be mostly reached and realized.

From some documents and from the Webinar organized by the Metropolitan City of Milan on 10 and 17 March 2021 in which five metropolitan cities took part to present their actions and initiatives towards the approval of the Metropolitan Agenda, provided for by the SNSvS (National Sustainable Development Strategy) with which Italy has implemented the Agenda 2030, the case studies have been identified.

The five European case studies, on the other hand, were chosen because they are carriers of innovative strategies and in many cases more advanced than the Italian case studies.

Here is where the filtering process took shape. From the reading of the aforementioned material, it was possible to identify the new models of sustainable development put in place by European cities and towards which Italian cities are moving. They are the 5P model which is the one promoted by the Agenda 2030, the Circular economy model and the Doughnut economy model.

At this point it was necessary within the filtering process to define three criteria with which to select which plans to analyse for each case study for the purpose of identifying the enabling factors for the ecological transition and the selection of good practices that can be implemented in Turin.

### 3.1.1 Screening

The first step of this research was a process of **SCREENING** of the literature on the ecological transition, the territorialization of sustainable development goals and in general of the major documents with information on the topic under analysis.

In particular, the Italian case studies were identified thanks to the webinar organized by the Metropolitan City of Milan on the dates of 10 and 17 March 2021 in which representatives of ASviS Italy and five Italian metropolitan cities took part. The theme of the webinar was in fact strongly correlated with that of this thesis as it dealt with the theme "Towards the Metropolitan Agenda for Sustainable Development", a document, as already mentioned in the theoretical background, of fundamental importance for Italian metropolitan cities as it allows them to territorialize the SNSvS (National Sustainable Development Strategy) in implementation and adoption of the Agenda 2030.

The main documents that have allowed the identification of Italian and European case studies, as bearers of good practices towards the ecological transition and promoters of new models of sustainable development, are the ASviS report *I territori e gli obiettivi di sviluppo sostenibile* (Territories and sustainable development goals) (ASVIS Italia, 2020) published in December 2020 and the report of the OECD, the Organization for Economic Co-operation and Development, *A territorial approach to Sustainable development goals* (OECD, 2020a). The five metropolitan cities chosen have also recently approved, some in the last year, a new Metropolitan Strategic Plan or an update of this.

After determining the case studies on which the analysis will be focused to identify which are the determining factors for the ecological transition and which have been implemented in the different Italian and European territories, it is necessary to determine which plans will be analysed and compared for each of the case studies.

### 3.1.2 Filtering

To do this it was necessary to carry out a **FILTERING** process which is divided into two main phases.

Firstly, the sustainable development models that have been implemented, or are expected to be, have been identified by the various case studies examined; they are the 5P model, also promoted by the Agenda 2030, the Circular Economy model and the Doughnut Economy model. At this point it was necessary to determine three criteria that would allow identifying which plans to consider for each case study:

- CRITERION 1: the first criterion is that of the SCALE; in fact, only urban-scale plans were chosen, which therefore referred in detail to the case study in question. For the Italian metropolitan cities, the plans that had been drawn up by the metropolitan cities themselves were considered.
- CRITERION 2: the second criterion that allows filtering between all the plans drawn up by the individual case studies is that of TEMPORAL DIMENSION; in fact, only the plans drawn up after the adoption of the Agenda 2030 for Sustainable Development in 2015 were considered.
- CRITERION 3: the third criterion, finally, takes into account the TIPOLOGY of each plan; in fact, only integrated plans were considered, excluding strictly sectoral ones. In fact, the integrated plans make it possible to have an overall overview of the mitigation measures for greenhouse gas emissions and the measures implemented towards the ecological transition.

In general it is necessary to make a clarification; among the case studies chosen as carriers of more or less advanced or innovative policies towards ecological transition, the case of Copenhagen, the capital of Denmark, stands out, as unlike the others, the plan analysed was drawn up in 2012 on the basis of data and surveys in 2009, therefore prior to the adoption and approval of the Agenda 2030 in 2015. This proves to be in line with its objectives; in fact Copenhagen is the only European city to have the goal of climate neutrality already set for 2025 and already in the process of being achieved unlike all the other case studies analysed that set the goal of neutrality in the 25 years later, that is in 2050 with a mid-term to 2030 but which in any case is much later than the Danish capital.

For each city, a plan was selected that reflected the chosen criteria starting from European case studies towards Italian case studies.

## 3.2 Results

### 3.2.1 Screening

The case studies chosen for the analysis carried out by this thesis are five Italian metropolitan cities and five European cities. In particular, for Italy, CM Turin, CM Milan, CM Genoa, CM Bologna and CM Venice. For Europe, instead, the following were chosen: Amsterdam, capital of the Netherlands, Copenhagen, capital of Denmark, Bristol, city on the banks of the Avon River in south-west England, Paris, capital of France and the Basque Country, autonomous community of Spain which include within them three Spanish provinces whose capitals are the cities of Vitoria-Gasteiz, Bilbao and San Sebastian. In order to contextualise and better understand the processes in place in each of the case studies, the territorial context must be described. A brief table summarizes them (Table 2) and they are detailed in the following paragraphs.

| CITY | COUNTRY | TERRITORY | DYNAMIC OF POPULATION |
|---|---|---|---|
| AMSTERDAM | NETHERLANDS | Low level of altitude, 2m below the sea; connected by the sea | 2 million of inhabitants considering also the metropolitan city |
| COPENHAGEN | DENMARK | Flat area; located on two islands | Just over half a million of inhabitants, 1 million considering metropolitan area |
| PARIS | FRANCE | Flat crossed by the seine | Positive trend form 2000; 10 million of inhabitants if we consider the metropolitan region |
| BRISTOL | UK | Flat on the banks of river Avon | Less than half a million, 1 million if we consider the metropolitan area |
| BASQUE COUNTRY | SPAIN | Mountain with Highlands | 2 million of inhabitants; composed by Bilbao, Vitoria Gasteiz and San Sebastian |
| TURIN | ITALY | Mountainous in a good percentage | Decrease in city - increase in metropolitan area; more than 2 million of inhabitants |
| MILAN | ITALY | Flat inside the plain of the Po river | Growth; more than 3 million of inhabitants in the mc |
| GENOA | ITALY | Bounded by alps and Apennine mountains | Strong growth which brought to the conurbation of the entire coast |
| BOLOGNA | ITALY | Flat in heart of Pianura Panada; strategic position | Positive trend just over one million inhabitants |
| VENICE | ITALY | Low level of the altitude; uniqueness; connected by the sea | Decline in residents; less than 1 million in the mc |

*Table 2 - Territorial and Geographical context of the case studies. Source: Author 2021*

## Amsterdam: Geographical and economic context

Amsterdam is the capital of the Netherlands and developed in North Holland; has a population, also considering the metropolitan area, of about two million inhabitants and it too has the particularity of rising at a very low altitude, two meters below the sea level, which forces the regulation of flows of floods through state-of-the-art dam systems.

This uniqueness, however, makes the system very fragile and therefore further ignites attention to the consequences of climate change and therefore to greater attention to economic development models.

Amsterdam has several transport systems despite the complex articulation of the territory: it has in fact five subway lines, buses, ferries and water buses that allow connections with all parts of the city. Furthermore, the city has always been very attentive to ecological policies and has developed an unparalleled system of cycle paths and services and infrastructures connected to them.

Its port is also of considerable importance, fundamental for commercial traffic in northern Europe.


*Figure 16 - Localization of Amsterdam in the Netherlands. Source: https://www.viaggiatori.net/turismoestero/Olanda/mappa/*

## Copenhagen: Geographical and economic context

Copenhagen is the most populous Danish city with just over half a million inhabitants and is the capital of Denmark. It is located on two islands and the Oresund Strait separates the city from Malmo, another Danish city. The metropolitan area located around Copenhagen makes it reach almost a total of one million inhabitants. It is among the cities with the highest quality of life in Europe and is located on a predominantly flat area in northern Europe. Although the whole of Denmark is made up purely of islands, public transport is widely developed and of excellent quality. The cycle paths are also widely developed as are all the services and infrastructures useful for them.

In general, Denmark has a low unemployment rate and is almost self-sufficient from an energy point of view as it has been focusing on the exploitation of renewable energies for years.


*Figure 17 - Localization of Copenhagen in Europe. Source: https://copenaghen.it/dove-si-trova-copenaghen*

## Paris: Geographical and economic context

Paris, the capital of France, is located in the northern part of the country on the banks of the River Seine and, with over two million inhabitants, it is the fourth most populous city in Europe. Historically, a city that has led to social, cultural and economic development, also thanks to its strategic position.

The territory on which the city of Paris develops is purely flat and crossed by the river Seine. The city underwent a demographic decline during the twentieth century which then stopped until it returned to assume a positive trend at the beginning of 2000.

If we consider the entire metropolitan area of Paris, it is made up of 412 municipalities with a total of about 10 million inhabitants. It is also the engine city of the French economy and also plays an important role in relation to the European economies. This important economic development has inevitably also increased the impact of the city of Paris on the planet's resources; already in 2004 Paris began to evaluate the impacts of its activities in terms of greenhouse gas emissions, with the public facilities sector leading the way. Since then it has approved policies to mitigate and reduce greenhouse gas emissions with the aim of achieving climate neutrality by 2050.


*Figure 18 - Paris in the European context. Source: https://www.alamy.it/foto-immagine-parigi-francia-corsica-mappa-atlas-mappa-del-mondo-politico-acqua-nord-147038263.html*

## Bristol: Geographical and economic context

Bristol, a city and county of south-western England, is a smaller inhabited centre than the cities so far chosen with a resident population of less than half a million. If, on the other hand, we consider the entire urban area surrounding the city, it reaches about one and a half million inhabitants; it is in fact the sixth most populous city in England while the eighth if we consider the whole of the United Kingdom. It is located west of London, the capital of England.

The city of Bristol is located on a predominantly flat area and on the banks of the River Avon. It is one of the main cardboard production centres. In this context too, Bristol intends to develop emission reduction strategies and to achieve climate neutrality by 2030.


*Figure 19 - Bristol in southern England. Source: https://www.britannica.com/place/Bristol-England*

## Basque Country: Geographical and economic context

The Basque Country is an autonomous community of Spain with a total population of around two million. There are three main cities that compose them: Bilbao, which is the most populous, Vitoria Gasteiz which is the capital and San Sebastian.

Geographically, the autonomous community of the Basque Country is located in the north of Spain almost on the border with France. It is a very virtuous and cutting-edge community, so much so that it has very low unemployment rates. The community's economy is mainly based on agricultural production and on the metallurgical, textile and agri-food industries which are mainly concentrated in the Bilbao area.

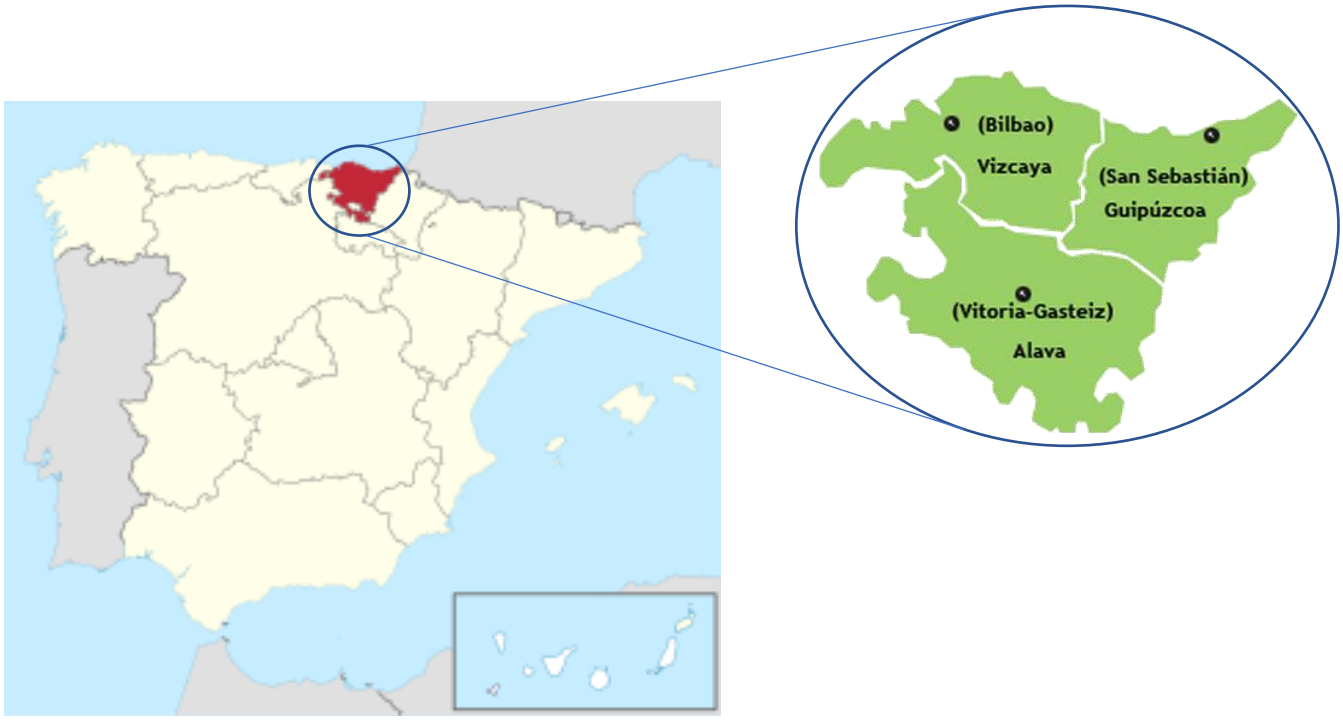



*Figure 20 - Basque Country in Northern Spain and detailed zoom. Source: Author, 2021*

## Metropolitan City of Turin: Geographical and economic context

Turin, the chief town of the Piedmont region in the north-west of the country, looks like a city in strong transformation; in fact the purely industrial nature that has allowed a strong economic development and a demographic increase in the last decades with strong immigration phenomena, is now subordinated to a tourist and university attraction. An important phenomenon that is affecting Turin is a slight but constant decline in the population residing in the city. In fact, a large number of the population has moved to the municipalities of the metropolitan city, an administrative entity established since 2014 which instead records stable percentages of the resident population. In general it is made up of 312 municipalities and has more than 2 million inhabitants overall.

In addition to the resident population, the city's employment capacity has also decreased in Turin, with high percentages of unemployed especially among young people. In general, therefore, making a comparison with other Italian metropolitan cities, the Metropolitan City of Turin presents itself as a complex system and in a strategic position as it is close to France, the Alps and is the only Metropolitan City to include a good percentage of mountainous territory. There are in fact mountainous areas in the Pinerolese area, in Val Susa and Val Sangone, in the Lanzo Valleys, in the Canavese and in the Eporediese.

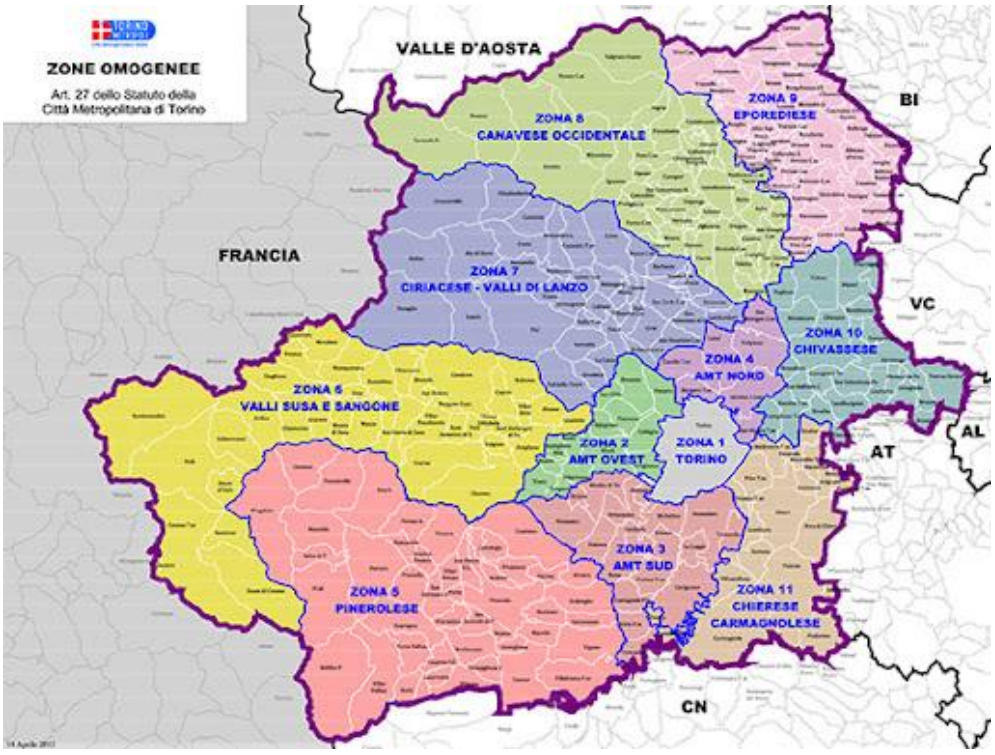



*Figure 21 - Metropolitan city of Turin and the areas that compose it. Source: http://www.cittametropolitan.torino.it/cms/urp/comuni-unioni-comuni*

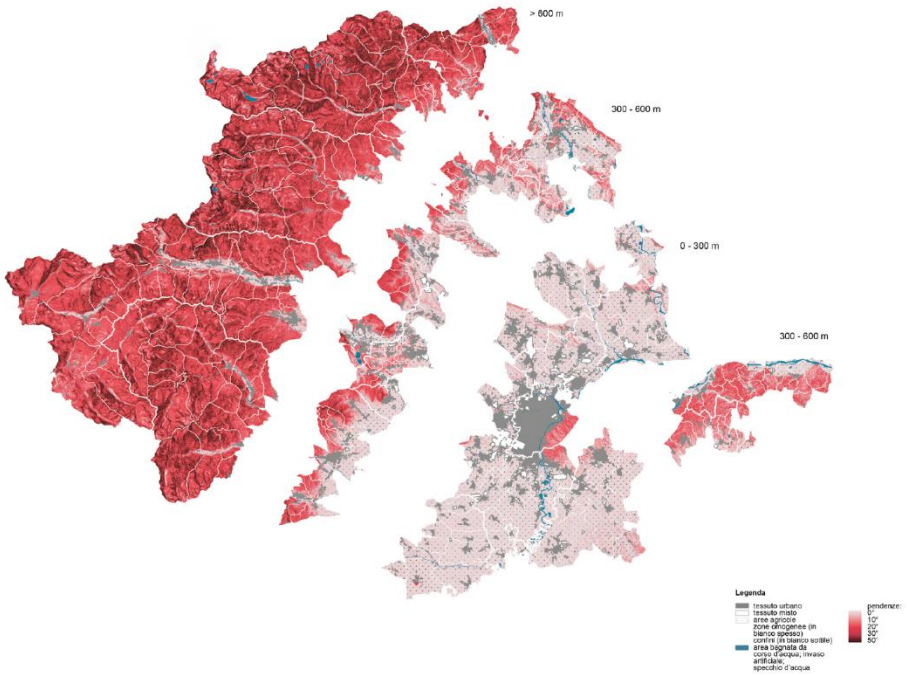



*Figure 22 - Geographical conditions of the Metropolitan city of Turin: subdivision by altitude bands. Source: (CM Torino, 2021)*

The territory of the metropolitan city of Turin is also crossed by important rivers such as the Po and the Dora, has the mountainous part mainly towards France, to the west and develops in the flat part, to the east, occupying part of the territory of the Po Valley.

## Metropolitan City of Milan: Geographical and economic context

Milan, the chief town of Lombardy, is the nerve centre of the Italian economy and innovation. Metropolitan city of Milan is a dynamic centre in close synergy with other European and world realities. It is located in a strategic position and within the Po Valley. It proves to be in full development both from the point of view of the growing population, employment activity, tourism production and the students who choose Milanese universities each year for their training. An important showcase for the business and European world was the 2015 Universal Exhibition hosted by the Metropolitan City of Milan and the 2026 Winter Olympics assigned to Milan and Cortina d'Ampezzo will be. Unfortunately, despite a strong growth in the context, there are still strong social and economic inequalities and high rates of unemployment among young people.

It is therefore essential to implement a participatory approach in the construction of processes of economic and social development and transformation of the system by implementing a bottom-up approach.

The metropolitan city of Milan is made up of 133 municipalities and is mainly developed in the plains; it is divided between the Ticino River and the Adda River and is crossed by a canal of Navigli. It is the third most populated area in Europe with more than 3 million inhabitants and is rich in infrastructure; this allows it to be an important hub for the economic growth of the whole country.


*Figure 23 - Metropolitan City of Milan: Geographical and economic context. Source: https://www.cittametropolitana.mi.it/portale/territorio/zone_omogenee/*

## Metropolitan City of Genoa: Geographical and economic context

Genoa is the chief town of Liguria and it, with its metropolitan city, determined by the Delrio law in 2014, includes a varied portion of the territory, though very small. The Metropolitan City of Genoa has also undergone a strong demographic and building growth that has led to the linear conurbation of the entire coast, west and east of Genoa. This has made an already highly varied and vulnerable territory increasingly fragile. Historically, the difficult geographical position, given the narrow flat strip that has allowed the development of industrial and productive activity and the proximity to other large realities such as the French, Piedmontese and in general the Po Valley has always weighed as a disadvantage for the Ligurian territory.

The flat areas of the Ligurian coast are also crossed by water courses, which due to the uncontrolled urbanization of the neighbouring areas represent a continuous danger as they are subject to frequent flooding. The metropolitan city of Genoa and Liguria in general is bounded by the mountain system of the Alps to the west, which are characterized by high reliefs and the Apennine Mountain range to the east. It is made up of 67 municipalities, 17 of which are coastal.

The metropolitan city of Genoa is in fact characterized by mountainous territory for 69.5% of the total with mountain ranges that directly overlook the sea. Also not to be underestimated is the presence of the port of Genoa, one of the major ports of the peninsula. The mobility system within this area develops mainly along the coast, in the flat portion and has points of important connection with neighbouring regions, both by rail and by road.

Genoa is therefore a very complex and vulnerable territorial system that needs constant protection.

The population, unlike other metropolitan cities, has increased and is mainly concentrated in the area of Genoa; the number of companies also increased slightly with the number of employees higher in percentage terms than that of other Italian metropolitan cities.

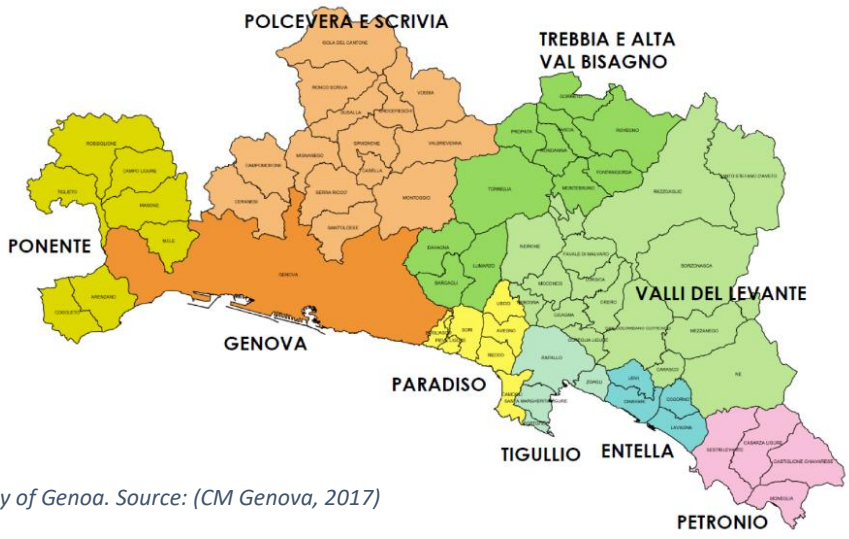



*Figure 24 - Metropolitan city of Genoa. Source: (CM Genova, 2017)*

## Metropolitan City of Bologna: Geographical and economic context

Bologna is the chief town of the Emilia-Romagna Region; located in the beating heart of the Italian peninsula, it represents a nerve centre in the infrastructural, economic and social system.

The territory of the Metropolitan City of Bologna includes 55 municipalities divided into 7 Unions of municipalities and there is a total population of just over one million people which has registered a positive trend in recent years, contrary to what has instead happened in the region. In general, the metropolitan city is home to many of the main Italian companies, especially in the food sector. This is thanks to the strategic position of the area, the hub of the motorway network and rail transport of the country. In fact, there are four motorways that cross the territory of the metropolitan city.

The territory in which the metropolitan city of Bologna develops is mainly flat and is crossed by several rivers, the main one of which is the Reno.

The Metropolitan City of Bologna is the only one in Italy to have drawn up the metropolitan Urban Agenda in addition to its strategic plan.

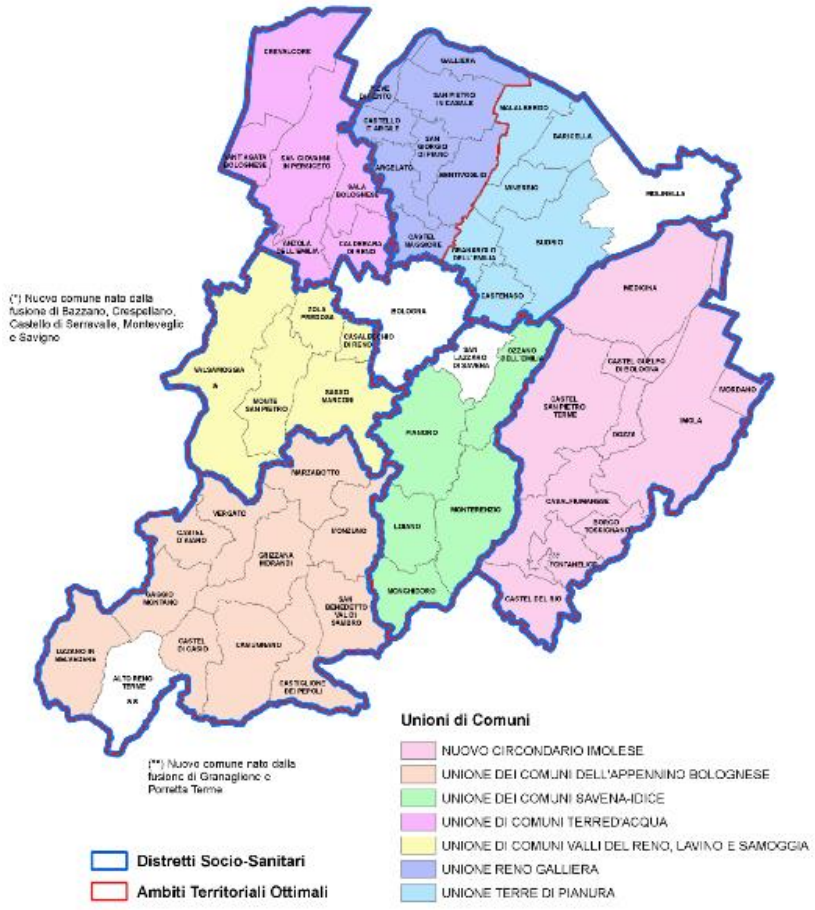



*Figure 25 - Metropolitan City of Bologna. Source: (CM Bologna, 2018)*

## Metropolitan City of Venice: Geographical and economic context

Venice is the chief town of the Veneto region and its metropolitan city, established in 2014, includes 44 municipalities. Venice represents a territorial context that is unique in the world, a place where traffic congestion is caused by ferries and gondolas on the canals and not by busy streets with cars; in fact, it is defined as a city of water. The Metropolitan City of Venice is already historically placed, thanks to its port, at the centre of the main commercial and cultural exchanges; in fact, it has seen very different cultures meet and mix in its territory.

The metropolitan city records a slight decline among its residents but at the same time Venice is among the most visited cities in the world due to its uniqueness.

The conformation of a city of water means that even the infrastructures are governed by particular regulations and organizations. The Metropolitan City of Venice is spread over an area of 120km in length, mainly flat and homogeneous from an infrastructural point of view.

The uniqueness of the territory also inevitably generates a widespread vulnerability to drastic and sudden changes. In fact, Venice is highly exposed, given the low altitude at which it is located, to frequent episodes of rising sea levels that generate the known phenomenon of high water. It is also among the cities most at risk due to the phenomenon of sea level rise due to the melting of glaciers caused by climate change.


*Figure 26 - Metropolitan city of Venice. Source: (CM Venezia, 2018*

The choice for this thesis was therefore to concentrate the analysis of the policies implemented towards the ecological transition in Europe and in particular in Eastern Europe and in central-northern Italy as all the case studies chosen are carriers of virtuous examples towards the ecological transition.

In the map below, Figure 27, it is possible to see a general overview of the case studies in order to have an overall view of the location of the research process implemented for this thesis.

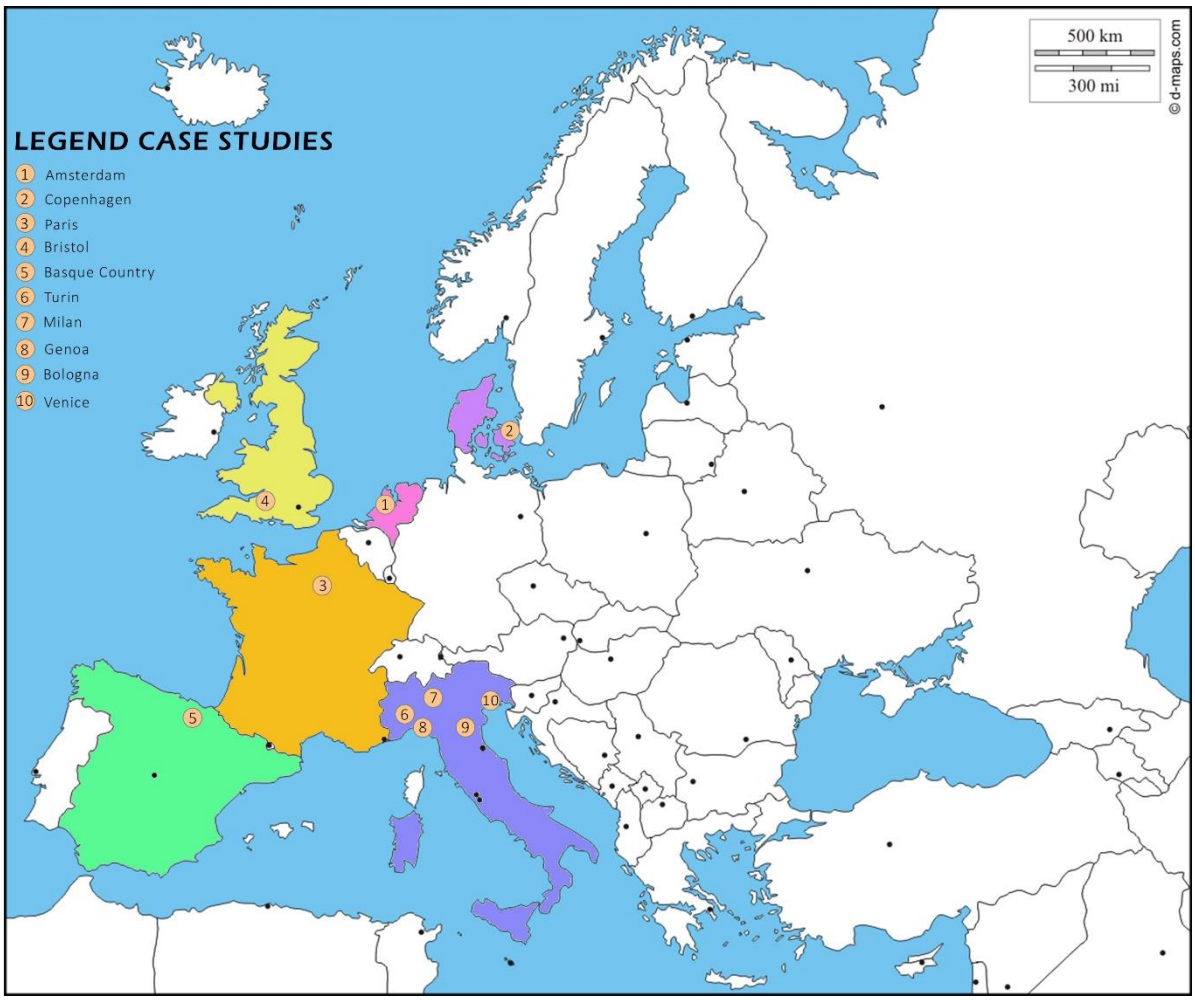



*Figure 27 - Overall case studies considered. Source: Author, 2021*

### 3.2.2 Filtering

Thanks to the chosen criteria it was possible to select the plan or plans, only in the cases of Amsterdam and Paris, which will be subjected to subsequent analysis to identify good practices towards the ecological transition and the achievement of climate neutrality by 2030, often classified as a mid-term, or year of monitoring, or by 2050, as in the case of the objectives of the Italian metropolitan cities and of Italy in general.

As previously indicated, it is only the Copenhagen plan that does not respect the time criterion imposed; the city is one of the most avant-garde in terms of sustainability policies and is at the top of the rankings for the quality of life it offers, so this may explain why a plan was approved in 2012 that has as the goal is to eliminate the city's greenhouse gas emissions by 2025.

The table below, Table 3, starting from the European case studies, shows the plans that will be analysed for the determination of good practices towards the ecological transition.

| CITY | COUNTRY | MODEL | PLAN CONSIDERED | SCALE | APPROVAL DATE | TIPOLOGY |
|---|---|---|---|---|---|---|
| AMSTERDAM | NETHERLANDS | 5P+CIRCULAR | NEW AMSTERDAM Climate Neutral RoadMap 2050 & Amsterdam Circular Strategy 2020-25 Strategy | URBAN | 01/02/2020 | INTEGRATED |
| COPENHAGEN | DENMARK | COPENHAGEN CARBON NEUTRAL BY 2025 | CPH 2025 - CLIMATE PLAN | URBAN | 01/09/2012 | INTEGRATED |
| PARIS | FRANCE | 5P+CIRCULAR | PARIS CLIMATE ACTION PLAN & CIRCULAR ECONOMY PLAN 2017-2020 | URBAN | 01/05/2018 & 01/07/2017 | INTEGRATED |
| BRISTOL | UK | 5P | ONE CITY PLAN 2021 | URBAN | from 2019_UPGRADE 2021 | INTEGRATED |
| BASQUE COUNTRY | SPAIN | 5P | BASQUE ENERGY STRATEGY 2030 | URBAN | 2016 | INTEGRATED |
| TURIN | ITALY | 5P | Piano Strategico 2021-23 Torino Metropoli Aumentata | CITTA' METROPOLITANA | 02/02/2021 | INTEGRATED |
| MILAN | ITALY | 5P | Piano Strategico triennale - Milano metropolitana al futuro | CITTA' METROPOLITANA | 01/09/2019 Upgrade i 2021 | INTEGRATED |
| GENOA | ITALY | 5P | Piano Strategico Metropolitano | CITTA' METROPOLITANA | 21/04/2017 [First draft] | INTEGRATED |
| VENICE | ITALY | 5P | Piano Strategico Metropolitano (PSM) - triennio 2019-2021 | CITTA' METROPOLITANA | 21/12/2018 | INTEGRATED |
| BOLOGNA | ITALY | 5P | Piano Strategico Metropolitano PSM 2.0 | CITTA' METROPOLITANA | 01/07/2018 | INTEGRATED |

*Table 3 - List of plans analysed by case study. Source: Author, 2021*

# CHAPTER 4: DEFINITION OF GOOD PRACTICES

In this chapter the process of selecting the good practices present in the analysed plans of each case study was conducted in order to determine those that can be implemented in the Metropolitan City of Turin.

The process used therefore made it possible to analyse the plans chosen for each case study and made it possible to identify the actions, strategies, actors and pilot projects that each city has already implemented or has planned to do.

## 4.1 Methodological framework

The research process was structured in four consecutive phases and ended with the implementation of a validation process to determine which good practices can be applied to the case study of the Metropolitan City of Turin. The entire structure of the process can be seen in the diagram below (Figure 28).

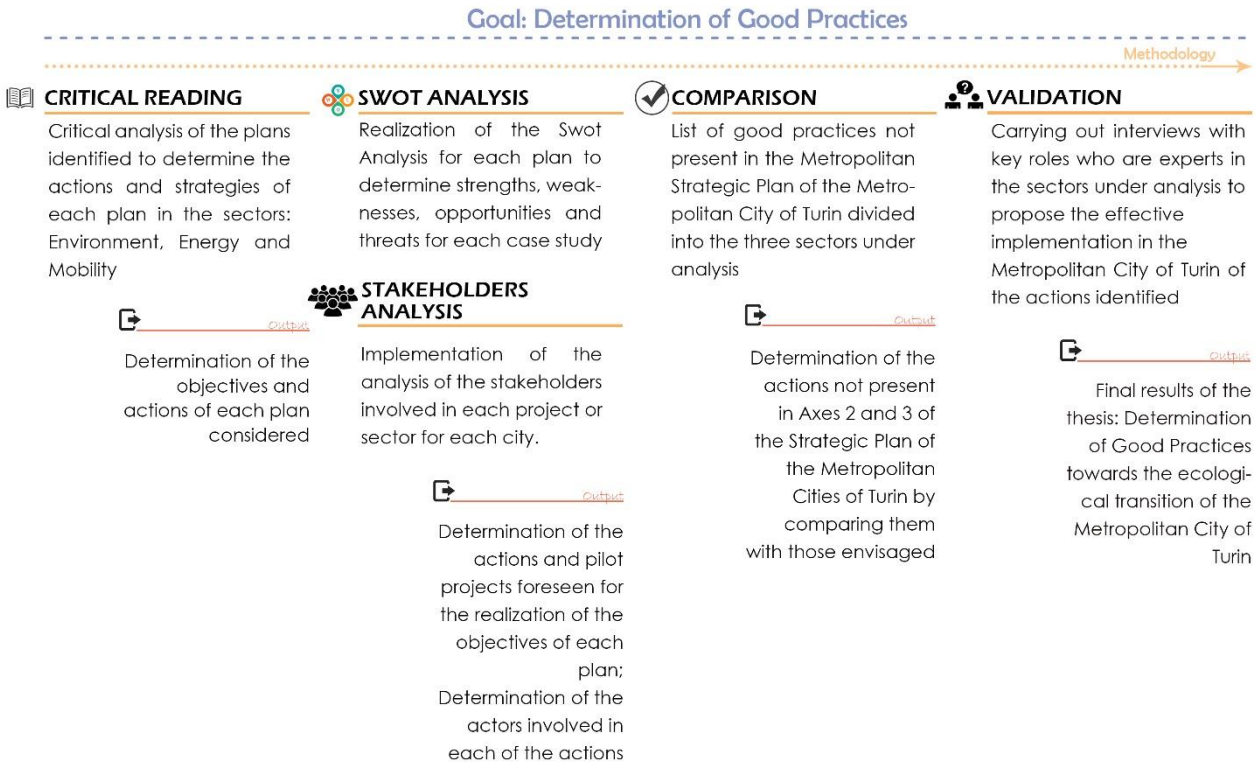



*Figure 28 - Steps followed for the determination of good practices. Source: Author, 2021*

Thanks to these three criteria already mentioned, the plans were then selected and subsequently read critically to identify the driving elements of the ecological transition and the good practices that are reported in them.

For each of the plans of each case study, an evaluation matrix was therefore created that takes into account the general objectives of the plan, the actions envisaged and the good practices already implemented or in progress as well as the sustainable development objectives related to each action or good practice.

It is necessary to underline that another filtering process has taken place here as only the best practices, strategies and actions relating to the sector of reducing greenhouse gas emissions, in particular $CO_2$, have been analysed and considered.

Subsequently, a Swot analysis was carried out of the plans taken into consideration as an effective tool to formulate guidelines for the ecological transition for cities and in particular applicable to the city of Turin. Furthermore, a Stakeholders analysis was carried out to identify which actors are involved and those to be involved.

At this point it is possible to identify good practices that can be replicated in the different territorial realities that have been taken from the other case studies and to determine those that are not present in the Metropolitan Strategic Plan of Turin to propose their implementation thanks to a comparative analysis; in order to validate these results to determine which actions could really be applied, interviews were carried out with representatives of the macro-sectors to which the identified actions belong. In particular, the analysis was divided into three sectors which are: Environment, Energy and Mobility.

The interview was then carried out with a representative for each sector and finally with a representative of territorial planning in Turin to see the real impacts or limitations present.

After the validation it was therefore possible to formulate guidelines and good practices for the ecological transition for the city of Turin and to determine which are the enabling factors and the main measures, taken by the other territorial realities, applicable to make the research process clear and understandable; it is therefore necessary to deepen and explain in detail all the steps that make up the methodological framework of this thesis.

### 4.1.1 Critical Reading

After determining which plans to take into consideration to determine the enabling factors for the ecological transition and the good practices envisaged or already implemented in the various case studies, we moved on to critical reading and comparative analysis of the plans.

It was therefore decided to carry out a further filtering process by analysing the strategies and actions relating to the energy, environment and mobility sectors for the implementation of the ecological transition according to sustainable development models. The social, cultural and economic sphere was therefore not taken into account in detail.

The objectives, actions, strategies, actors involved and the link with the Sustainable Development Goals were analysed for each plan. In some cases, it was also possible to determine some pilot actions, reported in them, which can be replicable practices in other case studies.

The critical analysis was carried out in two main phases: in the first phase, the plans that have been drawn up in order to achieve climate neutrality following the 5P model envisaged by the Agenda 2030 were considered; in the second phase of the analysis, the plans drawn up on the basis of the Circular Economy model were compared and analysed. The second phase is not present for all case studies, unlike the first for which all case studies have drawn up a plan.

This analysis process started from the European plans and went towards Italian case studies through a narrow-down process and thanks to their comparison, the actions or strategic lines envisaged by each plan and those included in the Metropolitan Strategic Plan of Turin were identified, identifying those already present and those that could be implemented.

### 4.1.2 Swot Analysis

In order to define a clearer and more detailed picture of the measures envisaged by each of the plans examined in the previous analysis step taking into account also the existing context for each case study, the SWOT analysis of all the plans examined was carried out in order to determine the strengths, weaknesses, the opportunities and threats for each case study. The plans for which these analyses have been carried out are those that have been drawn up according to the 5P model which therefore concern all the case studies.

To carry out the Swot analysis of each plan, the strengths that are the peculiarities of each case study based also on its geographical position, the weaknesses relating to the field of $CO_2$ emissions, the opportunities that are all the actions envisaged by each plan to obtain a reduction in emissions was identified and entered in the Swot matrix. Finally, the risks were identified, that are problems at which the city would be exposed to without a reduction in emissions or which threats the case study already records at the stage of drafting the plan.

### 4.1.3 Stakeholders Analysis

Following the critical analysis of the plans which took into consideration strategic lines, actions, objectives and also partially highlighted the actors involved, with the analysis of the stakeholders, the thesis wanted to deepen the actors involved and establish their degree of interest and power in individual actions or sectors of intervention. The stakeholder analysis was conducted for each case study, including in the power-interest diagram all the pilot projects or sectors in which the main actions to achieve climate neutrality are envisaged. It was conducted to determine which key actors are involved in the pilot projects or in the different sectors where the achievement of climate neutrality is expected.

The analysis sees for each action or sector of intervention the identification of the actors involved, each identified with a colour; the actor was then shown in the colour corresponding to the project in which he is involved in the power-interest diagram.

### 4.1.4 Validation

Thanks to a comparative analysis, the good practices not present and not foreseen in the Metropolitan Strategic Plan of Turin were identified, and, thanks to some interviews with key roles who are experts in the sector, carried out in person or with the help of online communication platforms, the best practices concretely feasible in Turin and the main methods of implementation have been defined.

A short interview was given to the actors, who work for the city of Turin in different entities, in which, once the results to which the thesis had led had been exposed, their effective applicability was examined, with what benefits, risks or what other solutions, perhaps not present in the analysed plans, could be effective for the Metropolitan City of Turin.

## 4.2 Results

The results of the research process are divided into two paragraphs: the first, 4.2.1, reports the analysis of the existing plans made through the tools mentioned above, the second, the 4.2.2, includes the possible implementations in the Metropolitan City of Turin.

### 4.2.1 Analysis of Existing Plans

Phase 1: Analysis of the plans that follow the 5P model

**EUROPEAN CASE STUDIES: AMSTERDAM**

***New Amsterdam Climate – Roadmap Amsterdam Climate Neutral 2050***

Amsterdam, the capital of the Netherlands, is among the territories most exposed to the effects caused by climate change as it develops almost completely below sea level which, given the ever-increasing levels of global warming, would cause heavy flooding on the town; the average sea level has in fact already increased by 85 cm in the last century. In addition, the city would be subject to more intense rains and an increase in average temperatures, already up by 1.6°C since 1950, which causes stress and sleep disturbances in the population (City of Amsterdam, 2020a).

In this way, moreover, with the increase in the average temperature, the demand for energy would also increase, thus increasing the emissions of greenhouse gases into the atmosphere, if it is not produced from renewable sources.

The *New Amsterdam Climate - Roadmap Climate Neutral 2050* plan shows the city paradigm that the administration hopes and wants to achieve by 2050: "Amsterdam is a fantastic city in which to live and work, and we want it to remain so. A healthy, thriving, green and future-proof city for all. We want Amsterdam to be a climate-neutral city with a circular economy, where energy is used efficiently and generated sustainably, and where raw and other materials are reused in a never-ending cycle. We also want Amsterdam to be a city that can cope effectively with the effects of climate change, such as flooding, increasing periods of drought and heat, and changing biodiversity. We have to change, so that everything we consider so important can remain the same" (City of Amsterdam, 2020a).

The city of Amsterdam wants to reduce its $CO_2$ emissions by 55% by 2030 and by 95% by 2050. The overall goal is to eliminate the use of natural gas by 2040 and reduce all emissions from the sector of transport by 2030.

Amsterdam is the first of the European cities to have developed the circular economy model in order to encourage reuse and reduce the amount of energy needed for production and

disposal. The city's goal is therefore to halve the amount of waste produced by 2030 and to become fully circular by 2050. Furthermore, Amsterdam shared the Doughnut economy model, theorized by Kate Raworth, which predicts that a city will be more be sustainable only if the social objectives are achieved without going beyond the natural limits of the planet.

The emissions of the Dutch capital derive from four sectors mainly, and it is for these that new measures are planned to reduce the amount of $CO_2$ emitted:

- Built environment
- Mobility
- Electricity
- Harbour and Industry

## Built Environment

Analysing the policies envisaged for achieving climate neutrality by 2050, for the built environment sector, the city of Amsterdam plans to disconnect all homes, district by district, from the heating network and propose an alternative solution to each area to guarantee the heating of buildings such as the production of heat from renewable sources, the production of heat from municipal waste or thermal energy systems from hydroelectric sources.

The goal of disconnecting all buildings from the heating network is a long operation and to be carried out gradually; this strategy involves the achievement of three main pillars, as reported in the New Amsterdam Climate (City of Amsterdam, 2020a):

- Scaling up the natural gas phase-out, district by district
- Developing sustainable sources for the heat distribution grid
- Building a city-wide heating infrastructure

Still in the built environment sector, the city of Amsterdam plans to decrease the amount of electricity and heat consumed by buildings. They, especially those for residential use, produce more than 50% of the total emissions of the sector due to the natural gas necessary for heating and to produce hot water.

Only by decreasing the amount of energy needed by buildings can it be possible to completely eliminate the use of natural gas for their heating. In fact, buildings powered by renewable resources have less impact on the climate as they require less energy and are also more comfortable and less expensive, as reported in the *New Amsterdam Climate Plan*.

The three pillars for achieving this goal are:

- Making housing energy-efficient
- Making the business market energy-efficient
- Making social and civic buildings energy-efficient

In the first case, to make homes more efficient, solar panels are installed on the roofs, as well as providing building owners with correct information about the benefits of using renewable sources to ensure the energy efficiency of buildings.

In addition to the housing sector, it is also necessary to reduce the consumption of electricity for offices, shops and professional or financial activities. To do this, the city of Amsterdam has provided supervisory bodies that verify that mitigation tools are adopted for greenhouse gas emissions thanks to the reduction of energy demand.

Buildings owned by the city also consume a lot of energy and need mitigation measures to reduce their needs and use renewable sources. It is planned to disconnect all public buildings from the natural gas network and to replace old lighting systems with LED lighting systems in sports facilities.

Finally, to ensure a constant low energy requirement of the buildings it is necessary that all the newly designed and constructed buildings are made with zero impact, also in order not to burden the already important and long transition of the other buildings.

In addition to the zero-impact guarantee of buildings once construction is completed, it is necessary that, in the future, even during construction works only low-emission materials that do not produce waste, as foreseen by the circular economy, are used.

The pillar for this action is: - Energy-neutral construction.

The actors involved in this strategic action are the city of Amsterdam, the local population, the companies that supply electricity and the owners of the individual buildings on which this action would be applied.

Mobility

Another sector from which most of the $CO_2$ emissions derive is the mobility sector; Amsterdam is a growing and expanding city and therefore the distances to be covered by road, rail or water also increase, inevitably causing an increase in greenhouse gas emissions. Emissions derive from the movement of people but also of goods; the goal of the city of Amsterdam is to move towards sustainable and non-polluting forms of transport.

In the city of Amsterdam, the amount of transport that takes place without the use of fossil fuels and therefore without the production of greenhouse gases is already proportionately high; in fact, there are many journeys that take place by bicycle, on foot or using electric

vehicles, even if the proportion of the total does not reach 5% (City of Amsterdam, 2020a). The means of transport on water, a characterizing element of the Dutch city, are already largely zero-emission.

The strategy envisaged for the reduction of greenhouse gas emissions into the atmosphere from the transport sector and mobility in general consists of two pillars, as reported by the *New Amsterdam Climate* (City of Amsterdam, 2020a):

- Limiting polluting traffic
- Greening all polluting vehicles and vessels

To reduce the traffic created using cars, for years Amsterdam has provided incentive measures and an increase in services and comfort for those who use the bicycle;

it is also planned to reduce the parking space for vehicles and at the same time the space is dedicated to facilities for pedestrians and cyclists.

Car sharing and car pooling measures are also designed to decrease the number of cars traveling every day.

On the other hand, to ensure green mobility and no greenhouse gas emissions, ships and vehicles are powered by electricity or hydrogen. The electricity used must also come from renewable sources. Among the measures implemented by the city of Amsterdam there is also "Clean Taxis" which requires taxis to produce zero emissions by 2025; the measures to allow this transformation are, for example, the inclusion of subsidies for electric taxis and the installation of a greater number of charging stations.

Electricity

Of fundamental importance in the energy transition process to ensure lower emissions of greenhouse gases is electricity also due to the desire to eliminate the use of natural gas in the city by replacing it with electricity that must be produced in a sustainable way without the use of fossil sources. One of the greatest possibilities for producing electricity from renewable sources is solar energy which, thanks to the installation of solar panels on the roofs of buildings, would ensure the sustainable production of electricity. The goal is to locally produce 30% of the total energy needs thanks to renewable sources such as the sun and wind, with the use of turbines. In fact, the city of Amsterdam expects that by 2040 all available roofs will be equipped with panels capable of producing electricity.

The pillars of this sector, to obtain the production of electricity from renewable sources are (City of Amsterdam, 2020a):

- Maximizing solar energy generation on roofs

- Optimizing use of potential wind energy
- Developing a future-proof electricity infrastructure

For the installation of a large area of solar panels it is necessary to guarantee support for the population through economic incentives and to emphasize the social value of the action as well as thinking and designing solar panels not only on private buildings but also along infrastructures or parking lots.

On the other hand, to guarantee the production of green energy thanks to wind turbines, it is necessary to locate the ideal place for their installation, for example by taking into account the minimum distance from the houses due to the noise generated, and to determine the actual possibility of realization also taking into account often present environmental or landscape limits.

Lastly, in order to avoid waste of electricity and in order to ensure its proper supply to all homes, it is necessary to make adjustments to the electrical infrastructure in order to avoid voltage peaks and malfunctions in the supply of electricity.

The main actors involved in the field of improving the supply of electricity so that it derives more from renewable sources are both the central government and the city of Amsterdam which can guarantee the improvement of the energy infrastructure; the owners of individual buildings are also involved as the surfaces on which the solar panels will be installed belong to private individuals and, moreover, the distributor and supplier of electricity plays a very important role, as well as research institutes seeking to develop cutting-edge energy saving methods.

### Harbour and Industry

The Port of Amsterdam plays a leading role in Northern Europe. It is in fact the seat of many of Amsterdam's production activities and is also a crucial logistic centre for the transport of goods. The activities of the port connected to the electricity needs are many; in fact it is not only used for production plants but also for the strategic position held by the port in the energy market. The goal of this sector, linked to production and the logistics sector, to reduce the amount of greenhouse gas emissions is to derive all the energy used from renewable sources.

The challenge regarding the harbour is in the *New Amsterdam Climate Roadmap 2050* where the role of the port of the future is described as follows: "The harbour area as a 'sustainable battery for the city, region and Europe' is a vision of the future harbour economy with few or zero carbon emissions and lots of space for generating, storing and distributing renewable energy to end-users on an industrial scale. The new harbour economy will deliver

renewable energy products and services, including sustainably-generated electricity, green hydrogen, sustainable fuels, energy storage capacity and switching capacity" (City of Amsterdam, 2020a). The transition path of the Port of Amsterdam and the industry sector is based on four fundamental principles, as reported in the New Amsterdam Climate Roadmap:

- Transforming the harbour into a sustainable battery
- Developing the green hydrogen economy
- Carbon capture, storage and utilization
- Saving energy in industry

For this sector, the main sources of $CO_2$ emissions are represented by the incineration of waste, the consumption of fossil fuels for navigation and fishing and the consumption of natural gas and heat used in industry. The goal of the energy transition in the port sector is to make it a "warehouse" of energy produced from renewable sources, including hydrogen, and at the same time reduce the amount of energy needed by 2050. The main actors involved in the transition of the port and the industrial sector of Amsterdam are: the city of Amsterdam itself which has a role of promoter and controller of green energy production measures, the Port of Amsterdam which with its infrastructures and thanks to its logistical role of goods and people is a major player in this transformation; the central government and the Province of Amsterdam are also involved in the transformation process.

Swot analysis was done for this plan (Table 4).

AMSTERDAM

PLAN: NEW AMSTERDAM CLIMATE - AMSTERDAM CLIMATE NEUTRAL ROADMAP 2050
YEAR OF ADOPTION: 02/2020

GOAL: REDUCE EMISSIONS BY 55 % by 2030 & 95% by 2050

**STRENGHTS**
- Phase out natural gas by 2040, and end all carbon emissions from transport by 2030
- Municipality will be a climate-neutral organization by 2030
- Achieve 100% circular economy by 2050
- Switch to 100% sustainably-generated energy

**WEAKNESSES**
- Total emissions: 5000 kton $CO_2e$
  - 25% Built environment
  - 18% Mobility
  - 39% Electricity
  - 18% Harbour & Industry

INTERNAL FACTORS

**OPPORTUNITIES**
- Built environment: Disconnect existing buildings from the natural gas grid and building energy-neutral new-build homes and offices, schools and hospitals
- Mobility: transition to a system in which people and goods can be transported without emitting $CO_2$
- Electricity: generating renewable electricity and building a reliable electricity infrastructure
- Harbour & Industry: transition to a sustainable industrial cluster that will supply Amsterdam and other regions with renewable energy.

**THREATS**
- Tragic effects of Climate Changes as rainfall more frequent, rise of average temperature and heat stress
- High level of $CO_2$ emissions

EXTERNAL FACTORS

*Table 4 - Swot Analysis of New Amsterdam Climate Plan. Source: Author, 2021*

To determine which actors were involved for each of the sectors most responsible for $CO_2$ emissions that distinguish the plan, a stakeholder analysis was carried out in which the actors were positioned in the power-interest diagram.

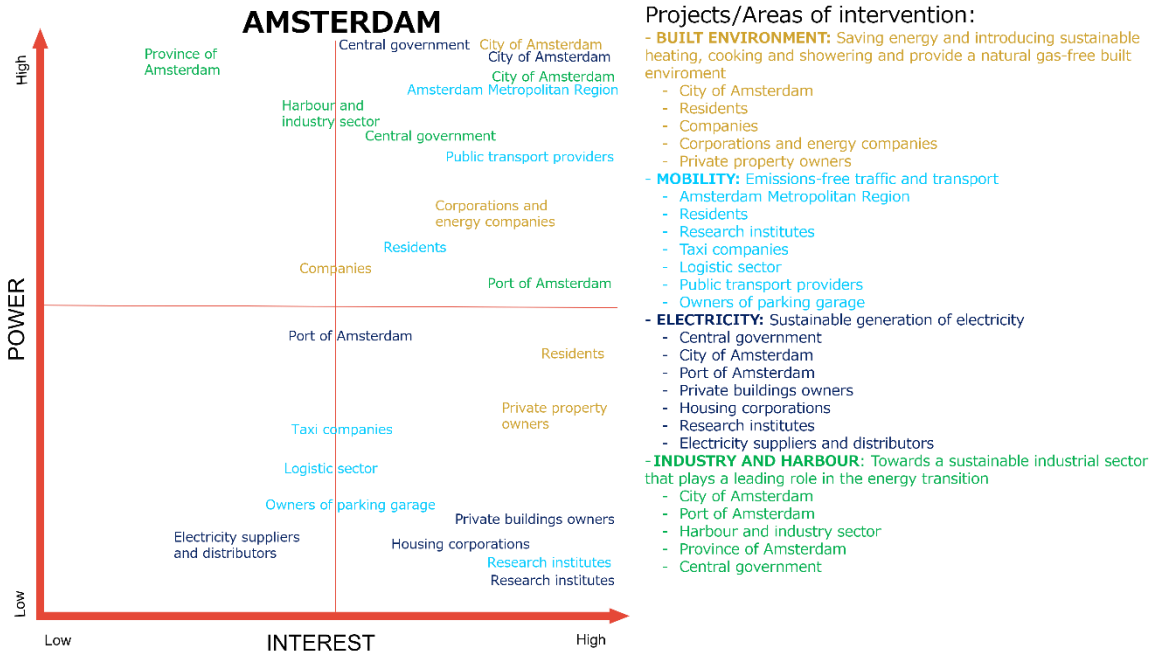



*Table 5 - Stakeholders Analysis of the New Amsterdam Climate Plan. Source: Author, 2021*

The European case studies highlight the predominant role of the administration of the city in question, as in the case of Amsterdam. The active participation of citizens as well as the owners of buildings or research institutes is of fundamental importance for the implementation of measures to reduce energy consumption and reduce greenhouse gas emissions. In both cases, the role of energy and service providers, such as that of public transport, is also important.

Summarising the main actions that the plan includes are reported in the table below (Table 6):

| | NEW AMSTERDAM CLIMATE | | | | |
|---|---|---|---|---|---|
| **Actions** | Energy Renovation project | Heat Decarbonisation | Green Hydrogen | Charging point | Zero emissions from taxis |

*Table 6 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## EUROPEAN CASE STUDIES: COPENHAGEN

### *CPH 2025 Climate Plan - Copenhagen Carbon Neutral by 2025*

As already pointed out above, the Danish case study does not reflect the temporal criterion set in the second step of this thesis, as the plan taken into consideration, *CPH 2025 Climate Plan* was drawn up in 2012 (City of Copenhagen, 2012). It does not explicitly put the 5P model into practice, as it was subsequently theorized by the Agenda 2030 with respect to the drafting of the plan under analysis.

The difference regarding the goal set for this plan should also be underlined: in fact, almost all the other case studies have the goal set at 2050 with the mid-term of 2030, while the Danish capital has a climate neutral goal of 2025. Copenhagen wants to become the first Carbon Neutral capital. This partly justifies the previous drafting of the plan which will lead to the reduction and zeroing of $CO_2$ emissions into the atmosphere.

The plan is the result of a great monitoring and collaborative effort, thanks to the participation of many stakeholders such as business communities, universities, political and economic organizations and citizens.

The Danish capital, to achieve climate neutrality, must generally reduce energy consumption and ensure that much or all of it is produced without the use of fossil fuels. The planned actions are divided into four main sectors:

- Energy consumption
- Energy production
- Green mobility
- City Administration initiatives

The sector that has the greatest influence on the possibility of reducing greenhouse gas emissions is that of energy production. This includes the production of green electricity through, that is, from renewable sources, without the use of fossil sources.

The mitigation actions, to achieve climate neutrality, refer to three successive time periods: 2013-2016; 2017-2020; 2021-2025.

#### Energy Consumption

In the field of energy consumption, the objectives of the city of Copenhagen are to guarantee a 20% reduction in heat consumption, a 20% reduction in electricity consumption by shops and services, a 10% reduction in the consumption of electricity in the household also thanks to the installation of solar panels on the roof of the buildings. To achieve these objectives, in particular to reduce energy consumption in the building sector, the improvement of

construction practice is foreseen for both new buildings and for existing buildings and the creation of good practices that can be used in the sector for different buildings.

In order to raise awareness of energy savings and efficiency, it is necessary to increase incentives for those who invest in energy improvement interventions in buildings and to carry out a complete information campaign on derived benefits. Among the tools to increase the production of energy from renewable sources, Copenhagen has provided for the installation of solar panels on the roofs of buildings thanks also to guidelines for their installation in different contexts. In addition, the installation of LED lamps for public lighting is planned, which guarantee lower electricity consumption but greater lighting comfort.

In general, Copenhagen aims to become a smart city which means at the same time guaranteeing lower energy consumption but also greater accessibility. Smart concerns both mobility and buildings and the production of innovative energy such as hydrogen.

## Energy Production

In the field of energy production, the main objectives to be achieved by 2025 for the city of Copenhagen are to make district heating not responsible for $CO_2$ emissions, to base the production of electricity no longer on fossil sources but on renewable energy such as the wind, in order to satisfy the energy needs of the city. In fact, it will also derive from biomass, geothermal energy and waste.

The production of energy from renewable sources is strongly influenced by the course of the climatic seasons; in fact, a variety of different sources are foreseen in order to guarantee the quantity of product needed throughout the year, which would allow the Danish city to be permanently disconnected from the heating network and to allow its production only through renewable sources.

Among the challenges put in place to achieve climate neutrality there is also the need to eliminate plastic from urban waste so that it can be used in energy production. Urban waste is in fact an important resource in this sector and as such must be managed; in fact, new plants will be built. The transition process is long and involves the construction of major works or infrastructures also by the Danish state. The city of Copenhagen plans to install wind turbines both inside the city edges and in other cities and on the coast that then allow the overall storage of the energy produced.

The actors involved in this process of transition towards the production of green energy are the city of Copenhagen itself both thanks to the supply of means and infrastructures for the production of energy from renewable sources, in addition to electricity suppliers and Danish citizens who are active part of this ambitious project.

## Green Mobility

Transport, and especially road transport, is the cause of more than 70% of total emissions in the mobility sector. Copenhagen is growing and it is necessary to ensure a sustainable transport network.

The Danish capital, with the goal of climate neutrality by 2025, wants to reduce the amount of $CO_2$ emitted also by the transport sector; in fact, its goal is that in 2025 75% of journeys take place on foot, by bicycle or through the use of public transport; moreover, it is expected that at least 50% of daily trips to work or study places take place by bicycle and that the use of public transport is increased, thanks to its strengthening, which must not cause emissions of greenhouse gases in atmosphere. In addition, new light vehicles or old pollutants are expected to use new fuels such as electricity itself, biogas, bioethanol or hydrogen (City of Copenhagen, 2012).

In order to encourage the use of bicycles, better conditions of comfort and safety are also provided for users who choose to travel on two wheels; moreover, over time, new fuels will acquire an increasingly lower price, unlike diesel and petrol, whose price is destined to rise.

The city of Copenhagen also provides intelligent traffic management thanks to sensors in order to optimize the monitoring of car, public transport and bicycle traffic and reduce $CO_2$ emissions into the atmosphere.

The actors involved in this sector are the city of Copenhagen, the citizens who have to change their habits related to the use of means of transport, the managing body of public transport in the Danish capital and finally the Danish Energy agency which monitors and manages the supply of energy for the different sectors of the city.

## City Administration Initiatives

The public administration sector in Denmark is also strongly linked to policies to reduce greenhouse gas emissions into the atmosphere; in fact, the city of Copenhagen wants to reduce the consumption of public administration buildings by 40% and ensure that the new public buildings comply with state-of-the-art emission criteria; in addition, the city provides that all vehicles in use by the administration will be powered electrically or with hydrogen or bio fuels (City of Copenhagen, 2012).

As for the public lighting sector, the city plans to halve the resulting consumption by replacing the old lamps with new LED devices, which consume less electricity and also ensure greater visual comfort and road safety. In addition, the city has stipulated that only electric motors are used when driving in Copenhagen.

Always linked to the reduction of the environmental impact in terms of electricity consumption, the city expects that solar panels will be installed on all public buildings, where they are not already present.

Copenhagen is an expanding city and therefore many buildings will be built in the next few years; they, in addition to municipal buildings, need to apply measures of limited energy consumption and be prepared for the future effects of climate change. A key role in coordinating and studying interventions for limiting greenhouse gas emissions is that of "The city lab", a knowledge institution, which collaborates with the city administration to experiment with innovative solutions.

The actors involved in this sector of policies towards the reduction of greenhouse gas emissions are the city of Copenhagen itself as the owner of the buildings on which to implement the interventions, knowledge institutions, such as the one just mentioned, the City Lab and the suppliers of electricity.

Thanks to the realization of the Swot analysis it has been possible to determine that Copenhagen is the most virtuous European capital in terms of objectives and results in mitigation and adaptation to climate change.

COPENHAGEN

PLAN: CPH 2025 – CLIMATE PLAN
YEAR OF ADOPTION: 09/12

GOAL: FIRST CARBON NEUTRAL CAPITAL BY 2025

**STRENGHTS**

- In 2011 has reduced emissions by 21% compared to 2005
- Several solutions to reduce GHGs emissions are based on already known technology
- Strong support from citizens of Copenhagen to the implementation of ecological transition and from external actors

**WEAKNESSES**

- No Weaknesses found

INTERNAL FACTORS

**OPPORTUNITIES**

- Use less energy to achieve carbon neutrality
- Produce green energy categorised in 4 themes:
  - Energy Consumption: Improve energy efficiency of buildings and the use of solar cells;
  - Energy Production: Install land-based wind turbines within municipal border
  - Green Mobility: Develope City of cyclist; Use of new fuels in transport sectors; improve public transport; monitor of the traffic; study of mobilty attitudes
  - City Admistration Initiatives: Install solar cells on municipal properties, develope energy efficient contruction; conversion of car fleet to electricity of hydrogen

**THREATS**

- $CO_2$ emissions that want to be eliminated
- Extreme effects of climate change

EXTERNAL FACTORS

*Table 7 - Swot Analysis of CPH 2025 Climate Plan. Source: Author, 2021*

To determine which actors in the case of Copenhagen were involved for each of the sectors most responsible of GHGs emissions that are presented in the plan, a stakeholder analysis was carried out in which the actors were positioned in the power-interest diagram.

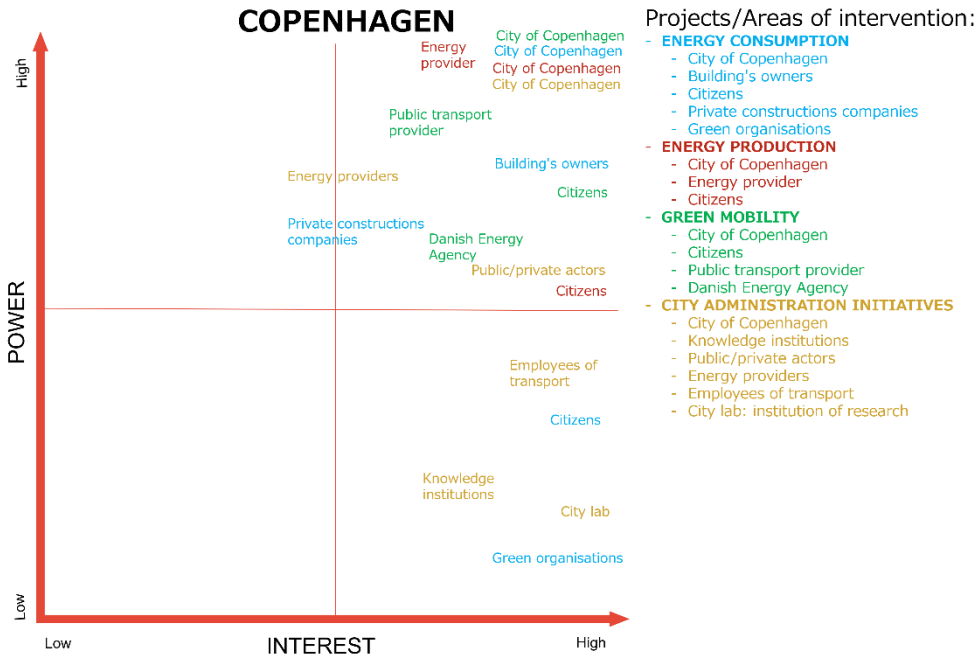



*Table 8 - Stakeholders Analysis of the CPH 2025 Climate Plan. Source: Author, 2021*

Summarising the main actions that the plan includes are reported in the table below (Table 9):

| | CPH 2025 CLIMATE PLAN | | | | | | |
|---|---|---|---|---|---|---|---|
| **Actions** | Energy renewable consumption | Energy efficiency buidings | Increased use of solar cells | Wind turbines for energy production | Improve safe conditions for cyclists | Conversion of car fleet to electricity or hydrogen | Electric engine in Copenhagen |

*Table 9 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## EUROPEAN CASE STUDIES: PARIS

### *City of Paris - Paris Climate Action Plan*

The plan approved by the city of Paris in May 2018 aims to transform Paris into a "Carbon Neutral City and 100% Renewable Energies" as the title of the plan states (City of Paris, 2018).

It provides actions and targets to reduce and zero greenhouse gas emissions and to make the French capital neutral in various sectors:

- Energy
- Mobility
- Buildings
- Urban Planning
- Waste
- Food

The French city has in fact provided various tools to accelerate the ecological transition as at the beginning of this plan it emphasizes that "Climate Change is one of the greatest challenges mankind has ever faced. In this ongoing race against time, the cities of the world would have a key role to play - both as pioneers and prescriber" (City of Paris, 2018).

The goal of the city of Paris is to achieve climate neutrality by 2050 as expected in 2015; previously, starting from 2004 the city of Paris had begun to evaluate the effects of climate change caused by high emissions of greenhouse gases and at the same time the first mitigation plans were approved and the first works to reduce energy consumption were carried out main cause of emissions.

The main measures envisaged by the city of measures in this plan include the construction of additional cycle paths for a total length of 700 km; then there will be the installation of charging stations for bicycles and electric cars throughout the city; in addition, another 24km of routes for public transport vehicles on rail will be created and the percentage of electricity from renewable sources produced thanks to the installation of 50,000 $m^2$ of solar panels will be increased. In addition to private assets, i.e. residential buildings, even public ones, such as schools, are expected to undergo renovation, building and energy interventions. Paris has already provided for the involvement of private stakeholders who, thanks to incentives, can be the engine of all these energy regeneration interventions.

The sectors where Paris has the greatest amount of $CO_2$ emissions are the tertiary sector and residential buildings. In addition to the objectives set for 2050 of climate neutrality, the

city of Paris has also foreseen a midterm to 2030, providing for a 50% decrease in GHG emissions and 35% in the amount of energy consumed. In addition, 45% of the energy produced will be derived from renewable sources of which 10% in the Parisian territory and finally no longer use fossil fuels. In fact, the goal is that, as reported in the plan "Guarantee a pleasant living environment that is adapted to the climate for all Parisians" (City of Paris, 2018).

Instead, for 2050, total climate neutrality with zero greenhouse emissions is envisaged, the achievement of 100% of energy production from renewable sources in addition to a 50% reduction in electricity consumption as included into the *Paris Climate Action Plan.*

## Energy

The main emissions of greenhouse gases derive from the consumption of energy produced from non-renewable sources, fossil in particular; in fact, Paris wants to completely eliminate the dependence on fossil sources for energy production and replace it with renewable energies such as solar and geothermal energy, which are widely present in the area. In fact, one of the 2050 objectives for the city of Paris is also to increase the amount of energy produced locally, which would guarantee greater safety and a more sustainable model.

The cities appear as dense agglomerations of buildings, ideal for the placement of solar panels on the roofs that can guarantee the production of energy from renewables, perhaps associated with a green roof that also guarantees the increase of green surfaces or an urban garden that it combines the environmental function with the social one; the citizens of Paris must in fact be involved and encouraged in the production of renewable energy. In addition to solar energy, Paris is located in an area rich in geothermal energy; this is why the city of Paris is planning to open a new plant to extract it.

## Mobility

The objective of the transport system of the city of Paris, including road or rail, is to ensure the efficiency of the service offered and at the same time not be responsible for the emission of greenhouse gases. The pollution produced by the mobility sector is among the most significant in the city of Paris; in fact, motor vehicles emit polluting substances such as nitrogen oxides and particulate matter into the atmosphere, in addition to $CO_2$. Transforming the way people move is one of the most difficult challenges in a city; for this reason, the active involvement of citizens and institutions is essential to develop a new way of moving in respect of the environment.

The goal is to achieve 100% sustainable transport without greenhouse gas emissions by 2050 (City of Paris, 2018).

The first of the important challenges that Paris is about to face is that of completing the transition from a strictly bourgeois mentality that sees the car as something privately owned, to a way of moving that instead adopts the principles of sharing, both through the sharing the car, or just sharing a passage to make a common journey.

Another important transformation that the city of Paris foresees, always linked to road transport, is the transformation of the entire fleet of cars powered by fossil fuels, such as diesel or petrol, to electric vehicles or powered by the latest generation renewable fuels. In fact, the city of Paris has set the time limit for eliminating diesel-powered vehicles at 2024 and at 2030 for petrol-powered ones. It also provided grants and incentives for those who no longer use their cars and for condominiums that allow the installation of bike shelters and electric charging stations.

Starting from 2020, the city of Paris has provided for differentiated parking rates based on the amount of pollutants emitted by the vehicle, which amplifies the current free parking facility for those who own an electric vehicle. It is important to underline that even the current infrastructures, with the change in mobility expected in the coming years, will have to be heavily modified because, for example, the number of private cars will decrease due to shared vehicles, but also to the important transformations taking place in the world of work.

An important novelty that could strongly influence the adaptation by the population but at the same time give a great help in terms of reducing greenhouse gases is the modification to the style of driving; in fact, it can cause strong influences from the point of view of the quantity of pollutants emitted. In fact, starting from last year (2020), driving schools have been teaching eco-friendly driving to their students, not exceeding the limit of 30km/h within Paris.

The public transport network, with its fleet of vehicles, is also expected to be modernized and become carbon neutral by 2025. Thanks to the modernization, public transport aims to optimize times and guarantee a quality of service equal to that of the private transport. Finally, cycle mobility is encouraged thanks to the construction of new cycle paths and the increase in services for those who choose the bicycle as a means of transport.

### Buildings

Buildings and the building stock in general are responsible for 80% of greenhouse gas emissions in the French capital. The goal set starting from the date of approval of the plan and 2020 is to reverse this trend that leads buildings to have such a negative impact.

In fact, it is foreseen that public assets, such as public housing houses and schools, but also private assets, will be renewed.

In addition to the renovation of existing buildings, Paris requires that all new buildings have a low environmental impact and have a design that allows them the least possible dispersion of energy.

In addition to the building renovation planned for each building, also given by the fact that the building stock is very old, it is expected, to reduce the energy requirement, that during the night the lighting of non-residential buildings is reduced to limit light pollution and energy consumption. Furthermore, all new buildings must be designed and built in such a way as to be reversible, that is to be able to accommodate different functions during the life of the building without having to undergo renovation and therefore impact on energy consumption and emissions of $CO_2$.

The goal of the building sector of the city of Paris is therefore that "the building supply will develop to take account of new lifestyles incorporating the shared use of spaces and services. The challenge for Paris is to become an easier place to inhabit, more socially responsible and more energy-efficient, particularly from the perspective of reducing inequalities and eradicating fuel poverty "as reported in the *Paris Climate Action Plan* (City of Paris, 2018).

The main actors involved in this sector are the city of Paris itself, the private owners of buildings, the citizens who can be actively involved in these transformations and finally, the electricity suppliers.

## Urban Planning

The sector of territorial planning or urban planning in general can play the role of driving force for the other sectors listed above; in fact, it can establish the operations of soil transformations to ensure the development of more sustainable mobility, more green spaces whose presence can allow an improvement in the air quality in inhabited centres and in general improve the quality of life and guarantee the operations that they are leading to the ecological transition of cities.

Urban planning, in fact, thanks to all the regulatory instruments it provides and at its disposal, can regulate the transformations of the city in all areas.Paris has approved, among others, the PLU, Paris Local Land-Use which is a regulatory tool to ensure the improvement of environmental and social conditions thanks to the adoption of the sustainable concept of spatial planning.Among the measures envisaged to reduce the quantities of greenhouse gases in the atmosphere, the city of Paris plans to increase the proportion of urban green in newly created or existing urban fabrics through the installation of green walls and roofs along the buildings or plants in courtyards. open.

The reduction of greenhouse gases in the atmosphere guarantees the reduction of the effects of climate change in urban areas, such as heat islands or the risk of flooding; this is also the reason why all the new neighbourhoods that will be built in Paris will have to present the planned mitigation measures.

The actors involved in this sector are only the Urban Planning Office of the city of Paris and the electricity supplier.

## Waste

The demographic growth in addition to the transformation of the economic model that the city is witnessing has also led to an increase in the amount of waste produced by each inhabitant. Most of the waste comes from plastic packaging; for this reason the city of Paris, in addition to developing Circular economy policies following the Dutch model, has also planned to create a new distribution model, for example in bulk without packaging. In order to increase the percentage of recycled material and therefore reduce the energy requirement for waste disposal, it is also necessary to rethink the collection and recycling system so that it can be 100% recycled.

In the French capital, initiatives were also organized to promote the reuse of objects and materials; in fact, the involvement of the population is of fundamental importance to underline the environmental and social benefits thanks to a saving of material resources and energy.

Among the initiatives to reduce the amount of material, which is potentially waste, the city of Paris has established a tax on printed advertising material in order to incentivize companies to limit their production of paper, which inevitably becomes waste.

The actors involved in this sector are only the waste collection company, the citizens who must be properly sensitized by the city of Paris itself.

## Food

A high production of greenhouse gases also derives from the food sector, or rather the supply of food in cities. The city of Paris, in fact, intends to promote urban agriculture compatible with eco-friendly policies. In fact, the creation of urban gardens on the roofs of buildings or in open areas around the city is strongly encouraged.

Even the type of products and the style of diet followed can cause an increase in emissions of greenhouse gases into the atmosphere; in fact it is from diets rich in meat and derivatives that there is a greater production of $CO_2$; this is why it would be useful to follow a "flexitarian diet, that is, a diet rich in vegetables and with less animal proteins". In 2018 the city of Paris

developed the first climate change mitigation strategy linked to the theme of food; the goal is to create "a sustainable, inclusive, resilient, safe, and diversified food system to mitigate and adapt to climate change" as reported in the *Paris Climate Action Plan* (City of Paris, 2018).

The Swot analysis was also carried out in the case of the Paris plan to identify its strengths, weaknesses, opportunities and threats.

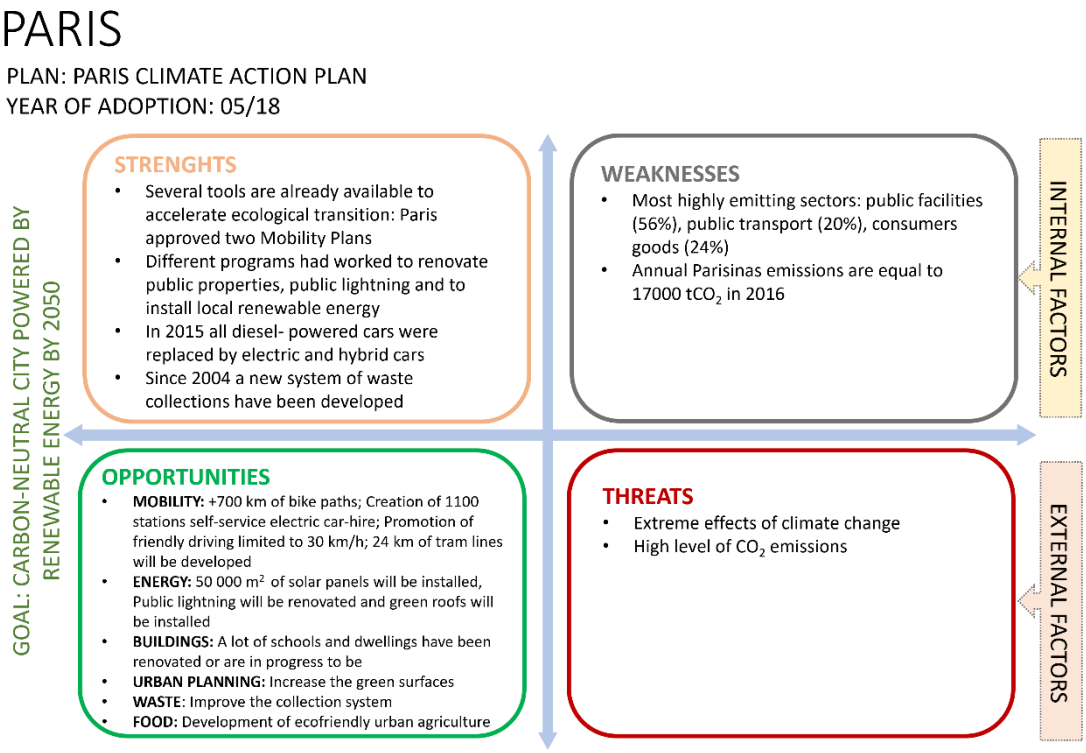



*Table 10 - Swot Analysis of Paris Climate Action Plan. Source: Author, 2021*

Also in this case, the creation of a stakeholder analysis made it possible to identify the main actors involved in the various emission sectors.

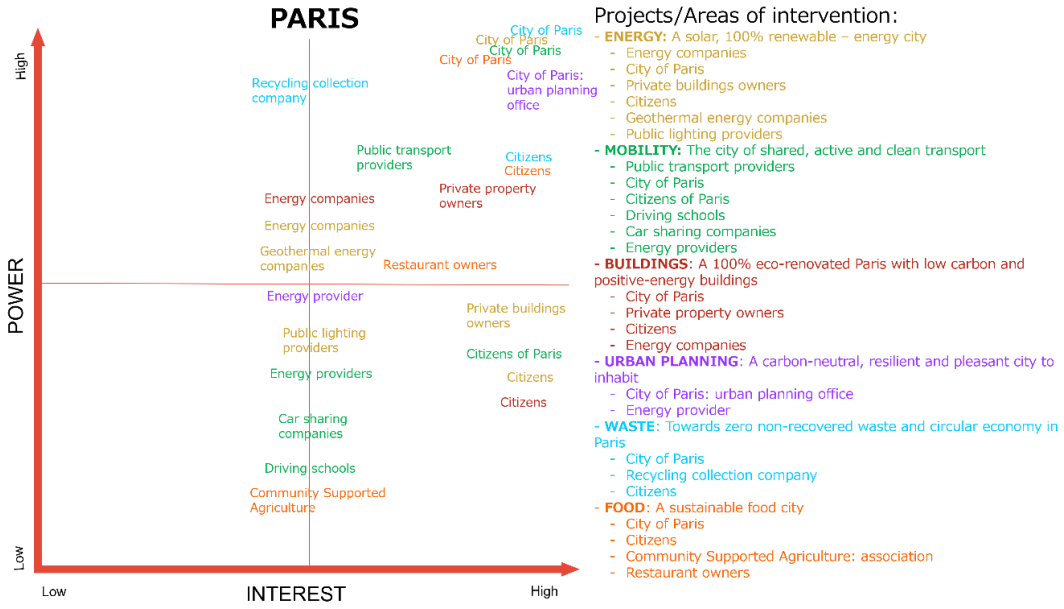



*Table 11 - Stakeholders Analysis of the Paris Climate Action Plan. Source: Author, 2021*

In the cities of Paris, the same administrative organizations play a predominant role. To them, especially in the case of the French capital, are added the citizens, an active part of every branch of action towards the ecological transition, and the bodies managing the services that must be remodelled to ensure less emission of greenhouse gases.

Summarising the main actions that the plan includes are reported in the table below (Table 12 a,b):

| | PARIS ACTION CLIMATE PLAN | | | | | |
|---|---|---|---|---|---|---|
| **Actions** | Use roofs for energy production | Limit night time lightning of non-residential buildings | Urban green on roofs and walls and urban agriculture | Tax on printed advertising materials | Exploit geothermal resources | Replace lightning system with LED |

| | PARIS ACTION CLIMATE PLAN | | | | | |
|---|---|---|---|---|---|---|
| **Actions** | Participatory production of renewable energy | New Infrastructures for cycling mobility | Emission-based parking rates | New style of driving | Buildings should have versatility | Energy renovation in buildings |

*Table 12 a, b - Brief summary of the actions that the plan provides. Source: Author, 2021*

## EUROPEAN CASE STUDIES: BRISTOL

### *Bristol One City Plan and One City Climate Strategy*

After the declaration of a climate emergency, for the first time by a European city, in 2019 Bristol approved the *One city Climate Strategy* - a strategy for a carbon neutral, climate resilient Bristol by 2030 with the aim of making the city neutral from point of view of emissions (City of Bristol, 2019).

The objective of the strategy adopted is that "in 2030, Bristol is carbon neutral and climate resilient. We have collectively achieved a fair and inclusive transition; capturing the opportunities of new jobs and investment, improved health, wellbeing and education, and a better environment for local people. We have helped lead the way to a safer global climate" as reported in the *One City Plan* (City of Bristol, 2021).

The strategy took shape from the approval of the *One City Plan* drafted in its first version in 2019 and updated annually with the aim of creating in 2050 "Bristol is a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success" as reported on the cover of *One City Plan 2021* (City of Bristol, 2021). The Bristol plan is made up of six main themes: Children and Young People, Economy and Skills, Environment, Health and Wellbeing, Homes and Communities and Transport.

The strategy also emphasizes the importance of everyone's participation and intervention, especially citizens who live in the city today, who have seen it transform in the past and who will live it in the future. The strategy was also developed with objectives for 2030, midterm with respect to the final goal of climate neutrality for 2050. The city of Bristol, in its strategy, differentiates two types of emissions; "Scope 1 Emissions" represent direct emissions, such as those resulting from combustion resulting from the use of vehicles. "Scope 2 Emissions", on the other hand, refers to the indirect emissions of greenhouse gases that derive from the production of electricity and heat.

The strategy is made up of ten thematic areas in which action is needed to reduce the pollutants emitted in each sector; it was defined thanks to the involvement of different actors. The thematic areas are:

- Transport: in this sector the goal is to promote the use of bicycles, zero-emission public transport and walking;
- Buildings: it is planned to implement an energy improvement of existing buildings and strategies to ensure adaptation to climate changes that could affect them;
- Heat decarbonisation: in this sector it is planned to create a new method for heating and hot water without the emission of pollutants into the atmosphere;

- Electricity: a decrease in the overall energy requirement and a maximization of local renewable energy production are expected;
- Consumption and Waste: a responsible purchase of raw materials and services and the non-production of greenhouse substances from waste disposal is envisaged;
- Business and the company: Bristol's economic and business sector is transformed into a carbon neutral system and thus creates new jobs;
- Public, Voluntary, Community and social enterprise services: in this sector the zeroing of greenhouse gas emissions is expected and these activities are structured to resist climate change;
- Natural Environment: the climate is constantly changing; the protection and improvement of flora and fauna is therefore envisaged;
- Food: the construction of a more sustainable system is envisaged as the products are local and obtained with respect for the environment;
- Infrastructure interdependencies: involves collaboration for the supply of basic services of a city such as transport, water, waste and energy.

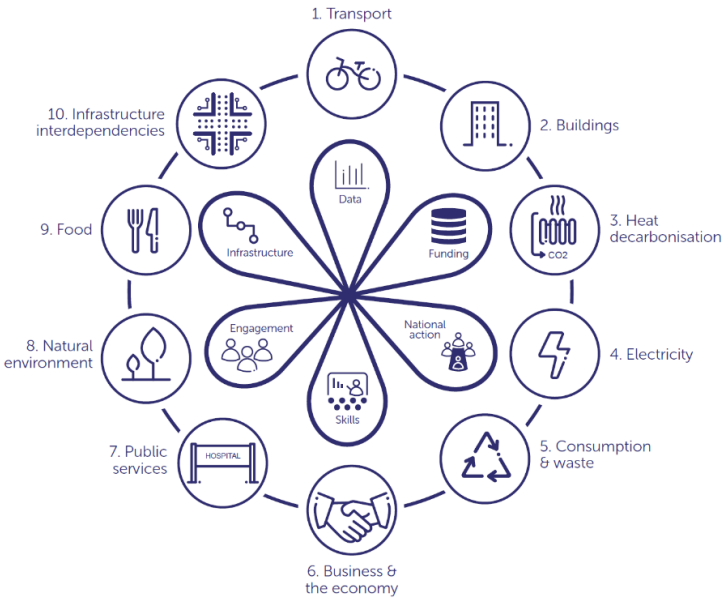



*Figure 29 - Diagram representing the interactions between the various areas of the strategy. Source: (City of Bristol, 2019)*

Bristol presents itself as a growing city both demographically and economically, it is a city where very different realities coexist, often in close contact. Over the years, various critical issues have already emerged on the English city that is now trying to solve and improve with this strategy.

## Transport

The transport sector includes within it both the mobility of goods and people; it is responsible for 34% of the carbon footprint of every inhabitant of Bristol; the reduction of the amount of greenhouse gases in the atmosphere is possible thanks to the reorganization of transport within the city and to and from the city. For travel within the city, it is necessary, first of all, to reduce the number of vehicles on the roads and to encourage the use of public transport and bicycles as well as moving more frequently on foot.

Furthermore, it is necessary to eliminate diesel and petrol-powered vehicles and replace them with vehicles powered by renewable fuels.

The goal in this sector to be achieved by 2030 is to develop a sustainable transport system with interchanges between the different means of transport, that all cars are vehicles with very low emissions and that everyone can access the transport system that must be suitable to withstand the effects of climate change.

The actors involved in this sector are the public transport service providers of the city of Bristol, the city of Bristol itself, the citizens who have to change their habits on the way to move and the private individuals, large users of mobility, who will have to adapt their means.

## Buildings

To achieve climate neutrality by 2030, it is necessary to radically transform all existing buildings, both residential and commercial. Even the new buildings, given the expansion that the city is undergoing, will be built according to the criteria that guarantee not to emit greenhouse gases and to withstand the effects of climate change. In particular Bristol provides for better energy performance by buildings by reducing the amount of energy needed while still guaranteeing an effective building heating system accessible to all.

The 2030 goal, in particular, for this sector is that "all buildings in the city will be carbon neutral and use resources efficiently, ensuring everyone can enjoy affordable warmth in winter and avoid overheating in summer" (City of Bristol, 2019) and that all buildings are resilient, that is, they can adapt to the changes that are bringing and will bring about climate change.

The actors involved in this strategy to reduce greenhouse gas emissions are the city of Bristol which must promote energy renewal policies together with the central government, the construction companies of private buildings that must adapt to these new construction or renovation standards. in addition to the owners of public sector buildings, often very old, who have to invest to energetically improve the buildings.

## Heat Decarbonisation

The $CO_2$ emissions deriving from the heating of buildings and the production of hot water are largely responsible for almost half of the total production of greenhouse gases in the city of Bristol; to improve this data and ensure that the energy needs of buildings decrease, it is necessary to invest in the insulation and energy performance of buildings.

The goal of the city of Bristol is to eliminate the supply of natural gas for heating buildings by 2030; to do this, however, it is necessary to replace the gas systems and boilers with electric heat pumps powered by renewable energy.

The general goal for 2030 is therefore that "Bristol will have to implement carbon neutral forms of energy for heating and hot water for all by 2030" as reported in the strategy (City of Bristol, 2019).

The actors involved in this strategy for the reduction of greenhouse gases from the heating sector are the city of Bristol which must promote and verify that this measure is put into practice and the electricity supplier as natural gas will be replaced by electricity.

## Electricity

Bristol in 2030 will no longer depend on natural gas which will be replaced by electricity which, thanks to a transformation of the entire energy production sector, will have to derive from renewable sources that do not include $CO_2$ emissions into the atmosphere. In this way, however, the demand for electricity, also thanks to vehicles that will no longer be powered by fossil fuels but by electricity, grows exponentially. Among the methods of producing electricity from renewable sources, the quantity of which cannot be produced only locally, is that of installing solar and photovoltaic panels on residential buildings and not throughout the city.

Bristol's 2030 climate neutrality target in this sector is that "All electricity supplied to and generated in Bristol will be carbon neutral (taking into account the anticipated 50% increase in demand by 2030)" as reported by *One City Climate Strategy* (City of Bristol, 2019) and that the electricity system is also able to withstand current and future climate changes.

The actors involved in this sector for the reduction of greenhouse gas emissions are the owners of the buildings who must put into practice the provisions dictated by the central government and the public sector whose buildings can be exploited for the positioning of solar panels.

## Consumption and Waste

The largest quantity of greenhouse gases produced in this sector derives from the consumption and waste sector, in particular from their incineration. The strategy envisaged by the city of Bristol to reduce the $CO_2$ emitted into the atmosphere involves reusing many of the products that would otherwise be destined for landfill and incineration. To increase the amount of reuse and recycling, the waste collection system must also be strengthened so that Bristol "will generate no carbon emissions from waste management" in 2030 as envisaged by the *One City Climate Strategy* and “Bristol will be recognized as a city of responsible consumption, buying goods and services that are carbon neutral, and reducing our exposure to climate hazards in the supply chain" (City of Bristol, 2019).

In this way the amount of waste produced will be reduced and at least 65% of the waste produced will be repaired and reused.

Among the actors involved in this action are the citizens of Bristol themselves who play an important role as they are willing to recycle and reduce the energy needs necessary to dispose of them, companies as they are responsible for many of the waste produced and the city of Bristol as a standard and verifies compliance with recycling regulations.

## Business and Economy

The sector in question is responsible for much of the total amount of greenhouse gas emissions into the atmosphere; to reduce the negative impact it is necessary to pursue the principles of the circular economy and the green economy which want to keep the productivity of each company high but reduce consumption and emissions.

The objectives that the city of Bristol has set itself in this sector to be achieved by 2030 are: "Bristol's businesses will be carbon neutral and climate resilient" and in general provides that "Bristol will have a strong carbon neutral, and climate resilient economy, maximizing on the opportunity from the transition "as reported in the *One City Climate Strategy* (City of Bristol, 2019).

## Public, Voluntary, Community and Social Enterprise Services

Greenhouse gas emissions from this sector represent 14% of the total emissions of the city of Bristol.

This sector is not taken into account in detail as it is not included within the filter placed to limit the field of analysis to the sectors of environment, energy and mobility.

## Natural Environment

By natural environment we mean all living species and natural resources. The goal of this sector is to promote the development and protection of natural infrastructures to reduce the impact of climate change on them. Furthermore, green infrastructures, thanks to the ability of vegetation to capture $CO_2$ and release oxygen, can decrease the effects of heat islands, especially in urban areas, increase the drainage capacity of surfaces and increase comfort in urban areas.

The goal is therefore to increase the green areas present in urban centres to mitigate heat waves in built-up areas and reduce the risk of flooding given the presence of many non-permeable surfaces.

In general, the city of Bristol wants that by 2030 “The natural environment in Bristol will be restored, protected and enhanced to deliver climate change benefits” as reported by the *One City Climate Strategy* (City of Bristol, 2019) also the city intends develop a strategy to limit the damage caused by climate change.

## Food

The food sector, which takes the form of food production outside the city of Bristol and the transport necessary to get food and materials to Bristol's schools, hospitals or shops, is responsible for 14% of total emissions of $CO_2$ in the atmosphere.

Also this field can be severely damaged by climate change as they could cause severe damage to raw materials with extreme rain and drought events and consequently increase production costs and increase the distance that must be travelled between the site of production and sales or production, thus increasing emissions of greenhouse gases into the atmosphere.

To reduce the amount of $CO_2$ in the atmosphere, the city of Bristol wants to make the chain for the supply of food and its transport within the city sustainable as well as to reduce the amount of $CO_2$ emitted into the atmosphere thanks to the consumption of products. carbon neutral. The actors involved in this sector are the city of Bristol itself which promotes the production of low $CO_2$ emissions food, citizens who must change their supply habits to ensure lower emissions and the regional government.

## Infrastructure Interdependencies

This sector includes within it all the blue and green infrastructures and essential services for a city such as, for example, the presence of the water network and its supply, the public transport network and their management, the management of waste collection and the

supply of electricity. For each of these sectors, the actors involved in the supply and management of the service are involved with the aim of collaborating in order to "improve the resilience of the services provided by our infrastructure systems to future climate change and extreme weather events" as reported Bristol's strategy in this area (City of Bristol, 2019). In fact, it is more linked to adaptation to climate change than to the reduction of $CO_2$ emitted, although among the objectives envisaged, the managers of the essential services of a city undertake to limit the amount of greenhouse gases emitted.

All the information included into the plans have been included into the Swot matrix (Table 13):

BRISTOL

PLAN: ONE CITY PLAN 2021 & ONE CITY CLIMATE STRATEGY
YEAR OF ADOPTION: 2021

GOAL: 2030 CARBON NEUTRALITY and CLIMATE RESILIENT

**STRENGHTS**

- In 2018 Bristol was one of the first cities to declare a Climate Emergency with an ambition of citywide carbon neutrality by 2030
- 10 themes: Transport, Buildings, Heat decarbonisation, Electricity, Consumption and waste, Business and economy, Public services, Natural environment, Food, Infrastructure interdependencies

**WEAKNESSES**

- Strong effects of climate change
- Increase demand for electricity that replace carbon
- City would not produce enought zero carbon electrity in its boundaries

INTERNAL FACTORS

**OPPORTUNITIES**

- In 2050 Bristol will be a fair, healthy and sustainable city
- Transport→ sustainable carbon neutral transport system with modal shift to significantly more citizens walking, cycling.
- Buildings→ All buildings will be carbon neutral and use resources efficiently, ensuring everyone can enjoy affordable warmth in winter and avoid overheating in summer
- Heat decarbonisation → Bristol will have to implement carbon neutral forms of energy for heating and hot water for all by 2030
- Electricity → All electricity will be carbon neutral
- Consumption and waste → No carbon emissions from waste management
- Business and economy → Bristol's businesses will be carbon neutral and climate resilient
- Public services → carbon neutral public, voluntary services and supply chains
- Natural environment → It will be restored, protected and enhanced to deliver climate change benefits
- Food → resilient food supply chain that supports the city region's local food economy
- Infrastructure interdependencies → improve the resilience of the services provided by our infrastructure systems to future climate change and extreme weather events

**THREATS**

- Extreme events
- High level of $CO_2$ emissions

EXTERNAL FACTORS

*Table 13 - Swot Analysis of One City Plan 2021. Source: Author, 2021*

The analysis of the actors involved for each of the sectors for which the plan provides for the reduction of emissions was carried out by inserting these in a power-interest diagram:

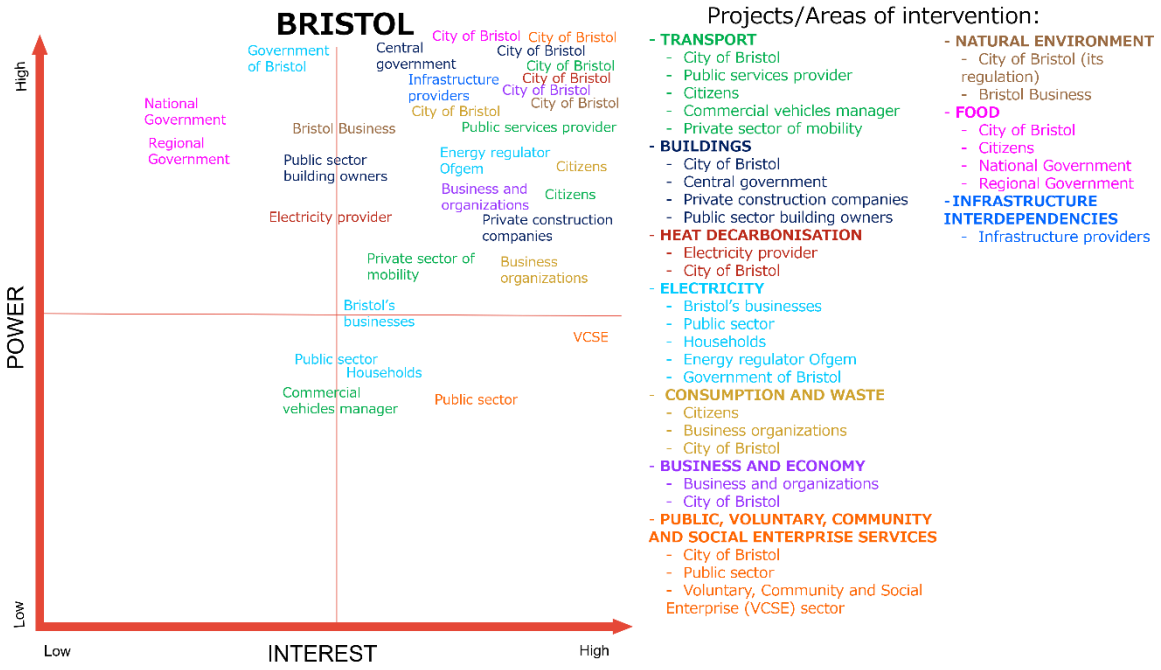



*Table 14 - Stakeholders Analysis of the One City Plan 2021. Source: Author, 2021*

In Bristol, citizens and the private sector that owns buildings also play a key role in actions towards achieving climate neutrality. Also Regional and National Government have a central role in the mitigation policies.

Summarising the main actions that the plan includes are reported in the table below (Table 15):

| | BRISTOL ONE CITY PLAN | | | | | |
|---|---|---|---|---|---|---|
| **Actions** | Increase the use of ultra-low emissions vehicles | Energy renovation in buildings | Heat decarbonisation with electric heat pumps | Install solar and PV panels on roofs | Reduction in waste production through reuse | Restoration of natural environment |

*Table 15 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## EUROPEAN CASE STUDIES: BASQUE COUNTRY

### *Basque Energy Strategy 2030*

In 2016, after a long series of plans approved by the Spanish autonomous community for the reduction of energy needs that already concerned the mobility, housing and environment sectors, and for the reduction of the emission of greenhouse gases into the atmosphere, the community approves the *Basque Energy Strategy 2030*. Currently, the Spanish energy needs are closely linked to the use of fossil sources but with this plan and the previous ones, the government undertakes to decrease the amount of energy derived from fossil sources and, on the contrary, to incentivize its production from renewable sources.

The Basque Energy Strategy is based on some general guidelines (Eve - ENTE VASCO DE LA ENERGIA, 2016):

- Stimulate the creation of an economic and social system that requires a smaller quantity of energy in all sectors, from transport to the needs of individual homes;
- Encourage the use of renewable and no longer fossil sources in order to develop a need in line with the resources of the planet;
- Promote the abandonment of fossil fuels for cars by replacing them with electric vehicles;
- Achieve a decrease in the quantity of greenhouse gases emitted into the atmosphere so as to reduce the effects of climate change;
- Modernize the energy supply system, making it more efficient and sustainable, so that it is suited to the needs of users;
- Take advantage of the benefits that the modernization of the Basque industry could bring thanks to the modernization of plants and the use of renewable energy.

To achieve these general strategic lines, the plan envisages eight different areas of action (Eve - ENTE VASCO DE LA ENERGIA, 2016):

1. Improve competitiveness and energy sustainability in Basque industry
2. Reduce dependence on oil in the transport industry
3. Reduce energy consumption and increase the use of renewables in buildings and the home
4. Promote a more energy-efficient Basque public administration
5. Encourage efficiency and harness existing resources in the primary sector
6. Promote renewable energy production
7. Supervise energy supply infrastructures and markets

8. Orient technological energy development

First of all, to "Improve energy competitiveness and sustainability in Basque industry" it is necessary to encourage the use of energy derived from renewable sources, such as biomass, to meet the needs of the Spanish industry, so that the latter increases in production. Renewable sources can also be used for the production of heat, which is widely used in industry.

Furthermore, to reduce the use and therefore the dependence on fossil fuels to power vehicles, it is necessary to replace them with sustainable fuels or to promote the use of means of locomotion that are not a source of greenhouse gas production. Cycling or electric mobility is an example of this.

In the buildings sector, to ensure that they are not sources of excessive and unnecessary emissions of greenhouse gases, the Basque government plans to improve the energy efficiency of buildings and to promote the use of renewable energy production systems also in individual buildings, residential or not. These renewable energy production measures are also envisaged for public administration buildings which can guarantee, thanks to the use, for example, of solar panels, the self-production of the energy necessary for internal needs. In addition to the buildings, it is also expected that the administration vehicles, currently powered by fossil fuels, will be replaced with zero-emission vehicles.

Among the renewable resources that the Basque government wants to encourage its use is biomass to be used for the production of heat in industry, industry or for heating residential or tertiary buildings. In general, incentives for the production of renewable energy are envisaged, also thanks to the numerous benefits they bring.

Among the renewable sources that can produce energy in line with the needs but above all with the planet's resources are: energy from the sun, wind, sea, water and solar thermoelectric.

In all the actions that the Basque government envisages, both the specific government offices and EVE, or Ente Vasco de la Energía, which deals with the supply and energy infrastructure, have extensive involvement.

A fundamental factor that must be taken into consideration is the local availability of the material that allows the production of renewable energy and whose transport does not involve excessive costs in monetary and environmental terms. The Swot analysis has been realised also for this case study in order to define the Strengths, Weaknesses, Opportunities and Threats in this plan.

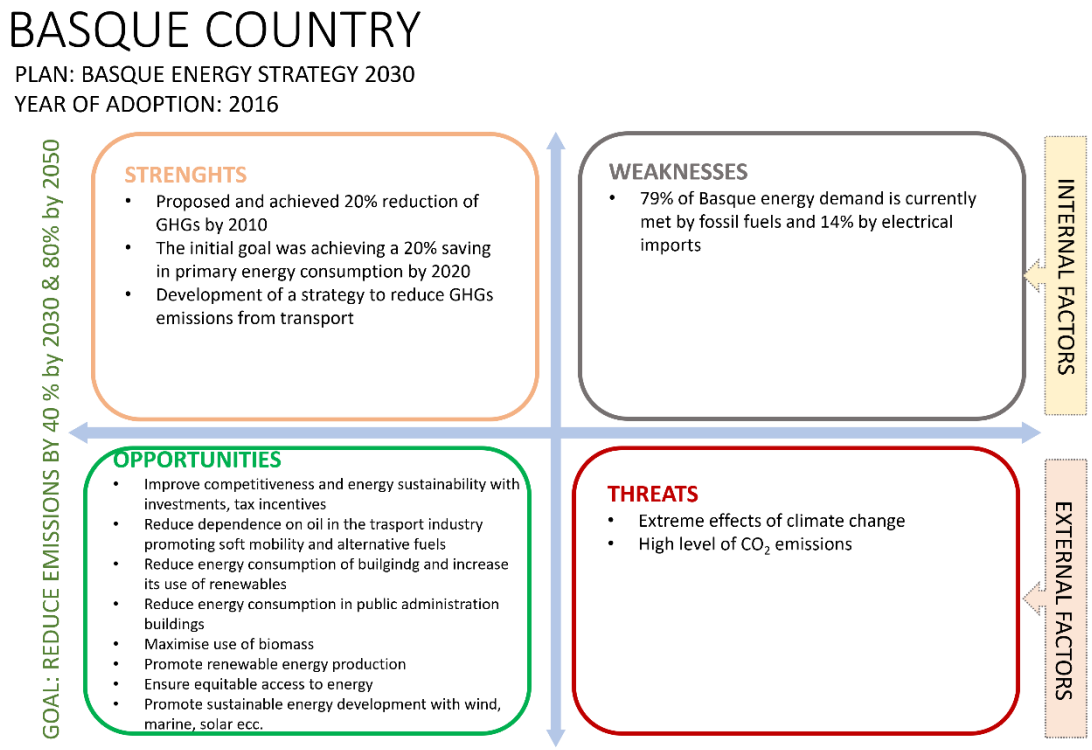



*Table 16 - Swot Analysis of the Basque Energy Strategy. Source: Author, 2021*

The energy needs of the Basque Country are currently met by fossil sources; these also include important lines of action to ensure the decrease in the use of fossil fuels and reduce emissions by 40% by 2030 and by 80% by 2050.

For each area of interventions, the main stakeholders have been identified together with their position into the power-interest diagram.

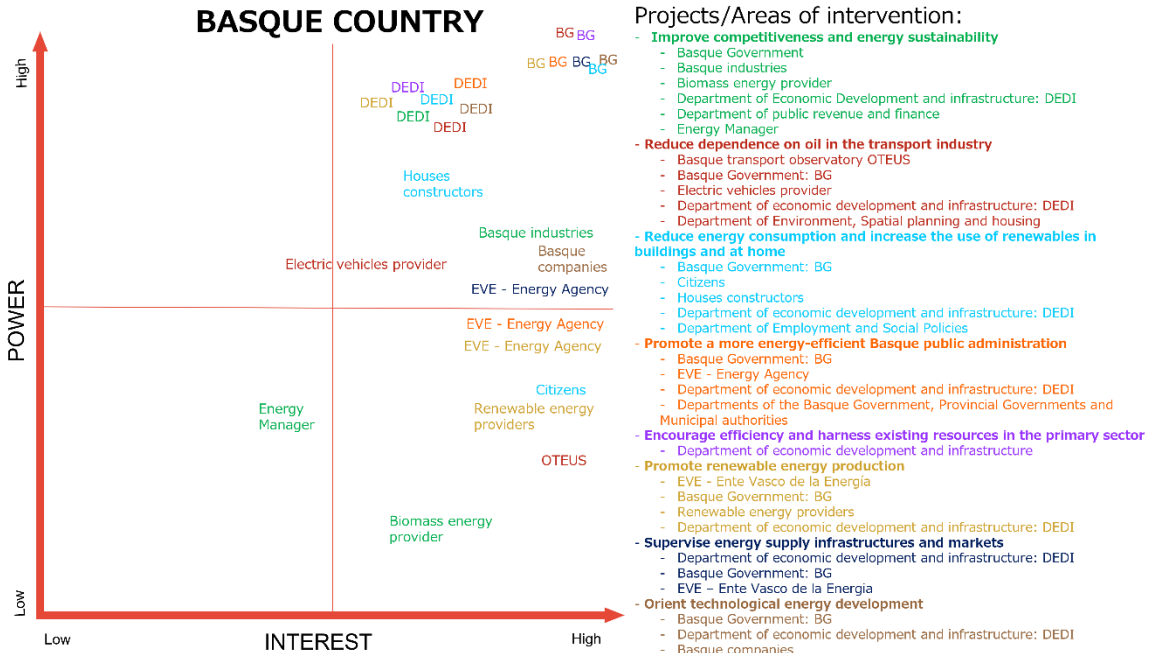



*Table 17 - Stakeholders Analysis of the Basque Energy Strategy. Source: Author, 2021*

Finally, in the Basque Country, being an autonomous community made up of three main cities, the main role in the actions to reduce the emission of greenhouse gases into the atmosphere is of the Basque government which, together with the Department of economic development and infrastructure is involved in all Actions. An important role is also played by EVE, the Ente Vasco de la Energia, which is the manager and supplier of electricity in the Basque Country and can therefore strongly influence the orientation towards sustainable energy production.

Summarising the main actions that the plan includes are reported in the table below (Table 18):

| | **BASQUE ENERGY STRATEGY** | | | | |
|---|---|---|---|---|---|
| **Actions** | Increase the use of biomass for energy production | Promotion of electrical transport | Promotion of energy sustainability | Energy production from sustainable resources | Promotion of soft mobility |

*Table 18 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## ITALIAN CASE STUDIES: TURIN

***Torino: Piano Strategico Metropolitano 2021 – 2023 Torino Metropoli Aumentata – (Metropolitan Strategic Plan 2021 - 2023 Turin Metropolis Augmented)***

The objective of the thesis is to define which good practices towards ecological transition can be implemented in the Metropolitan City of Turin: to do this it is important to determine which ones are already foreseen.

Thanks to the filtering process previously carried out, the *Piano Strategico Metropolitano 2021-2023 Torino Metropoli Aumentata* (Metropolitan Strategic Plan Turin Augmented Metropolis) was identified for Turin, (CM Torino, 2021), a fundamental instrument envisaged by the *Strategia Nazionale di Sviluppo Sostenibile* (National Sustainable Development Strategy) (Ministero dell'Ambiente, 2017) for the implementation of Agenda 2030 in Italy which took shape starting from September 2020 including a conspicuous participatory component implemented with a bottom-up approach. The construction phases of the plan are essentially 2, the forum phase and the convergent phase. Below is an explanatory diagram of the participatory process for the implementation of the strategic plan (Figure 30).

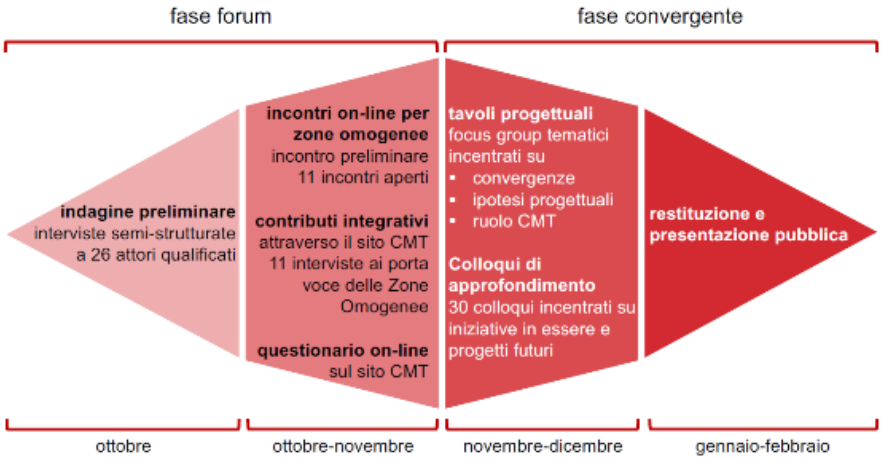



*Figure 30 - Diagram representing the stages of implementation of the Turin strategic plan. Source: (CM Torino, 2021)*

The plan was adopted and published on February 18, 2021. The Turin strategic plan is developed in 6 strategic axes, 24 strategies and 111 actions; the axes are:

AXIS 1: Digitization, innovation and competitiveness of the production system

AXIS 2: Green revolution and ecological transition

AXIS 3: Infrastructures for mobility

AXIS 4: Education, training and research

AXIS 5: Social, gender and territorial equity

AXIS 6: Health

It is easy to see how the axes fully reflect the themes of the Sustainable Development Goals and how, thanks to this metropolitan strategic plan, the NextGenerationEU can be realized.

Thanks to the filtering process specified above, it is possible to limit the analysis to axes 2 and 3 as they concern fields closely related to the ecological transition.

Axis 2, for a greener and more ecological Turin, specifically provides five strategies with reference to the sustainable development goals number 1,3,6,11,13,14 and 15. They are:

2.1 Building and infrastructuring the green metropolis

2.2 Promote the intelligent reuse of brownfield sites of existing heritage

2.3 Enhance the opportunities of renewable energies for the metropolitan areas

2.4 Becoming a green building metropolis

2.5 Becoming a circular metropolis.

For each of the strategies defined in axis number 2, actions are then defined, the actors involved and the objectives of the Bologna charter adopted by the Mayors of the metropolitan cities to which the single strategy refers.

The first strategy foresees that Turin becomes "the greenest metropolis of the world" and refers in particular to four of the objectives of the Bologna Charter:

- Adaptation to climate change and risk reduction
- Water quality
- Ecosystems, urban greenery and biodiversity protection
- Sustainable mobility

The actions envisaged for the development of this strategy are: “Rete Metropolitana delle infrastrutture Verdi” (Metropolitan green infrastructure network) which provides for the connection of protected mountain, hilly and river areas in a single integrated system, usable by the whole community, which cross very dense urban areas thanks to artificial ecological crossings such as the "Green Corridors" which are defined as "linear natural infrastructure, such as trees and plants, that link up other green and open spaces to form a green urban network" thanks to the project promoted by Natural Walking cities (Natural Walking cities, 2019).

The actors involved in the project are the Piedmont Region, the Metropolitan City of Turin, Municipalities and Unions of Municipalities, forest managers, park authorities and environmental associations.

“Torino Metropoli Parco” (Turin Metropolis Park) envisages the creation of a single metropolitan park by coordinating all the metropolitan, mountain, hilly and river protected areas. In Italy there are already parks of this type in Lombardy, the Monza Park, which extends for 688 hectares and the Brescia Hills Park which instead measures 2,183.00 hectares. On the other hand, the Appian Way Regional Park in Rome is much larger with 4,580.00 hectares (batchgeo, n.d.).

Also in this case, as in the previous one, the most involved actors are: the Piedmont Region, the Metropolitan City of Turin, Municipalities and Unions of Municipalities, Park Authorities and environmental associations.

Another planned action is "Gran Bosco Torino" (Gran Bosco Turin) to enhance existing forests and promote sustainable management of existing forests. An example is the "Trees as infrastructure" platform that allows you to identify all the benefits deriving from planting plants in cities and for the environment thanks to the reduction of noise generated by the absorption of this, to the reduction of the island of heat present due to the conformation of the cities and thanks to the reduction of $CO_2$ as the plants, in the process of chlorophyll photosynthesis, absorb it but also causes storm water reduction, regenerated soil and better walking conditions as well as an increase in biodiversity as reported by the TreesAI team which considers nature is a fundamental part of urban infrastructure, like roads, bridges or railways (TreesAI, n.d.).

The actors involved in this project, in addition to those already mentioned for the previous actions, are the local associations and the IPLA (Institute for Wood Plants and the Environment).

With the action "Territorio Curato" (Curated Territory) the objective is to promote land maintenance contracts for farms and promote the construction of collaborative networks for the recovery of abandoned land thanks to the participation of land associations and consortia forestry. The actors involved in this project action, in addition to those already listed, are Enterprises and the Credit System.

In order to recover and re-naturalize unused open areas such as excavations and quarries for water storage basins, controlled flooding contracts are promoted thanks to collaboration with the agricultural world. This action is called "Relisienza idrica fruibile” (Usable water resilience) and takes an example from the Amsterdam Rainproof platform which offers the sharing of knowledge and experience on the subject of water basin management gained thanks to Dutch experience (“Amsterdam Rainproof,” n.d.).

The "Rewilding" project aims to re-wild portions of the metropolitan territory to allow the increase of metropolitan biodiversity on the example of the European project of the same

name which aims to make Europe a place with more space for wild nature, fauna and natural processes (Rewilding Europe, n.d.).

The main actors involved into these projects are the MC of Turin, Municipalities and Unions of Municipalities, Forest managers, Park Authorities and IPLA, Institute for Wood Plants and Environment.
"Metropoli ciclabile e pedonale" (Cycle and pedestrian metropolis) is a project that involves the Piedmont Region, CM of Turin, Park Authorities, local associations, CAI (Club Alpino Italino), FIAB (Italian Environment and Bicycle Federation) and tour operators that aims to create a unitary system for cycling and hiking the network of routes already present.

The second strategy envisaged for axis 2 of the PSM of the Turin CM (CM Torino, 2021) envisages "Promoting the intelligent reuse of abandoned areas and existing assets"; it refers to the Objectives of the Bologna Charter (CM BO et al., 2017):

- Sustainable land use and solutions based on natural processes;
- Energy transition;

To do this, one of the planned actions is the "Centro di Competenza aree dismesse" (Disused Areas Competence Centre) which plans to support planning and investment activities on abandoned areas and requiring remediation operations. Among the actors involved, in addition to the Piedmont Region and CM of Turin, there are also research centres, business incubators and accelerators and science and technology parks as are the research departments within the Polytechnic of Turin such as the DIATI, DAD, DIST or the Environment Park, Science and Technology Park for the Environment of Turin.

Another action focused on the recovery of the existing heritage is the Transit-Oriented territorial Regeneration (TOR) which involves the recovery of abandoned areas near the stations in the cities. It is the TOD, Transit Oriented Development Institute that promotes the creation of compact, walkable and mixed-use communities in high quality and usable railway systems. The main objective is to design and structure the mobility system without the need to use the car in order to reduce greenhouse gas emissions (TOD, n.d.). In addition to CM of Turin, the main actor of this action is INU, the National Urban Planning Institute that plays a key role in the regeneration of entire portions of the territory.

Closely connected to the theme of the second strategy of the PSM of Turin is the action that provides for the "Demolition of incongruous buildings", allowing to limit the consumption of land, a non-reproducible asset, by demolishing unused commercial, agricultural or

production buildings. Also in this case the key players are the same as in the previous action.

With the project "Dalla ruggine al sole" (from rust to the sun), whose key players are companies, ENEA, the national agency for new technologies, energy and sustainable economic development, and the Energy Centre as well as CM Torino and the Piedmont Region is expected the reuse of abandoned industrial areas to produce green energy thanks to the use of photovoltaic panels or wind turbines, bearing in mind the possibility of construction according to the existing landscape regulations. The project comes to life from the existing initiative promoted by Centre for Creative Land Recycling which is a non-profit organization that promotes the recycling of the earth through, among others, the use of solar panels in abandoned areas by creating "bright fields"; in this way an abandoned land can benefit the whole community and create energy from renewable sources (Center for creative land recycling, n.d.).

The third strategy of the PSM is developed in the energy field and envisages "exploiting the opportunities of renewable energies for the territories of the metropolis"; it refers to the "Ecological transition" objective of the Bologna Charter. To do this, it provides for the creation of a "Centro di competenza energia e ambiente" (energy and environment competence centre) that can act as a support in the planning field for small municipalities or unions of municipalities. The actors closely involved in the project are: Piedmont Region, CMTO, Research Centres, Incubators and Business Accelerators, Innovation Poles and Science and Technology Parks based in Turin, in addition to the National Association of Italian Municipalities (ANCI) and the National Union of Municipalities, Communities and Mountain Bodies (UNCEM). The Pilot Project for the enhancement and promotion of the wood-energy supply chain in Piedmont and neighbouring areas is part of this action. This intends to enhance and improve the entire wood supply chain from forest management with the aim of aggregating and managing private forest properties, to planning and managing the heat produced (Legno Energia Nord Ovest, n.d.).

In the context of mobility, on the other hand, the envisaged action is the creation of "Rete di ricarica elettrica per auto e bici" (Electric charging network for cars and bicycles) with the creation of charging stations in the hubs of the city and hub of modal interchange so as to always incentivize plus the non-use of polluting means. The protagonists of this action are the Piedmont Region, CMTO, Unions of Municipalities, Companies and Enel and Iren as electricity distribution bodies.

In order to ensure energy self-sufficiency for public buildings and isolated ones, located for example in the high mountains, “Energie Locali” (Local Energy) action was born which, thanks to the contribution of Research Centres, Incubators and Business Accelerators, Science and Technology Parks, which aims to create stand alone and off grid energy systems.

With reference to the action just mentioned, the "Comunità Rinnovabili” (Renewable Communities) are also an action envisaged by the PSM that aims at the creation of energy communities in both urban and rural areas. Turin has the largest energy network in Europe with more than half of its residents using the district heating system. The goal with the action "Estendere la più grande comunità energetica d’Europa” (Extending the largest energy community in Europe), thanks to the Piedmont Region, CMTO, Municipalities and Unions of Municipalities, Companies and Trade Associations, is to further extend its coverage on the Piedmontese chief town and in the neighbouring municipalities.

The fourth strategy of axis two of CMTO's PSM provides for Turin to "Become a metropolis of the Green Building"; it also refers to three of the objectives of the Bologna Charter, in particular:

- Sustainable land use and solutions based on natural processes
- Energy transition
- Ecosystems, urban greenery and biodiversity protection

To this end, various actions are envisaged, including "Incentivi alla costruzione in legno” (Incentives for wood construction) which envisages strengthening the local wood supply chain for both new constructions and building recovery.

Another action of profound importance is that of renewing the existing and old school heritage by integrating it with the new didactic and spatial models. With the “Scuole Eco” (Eco School) action, seismic adaptation, energy efficiency and digitalization of school buildings are envisaged. To date, there are two schools that have entered the “Turin makes school” project and have already been delivered refurbished thanks to the Agnelli Foundation and Compagnia San Paolo, which played a crucial role in this project (Torino fa Scuola, n.d.).

With the European project A.P.P.VER., “Apprendere per Produrre Verde” (Learning To Produce Green), the aim is to connect the green, public and private production system with the educational and professional world so that a model based on sustainability can be

created. The aim is also to be able to undertake, also thanks to this project, a real sustainability policy for schools in the area.

On private buildings, on the other hand, thanks to the "Bonus dall'edificio alla città" (Bonus from the building to the city) action, the aim is to coordinate energy and seismic redevelopment interventions for the improvement on a building scale of the single building and on an urban scale of the neighbourhood or city. Trade associations, professional associations and building administrators also play a crucial role in this action.

Fifth and final strategy of axis two of CMTO's PSM plans to "become a circular metropolis"; this strategy refers to three of the objectives of the Bologna Charter for the Environment: (CM BO et al., 2017)

- Circular economy
- Adaptation to climate change and risk reduction
- Water quality

Thanks to various actions including "Second Life" which plans to encourage the reuse of objects, buildings, electronic and digital equipment thanks to the dissemination of models and best practices used in other metropolitan contexts. The actors involved in this action include the Piedmont Region, CMTO, Municipalities and Unions of Municipalities, trade associations, research centres, innovation poles, waste management consortium and CONAI, the National Packaging Consortium.

The same actors are also the protagonists of the "Reti centri riuso" (Network of reuse centres) action which provides for the creation of a metropolitan network of reuse centres coordinated with a monitoring system of collection and recycling systems.

Also for the water system, such as the electricity one previously mentioned, the creation of off-grid and stand-alone systems is envisaged to ensure water and sanitary self-sufficiency and in the management of waste in isolated mountain settlements thanks to the action, respectively, "Acque locali" (Local Water) which, in addition to the aforementioned actors, envisages the involvement of the mountain Basin Imbriferi bodies and irrigation consortia and," Rifiuti locali" (Local Waste) which involves waste management consortia.

With the action "Servizi ecosistemici metropolitan" (Metropolitan ecosystem systems), the CM of Turin sets itself the goal of quantifying ecosystem services, that is the services that natural systems generate and that man uses, between the urbanized parts and those that are not so as to be able to measure and possibly integrate the urban planning standards currently envisaged. Among the actors involved are the Science and Technology Parks and ARPA Piemonte (Regional Agency for Environmental Protection).

Finally, one of the actions planned to make Turin a circular metropolis is that of the "Green Public Procurement" which provides for the presence of a system that guarantees that sustainable products and services are purchased by municipalities and public administrations. In this case, the actors involved include CM of Turin, the Piedmont Region, investee companies and entities connected to metropolitan public administrations.

By analysing axis three of the Metropolitan Strategic Plan of the Metropolitan City of Turin, infrastructures for sustainable mobility, strategies and actions were developed for a "Turin Metropolis more mobile, accessible and connected" as reported in the PSM itself (CM Torino, 2021). This strategic axis is connected with six of the seventeen Sustainable Development Goals in particular the 7,8,9,10,11 and 13 (United Nations, 2015).

The first strategy envisages "designing metropolitan mobility as a multimodal service to users and territories" and refers to the eighth objective of the Bologna Charter of "Sustainable mobility".

The actions envisaged in this strategy are various, including the establishment of a “Centro di competenza per la mobilità come servizio” (Competence Center for Mobility as a Service (MaaS)) which would allow small municipalities to come to the aid of planning multimodal mobility. MaaS is in fact the acronym for "Mobility as a Service" and represents a public-private partnership to ensure the integration of different forms of transport. Among the actors involved we find the same who operated in the field of the second axis of this PSM, in particular the Piedmont Region, CMTO, Municipalities and Unions of Municipalities, Research Centres, business incubators and accelerators, innovation poles, science and technology parks.

In the same context, with the aim of improving the integrated transport system, the action “Promuovere una connettività reticolare multimodale del trasporto pubblico locale” (Promoting multimodal network connectivity of local public transport) is envisaged to ensure an efficient connection between different modes of mobility, by rail, road or transport services sharing. To do this, it is necessary to involve entities and managers of Local Public Transport and Sharing Mobility companies.

At the heart of the integration and expansion of the public transport network, the completion of the "metropolitan road network and its integration with the cycle component" is planned with the extension of line 1 and the construction of line 2.

Another action envisaged in the planning of metropolitan mobility is that of “Creare le infrastrutture di interscambio per forme autonome e condivise di mobilità last-mile” (creating interchange infrastructures for autonomous and shared forms of last-mile mobility); this action envisages, again with reference to MaaS, the creation of more comfortable

interchange and waiting points with greater services such as, for example, the positioning of covered and air-conditioned shelters or closed and covered parking lots for two-wheeled vehicles. To this end, the involvement of the Mobility Agency and LPT and sharing mobility companies and managers is necessary.

Mobility management in order to reduce the emission of greenhouse gases and make the transport network more accessible must also be taken into consideration in areas with low population density or poorly connected. With the action “Stimolare la formazione di communities digitali per la mobilità condivisa” (Stimulating the formation of digital communities for shared mobility), the goal is to encourage the purchase and sharing of private vehicles in areas where public transport is scarce. SMARTA, Smart Rural Transport Areas, represents a European project, from which Turin can take an example, which aims to identify sustainable mobility solutions to improve the travel experiences of rural populations following the market study and the structure of each single reality (Smart Rural Transport Areas, n.d.).

The second strategy of CMTO's PSM envisages "Strengthening, qualifying and integrating the primary metropolitan infrastructure of public mobility"; it refers to two of the objectives of the Bologna Charter for the Environment:

- Sustainable land use and solutions based on natural processes
- Sustainable mobility

The actions envisaged by this strategy include the extension of the "metropolitan railway network" which provides for the re-use of some railway lines disused in recent decades. Furthermore, it is planned to “Potenziare il servizio ferroviario metropolitano” (strengthen the metropolitan railway service) existing on the lines most used by commuters. The construction of infrastructures is planned to increase safety in crossings, in particular to eliminate level crossings and equip the lines with underpasses and overpasses. In addition, the activation of stations is planned. In both of the aforementioned actions, the involvement of the Piedmont Region, CMTO, the Mobility Agency and RFI (Italian Railway Network) is envisaged.

It is RFI, together with companies and professionals, that is involved in the action of "Ridisegnare le stazioni ferroviarie della rete metropolitana” (Redesigning the railway stations of the underground network) with the aim of making them more comfortable and eliminating the tendency to abandonment still in place.

In addition, in order to increase travel comfort, it is planned to "Qualificare le vetture ferroviarie della rete metropolitana" (Qualify the railway cars of the underground network) by rethinking the interior layout to ensure greater bicycle transport capacity. Also in this case it is the bodies that own and manage the service, RFI and GTT, Gruppo Torinese Trasporti, which can adopt innovative solutions.

The services that aim to improve travel comfort include the installation of a single Wi-Fi on all means of transport and at stops with the "Wi-Fi on the go" action which could also allow data to be collected on transport quality and monitor individual movements.

RFI and GTT together with research centres, science and technology parks and companies in the sector are experimenting with hydrogen in the railway sector thanks to the action "Sperimentare e introdurre l'idrogeno ferroviario" (Experimenting and introducing railway hydrogen) which involves the inclusion of hydrogen propulsion to replace the cars currently in use that run on diesel, thus ensuring greater sustainability even on railway lines that are currently not electrified.

In order to ensure better interchange between different mobility systems, thanks to the "Bici & Bus" action, it is envisaged to equip all means of local surface public transport by road with equipment for transporting bicycles.

The third strategy of the PSM of the metropolitan city of Turin envisages "Redesigning the metropolis as a polycentric network of cities and neighbourhoods 15' "; it refers to four of the objectives of the Bologna Charter for the Environment:

- Sustainable land use and solutions based on natural processes
- Air quality
- Ecosystems, urban greenery and biodiversity protection
- Sustainable mobility

Among the actions envisaged in this strategy is the creation of "Nuovi boulevards suburbani" (New suburban boulevards) thanks to the collaboration of the Piedmont Region, CMTO, the Chamber of Commerce, trade and service trade associations. A transformation of the major development axes of the city is planned, given the recent expansion, with large urban boulevards full of public spaces, spaces for pedestrian and bicycle mobility.

The action "Percorsi ciclabili in rete per la micromobilità locale" (Networked cycle paths for local micro-mobility) refers precisely to cycle mobility which, thanks to the work of CMTO, Municipalities and Unions of Municipalities, provides for the creation in all municipalities of

safe cycle paths, connected to the public transport system and equipped with their own infrastructures if they develop in the context of mixed mobility.

Also for pedestrians, the creation of safe walkable paths is planned, well connected to other road or rail mobility systems thanks to the "Quartieri pedonabili" (Walkable Neighbourhoods) action, also suitable for children, which involves the involvement of trade associations and companies and local associations.

The fourth strategy of axis three of the CMTO PSM envisages "Connecting the metropolis to nearby global nodes"; Turin has in fact a series of inconsistencies from this point of view that require the use of a private car. This strategy refers to the objective of “sustainable mobility” of the Bologna Charter for the Environment.

The first action involves connecting the Sandro Pertini airport in Caselle with the Porta Susa railway station "A Caselle in treno da Porta Susa” (To Caselle by train from Porta Susa) as at the moment it can only be reached from more peripheral railway stations. Also in the context of the railway connection is the action "Malpensa hub Torinese?" as it is expected the construction of a direct rail link between the international airport of Caselle and Turin. Finally, another connection which is expected to be optimized is the railway line to Genoa and the sea; with the action "A Genova in meno di un’ora” (To Genoa in less than an hour), the aim is to improve a railway line thanks to upgrades on the line and the improvement of the service.

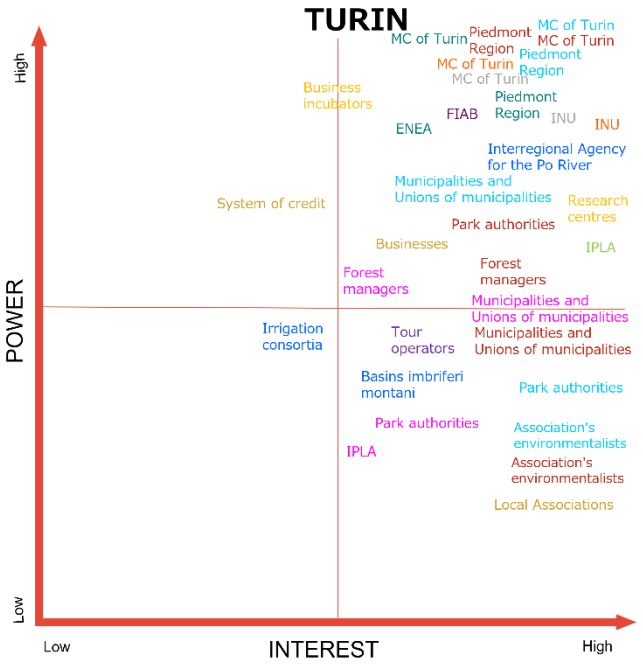
The Swot analysis has been realized underlining especially the opportunities included into the Axes 2 and 3 of the Strategic Plan.

TURIN

PLAN: PIANO STRATEGICO 2021-23 TORINO METROPOLI AUMENTATA (Strategic plan 21-23 Turin Augmented Metropoly)
YEAR OF ADOPTION: 02/02/21

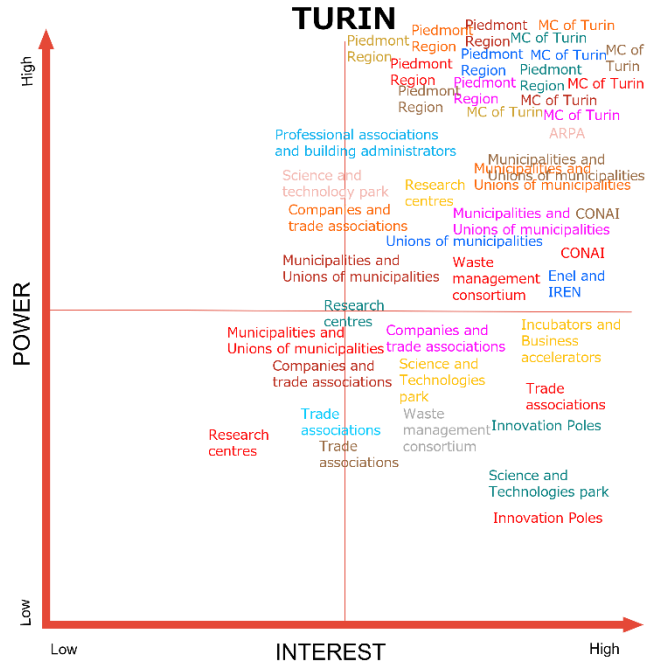

*Table 19 - Swot Analysis of PS Torino Metropoli Aumentata. Source: Author, 2021*

Given the high number of project actions that the two axes envisage, three power-interest tables have been created to include all the players for each of the strategic projects envisaged.




Projects/Actions axis 2:

- **Rete metropolitana delle infrastrutture Verdi:**
  - Piedmont Region, MC of Turin
  - Municipalities and Unions of municipalities
  - Forest managers
  - Park authorities, Association's environmentalists
- **Torino metropoli parco**
  - Piedmont Region, MC of Turin
  - Municipalities and Unions of municipalities
  - Park authorities, Association's environmentalists
- **Gran Bosco Torino**
  - IPLA: Institute for Wood Plants and the Environment
- **Territorio curato**
  - Businesses, Local Associations, System of credit
- **Resilienza idrica fruibile**
  - Interregional Agency for the Po River, Basins imbriferi montani, irrigation consortia
- **Rewilding**
  - MC of Turin, Municipalities and Unions of municipalities
  - Forest managers and Park authorities
  - IPLA: Institute for Wood Plants and the Environment
- **Metropoli ciclabile e pedonale**
  - Tour operators, local associations, the Italian Alpine Club, the Italian Environment and Bicycle Federation (FIAB)
- **Centro di competenza aree dismesse**
  - Research centres
  - Business incubators
- **Rigenerazione territoriale transit-oriented**
  - MC of Turin
  - INU: National Urban Planning Instiute
- **Demolizione edilizia incongrua**
  - Mc of Turin and INU
- **Dalla ruggine al sole**
  - ENEA
  - Piedmont region and MC of Turin




Projects/Actions axis 2:

- **Centro di competenza energia e ambiente**
  - Piedmont Region, MC of Turin, Research centres
  - Innovation Poles and science and technologies park
- **Rete di ricarica elettrica per auto e bici**
  - Piedmont Region, MC of Turin, Union of municipalities
  - Enel and IREN
- **Energie locali**
  - Research centres, science and technology parks
  - Incubators and Business accelerators
- **Comunità rinnovabili and Estendere la più grande comunità energetica d'Europa**
  - Piedmont Region, MC of Turin, Municipalities and Unions of municipalities, companies and trade associations
- **Incentivi alla costruzione del legno**
  - Piedmont Region, MC of Turin, Municipalities and Unions of municipalities, companies and trade associations
- **Scuole eco**
  - MC of Turin, Municipalities and Unions of municipalities, companies and trade associations
  - Compagnia San Paolo and Fondazione Agnelli
- **Bonus dall'edificio alla città**
  - Trade associations, professional associations and building administrators
- **Second life**
  - Piedmont Region, CMTO, Municipalities and Unions of Municipalities, trade associations, research centres,
  - innovation poles, waste management consortium, CONAI
- **Rete centri riuso**
  - Piedmont Region, CMTO, Municipalities and Unions of Municipalities, trade associations
  - Waste management consortium and CONAI: National Packaging Consortium
- **Acque locali and Rifiuti locali**
  - Piedmont Region, CMTO, Municipalities and Unions of Municipalities
  - MOUNTAIN Basin and waste management consortia
- **Servizi ecosistemici metropolitan**
  - Science and technology park and ARPA
- **Green public procurement**
  - CM of Turin, the Piedmont Region, investee companies

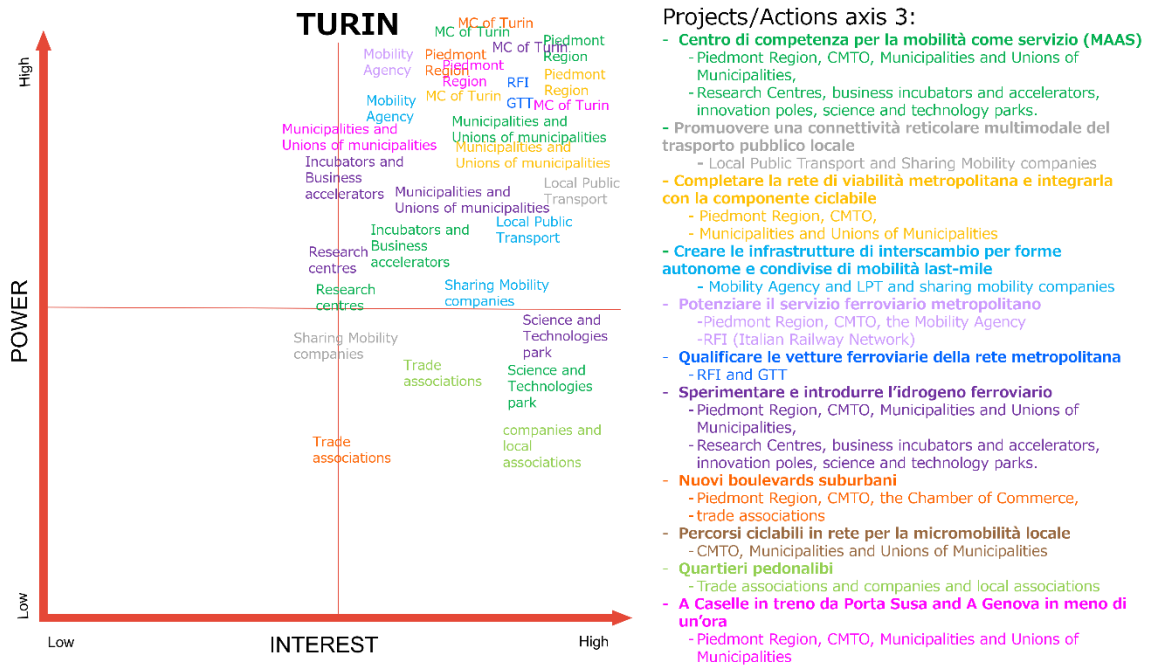



*Table 20 a,b,c - Stakeholders Analysis of PS Torino Metropoli Aumentata. Source: Author, 2021*

For the Turin case study, and in particular for the actions envisaged by each strategy of axes 2 and 3, the most connected to the thesis, a total of three Stakeholders tables were created given the high number of actions envisaged and divided between those of axis 2 and those of axis 3. It is possible to note that in general the Metropolitan City itself and the Piedmont Region are always involved in all actions, as they can play the role of overall promoter and coordinator. There are also various research bodies and business incubators that can guarantee innovation and experimentation in every action, as well as specific actors linked to individual sectors such as ARPA, FIAB, ENEA, Enel or RFI.

| | PSM TORINO METROPOLI AUMENTATA 21-23 | | | | |
|---|---|---|---|---|---|
| AXIS | AXIS 2 - GREEN REVOLUTION AND ECOLOGICAL TRANSITION | | | | |
| STRATEGIES | MORE GREEN | REUSE DISPOSED AREAS | RENEWABLE ENERGIES | GREEN BUILDING | CIRCULAR METROPOLIS |

| | PSM TORINO METROPOLI AUMENTATA 21-23 | | | |
|---|---|---|---|---|
| AXIS | AXIS 3 - INFRASTRUCTURE FOR A SUSTAINABLE MOBILITY | | | |
| STRATEGIES | MULTIMODAL MOBILITY | ENHANCE PUBLIC TRANSPORT | POLYCENTRIC NETWORK | CONNECTION TO NEAR POLES |

*Table 21 a,b - Brief summary of the strategies that the plan provides. Source: Author, 2021*

## ITALIAN CASE STUDIES: MILAN

***Milano: Piano Strategico triennale del territorio metropolitano aggiornamento 2019-2021 – Milano Metropolitana al futuro (Three-year Strategic Plan of the metropolitan area updated 2019-2021 - Metropolitan Milan to the future)***

Metropolitan City of Milan approved its *Piano Strategico triennale del territorio metropolitano aggiornamento 2019-2021* (Metropolitan Strategic Plan), PSM, in September 2019, updating the 2016-2018 Plan previously in force (CM Milano, 2019).

This is the plan that was taken into consideration for the Lombard case study. The plan presents a part of the analysis of the context and the objectives achieved four years after the constitution of the Metropolitan City following the law 56/2014; the central part of the document follows, which includes objectives and actors for each of the guidelines on which the plan is developed. Even the CMMI plan, like that of Turin, is the result of a participatory process that involved many local stakeholders with a bottom-up approach.

The main themes of the plan, which are generally also common to the other strategic plans and which can be found in the strategic lines, are:

- Work, development, innovation
- Social inclusion, welfare and community
- Environment, natural resources and landscape
- Mobility and sustainable energy

The PSM is developed on the 5P sustainable development model, in line with the Italian National Sustainable Development Strategy. The projects envisaged in the plan belong to six policy areas and also integrate with the objectives of the SNSvS; they are:

- Simplification and digitization
- Intercommunality, support for municipalities and European policies
- Economic development, training and work
- Territorial planning, metropolitan welfare and urban regeneration
- Environmental sustainability and parks
- Mobility infrastructures and systems

Considering the filtering process implemented to limit the areas, only the project actions that belong to "Environmental sustainability and parks" and "Mobility infrastructures and systems" were considered. The strategic projects envisaged by the plan are interpolated to these policy areas, which are projects that contribute to improving the competitiveness and

attractiveness of the metropolitan area. In particular, the projects reported by the Metropolitan City of Milan that concern the energy, environment and mobility sector and that Urban@It, the National Centre for Urban Policies, reports in the working paper focused on the Agendas for Sustainable Development of Italian metropolitan cities (Arzà et al., 2020).

The first project reported in the Urban@it working papers is "LifeMetroAdapt Platform" which aims to integrate climate change strategies on the territory of the CM of Milan. The project focuses in particular on the major effects caused on cities, such as heat waves, urban heat islands that develop in inhabited centres due to their conformation and the little presence of greenery and local floods.

The stakeholders involved in the construction of these adaptation strategies to climate change in the metropolitan city of Milan, in addition to the city itself, are: ALDA, European Association for Local Democracy, Ambiente Italia srl, an Environment consulting company, E-GEOS SpA that is a leader in information system and Legambiente Lombardia, an environmental association.

In addition to the desire to build solid governance for the management of climate change in metropolitan areas, Life Metro Adapt promotes Nature Based Solutions for the mitigation of the effects. Furthermore, it is also essential to increase the participation of citizens as they are the first to be involved and can directly implement adaptation measures. With the collaboration of the other Italian metropolitan cities it is also possible to create a strong network of shared experiences and projects.

The project was launched in September 2018 with a total duration of three years. The most involved sustainable development goals are 11 and 13 (United Nations, 2015).

Connected to this project, the "Nature for Cities" project was developed between 2016 and 2021, which derives from the European project Horizon EU and aims to promote the integration of Nature Based Solutions in urban and territorial planning and thus create a platform that can offer alternative solutions in line with the fight against climate change. Among the actors involved in this project there are four public administrations of the municipalities of the metropolitan city including the CM itself, various universities and research institutes.

Another project in the energy field for the reduction of $CO_2$ emissions is "Deciwatt" which aims to promote and implement new tools towards the renewal and energy improvement of existing assets. The main actors of this transition are the Metropolitan City of Milan itself - Area for the environment and protection of the territory and ENEA, New Technologies for Energy and the Environment. Through the “One-Stop-Shop” service, information will be

provided to optimally structure the energy renovation process. The most involved SDGs are 1, 7, 10 and 13 (United Nations, 2015). The project has a duration of 24 months starting from March 2020.

The "Multisource - ModULar Tools for Integrating enhanced natural treatment SOlutions in URban water CyclEs" project, undertaken in June 2021 with a duration of four years, derives from the section of active projects for the environment and the territory of the Metropolitan City of Milan. It has the main objective of creating an innovative process for the implementation of water treatment systems by promoting, in urban areas, the reuse of water, thus avoiding waste and decreasing the amount of energy needed. The project involves Sustainable Development Goals 6 and 12.

Still in the energy field, the "Metro Pizza - wood ovens and clean air" project takes shape with the aim of limiting $CO_2$ emissions from ovens and improving air quality. To do this, good practices have been developed such as the use of biomass, in particular wood-fired ovens, which produce fewer polluting particles. To ensure the success of the project, which ended in February 2020 after three years, all the pizzerias in the area were mapped. The project “PROFILE PIZZA, PaRticOlato da FornI a LEGna for PIZZA” (Particulate matter from wood-fired pizza ovens) was born for the same theme, which aims to study systems for the abatement of pollutants in wood-fired ovens for pizzerias which are, even if less electrically impacting, nonetheless polluting. The project started in 2020 and has a duration of two years. The actors involved are CMMI itself, ENEA, ARPA Lombardia, AMAT, Environment and Territory Mobility Agency and the University of Milan.

In particular, the Metro Pizza project also involves national expert associations in the sector.

The “Cambiamenti Climatici e Territorio” (Climate change and territory) project which envisaged the construction of a roadmap towards the drafting of the Climate Plan of the Metropolitan City of Milan. The stakeholders of the project are CMMI itself, the Milan Polytechnic and the IUAV University of Venice.

The project "Verso i paesaggi dell’abitare e del lavorare a prova di clima” (Towards climate-proof living and working landscapes) is still moving on climate design, with the aim of improving the comfort of public spaces and production areas in the Milanese hinterland. The project, which lasted fifteen months from April 2019, aimed to map which areas are most vulnerable and identify pilot project actions by developing a focus on the area of work and living to increase well-being in places and comfort. The stakeholders involved in this project are CMMI, the Politecnico di Milano with the Departments of Architecture and Urban Studies and the Planning & Climate Change Lab of the IUAV University of Venice.

The Swot Analysis of the strategic plan of the city of Milan included some of the emissions reduction projects within the opportunities and others were included in the threats to indicate their resolution.

MILAN

PLAN: PIANO STRATEGICO TRIENNALE - MILANO METROPOLITANA AL FUTURO (Strategic Plan - Metropolitan Milan to the future)
YEAR OF ADOPTION: 01/09/19

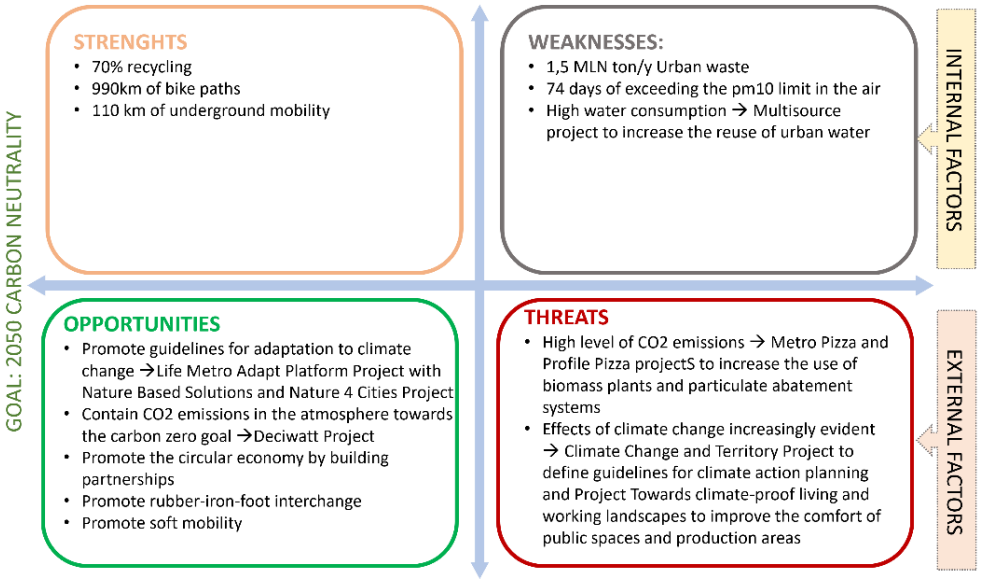



*Table 22 - Swot Analysis of PS Milano Metropolitana al Futuro. Source: Author, 2021*

Doing the Stakeholder analysis in the case of the Metropolitan Cities of Milan, the key players in the planned projects towards achieving climate neutrality are easily identifiable; the metropolitan city itself is the actor who can guide all the planned projects. The participation of some local bodies and research organizations as well as universities, the Politecnico di Milano and associations such as Enea, Arpa and Amat is also expected.

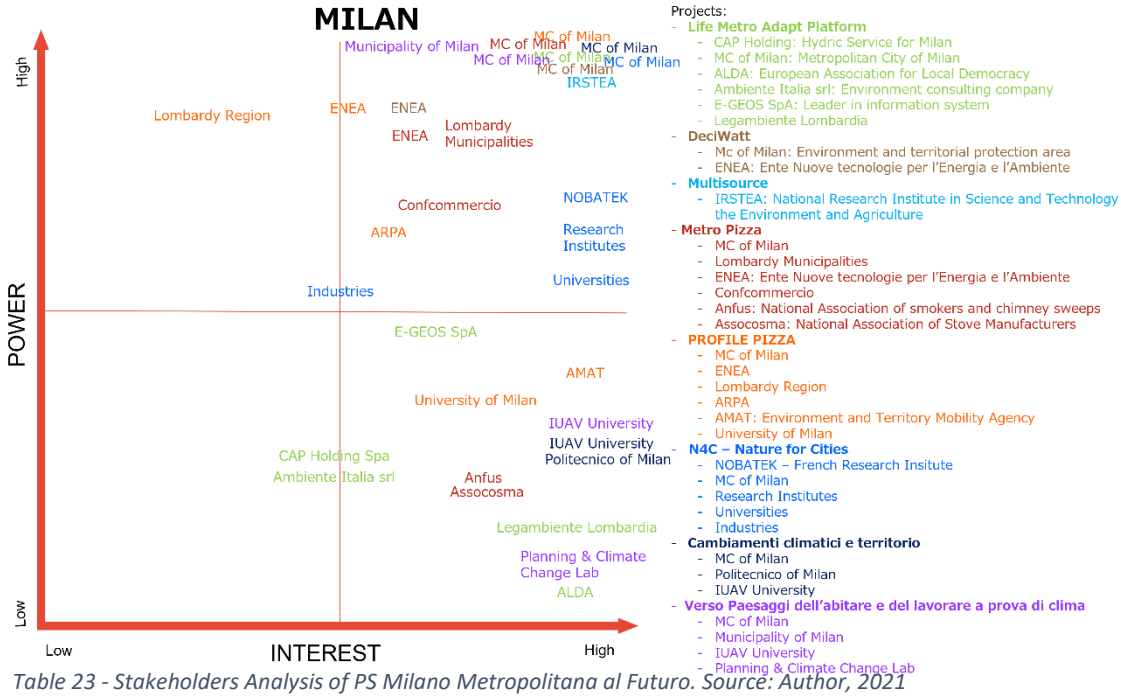



*Table 23 - Stakeholders Analysis of PS Milano Metropolitana al Futuro. Source: Author, 2021*

| | PSM MILANO METROPOLITANA AL FUTURO | | | | | |
|---|---|---|---|---|---|---|
| Actions and strategic lines | NBSs | Energy Renovation project | Natural treatment SOlutions in URban water CyclEs | Limiting emissions using biomass | NBSs Platform | Mapping data on climate vulnerability and socio-ec function |

*Table 24 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## ITALIAN CASE STUDIES: GENOA

***Piano Strategico della Città Metropolitana di Genova – Genova Piano Strategico Metropolitano (Strategic Plan of the Metropolitan City of Genoa)***

The *Piano Strategico della Città Metropolitana di Genova* (Metropolitan Strategic Plan of the city of Genoa) (CM Genova, 2017) approved in April 2017, took shape after various consultation and planning phases and following a complex participatory process that also saw the creation of focus groups and workshops which citizenship has participated in.

This is the plan that is being examined for the CM of Genoa as it reflects the criteria established in the Filtering phase of this research process.

There are five strategic lines on which the strategic plan in question is structured:

- Coordinate the change
- Develop metropolis Genoa
- Optimize services
- Adapt to climate change
- Build a sense of belonging to the Metropolitan City

There are many issues that have been identified and which are at the basis of the construction of the PSM, but the focus, also in this case, is on policies and projects in progress or already implemented towards the ecological transition with particular attention to the environment, energy sector and mobility.

The projects implemented in the process of implementation and territorialisation of the Agenda 2030 and with the objective of ecological transition are reported in part in the text of the Metropolitan Strategic Plan, but above all in the Urban@it working paper published

in 2019 and which deals specifically the theme of the *L'Agenda 2030 nel caso di Genova: l'innovazione tra sperimentazione e coordinamento* (Agenda 2030 in the case of Genoa: innovation between experimentation and coordination) (Lombardini and Risso, 2019).

Among all those reported, through the filtering process already explained above, those of the energy, environment and mobility sectors were taken into consideration for the purposes of the research thesis conducted.

"UnaLab - Urban Nature Labs" is included in the European project Horizon 2020 and aims to develop a more resilient, sustainable and smart city thanks to the use of Nature Based Solutions, as already envisaged by the Metropolitan city of Milan to cope with the effects of climate changes. There are numerous stakeholders included in this project; in fact, it includes a total of 28 partners from European and non-European cities of which four, including Genoa, is among the pioneers of NBSs practices. The project started in June 2017 and it is expected that by 2022, among other things, a park will be built in the area affected by the collapse of the Morandi viaduct in the Polcevera valley.

In the field of mobility, the project currently being implemented is "ELVITEN Electrified L-category Vehicles Integrated into Transport and Electricity Networks" which started in November 2017. It is also a project funded by the European project Horizon EU which aims to demonstrate how light electric vehicles can be successfully integrated into the already existing transport network of six European cities, including Genoa. The general objective of the project is to reduce the impact in terms of $CO_2$ emissions of the transport sector by encouraging the use of electric vehicles through the installation of new charging stations, monitor the fleet of electric vehicles and create a service free for shared electric vehicles. Among the stakeholders most involved in the project are various soft mobility promotion associations and the electricity supplier, as well as CM of Genoa itself.

With the aim of reducing energy needs and therefore reducing emissions of greenhouse gases into the atmosphere, the "Force - Cities Cooperating for Circular Economy" project was born, which involves the construction of reuse centres to promote the circular economy starting from management some waste.

The project involves 22 partners at European level, of which four are the main cities as they focus on the reuse and recycling of a particular material: Copenhagen deals with plastics, Hamburg with electrical and electronic waste, Lisbon with organic waste and Genoa with wood. The project's actions include the creation of partnerships between public and private actors for the reuse and recycling of a specific material.

Still in the energy sector, the "E.L.En.A – European Local Energy Assistance" project envisages the creation of a technical assistance system to help cities and regions to develop and implement projects that contribute to the objectives set by the Covenant of Majors with the objective 20- 20-20; to reduce greenhouse gas emissions by 20%, increase the share of energy produced from renewable sources to 20% and achieve 20% energy savings. The areas of intervention of the project are municipal public lighting, improved efficiency of municipal public buildings, sports facilities and school buildings managed by CM.

In detail, the project is articulated by Genoese case with the GEN-IUS project, “GENoa - Innovative Urban Sustainability”, which provides for the energy requalification of public buildings, the replacement of street lighting devices with more modern ones that guarantee greater energy savings as well as that the creation of energy districts connected to the Municipality of Genoa.

Finally, the pilot action “Parco Tigullio” located in Lavagna, municipality of the CM of Genoa, provides for the creation of a sustainable metropolitan space that simultaneously integrates the resilience of the urban space, zero emissions, soft mobility and zero waste. This project aims to be the experimentation of the birth of an urban space that unites all areas of sustainability, guaranteeing an effective ecological transition. The actors involved in this pilot project are the municipality of Genoa and CM itself.

The Swot analysis includes in the field of opportunities all the projects that the Metropolitan City of Genoa wants to carry out or is already working on to reduce the amount of $CO_2$ emitted.

GENOA

PLAN: PIANO STRATEGICO METROPOLITANO (Metropolitan Strategic Plan)
YEAR OF ADOPTION: 21/04/17

GOAL: 2050 CARBON NEUTRALITY

**STRENGHTS**
- 71,4% efficiency of water services
- Tourist attractions
- Environmental quality
- A widespread quality of life

**WEAKNESSES**
- 30% recycling
- Disruption of the territory and climate change
- The inefficiency of connections and public transport

INTERNAL FACTORS

**OPPORTUNITIES**
- UNaLAB project: adoptions of Nature Based solutions → allows the development of a European reference framework on the benefits, economic feasibility, etc. of NBS
- ELVITEN project: for the diffusion of sustainable mobility in private individuals → diffusion of the use of electric vehicles in urban areas
- FORCE project: to encourage the circular economy →Genoa deals with wood
- GEN-IUS →project for the reduction of $CO_2$ emissions

**THREATS**
- Poor ability to attract new investments and talent
- High level of $CO_2$ emissions
- Strong vulnerability to the climate change

EXTERNAL FACTORS

*Table 25 - Swot Analysis of PS Metropolitano. Source: Author, 2021*

In the case of the Metropolitan city of Genoa, the metropolitan city itself plays a key role in mitigation and reduction actions; however the involvement of non-profit associations and private entities is also envisaged.

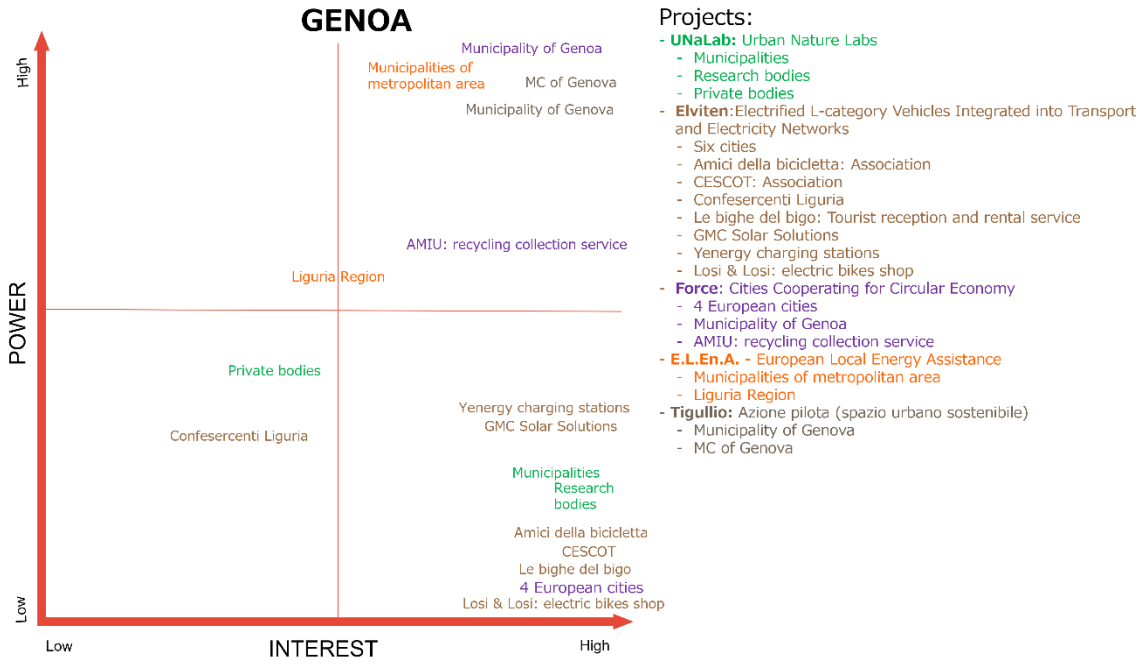



*Table 26 - Stakeholders Analysis of PS Metropolitano. Source: Author, 2021*

| | PSM GENOA | | | |
|---|---|---|---|---|
| Actions and strategic lines | NBSs | Electric mobility in systematic travel | FORCE - Cities cooperating for Circular Economy | GEN-IUS - Energy renovation of pubblic building |

*Table 27 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## ITALIAN CASE STUDIES: BOLOGNA

### *Piano Strategico Metropolitano di Bologna 2.0 (Bologna Metropolitan Strategic Plan 2.0)*

With the determination of the criteria for the choice of plans for each case study, the *Piano Strategico Metropolitano di Bologna 2.0* (Metropolitan Strategic Plan of Bologna 2.0), approved and adopted in July 2018, was chosen and critically analysed for the Metropolitan City of Bologna (CM Bologna, 2018).

The plan is based on three main pillars:

- Sustainability
- Inclusiveness
- Attractiveness

The three characteristics mentioned are articulated and developed in seven sectoral areas of implementation which are:

i. Metropolitan Bologna: sustainable, responsible and attractive
ii. Urban and environmental regeneration
iii. Mobility
iv. Manufacturing, new industry and training
v. Culture, knowledge, creativity and sport
vi. Education and upbringing
vii. Health, welfare, well-being

The key principle on which the plan is structured is the will to formulate objectives, actions and strategic lines in line with the characteristics and strengths of the territory, population and economy of the area.

The project actions and strategic lines proposed within the plan are many, but in particular four pilot projects have been identified to implement actions in the proposed areas, in particular in the field of mobility, sustainability and urban and environmental regeneration, as reported in the Urban@it working paper *Le strategie di sviluppo sostenibile della città metropolitana di Bologna* (The sustainable development strategies of the metropolitan city of Bologna) (Capuzzimati et al., 2020).

The first pilot action concerns the "Transizione verso l'economia circolare nel territorio collinare e montano della Città metropolitana di Bologna" (Transition towards the circular economy in the hilly and mountainous territory of the Metropolitan City of Bologna) and provides for the identification of guidelines for the transition towards the circular economy

model of companies located in the Tuscan-Emilian Apennines which, however, consider the particular characteristics of the territory in order to minimize energy consumption, the use of natural resources and the emission of greenhouse substances. The guidelines for the transition to the circular economy must also take into account the overall costs and those of mitigation or adaptation to climate change. The project also aims to raise awareness among administrations and citizens in the context of the definition of good practices which, once identified, can be shared and replicated. The project has a total duration of fifteen months and will end at the end of 2021.

The Metropolitan city of Bologna is the only one, at the moment, to have already formulated a Metropolitan Agenda in Italy, as required by the National Sustainable Development Strategy.

Another pilot action in the process of territorialisation of the sustainable development objectives and the realization of the proposed objectives is the "Studio di prefattibilità sulla riorganizzazione dei servizi di trasporto pubblico nelle aree produttive" (Pre-feasibility study on the reorganization of public transport services in production areas) as reported in the Urban@it working paper (Capuzzimati et al., 2020); in fact, the identification of the necessary services and conditions is envisaged to be able to create new local public transport lines directed to the most important industrial or logistic areas within the metropolitan city.

The project provides for a strong involvement of workers with a bottom-up approach from individual workers, thanks to questionnaires, and an analysis of the production system and existing mobility in order to study an improvement.

With reference to the field of urban and environmental regeneration, the pilot action "Linee guida per la forestazione metropolitana" (Guidelines for metropolitan forestry) is developed which aims to reduce emissions of greenhouse gases into the atmosphere by identifying an urban forestry model for public parks, but also of green areas along watercourses or on areas intended for mining activities.

Finally, the pilot action "Operation Center & City Web" is an experimental project that involves the participation of three municipalities in addition to the metropolitan city of Bologna and provides for the creation of two informatic platforms for sharing and exchanging information and good practices between the municipalities. of the metropolitan city involved in the project.

These two platforms have the objective, also thanks to the creation of a sensor system, to detect the different needs of cities and therefore to be able to develop suitable policies.

The Swot analysis identified among the opportunities the strategic projects that the Metropolitan city plans to implement to ensure a decrease in $CO_2$ emissions into the atmosphere.

BOLOGNA

PLAN: PIANO STRATEGICO METROPOLITANO PSM 2.0 (Metropolitan Strategic Plan 2.0)
YEAR OF ADOPTION: 07/18

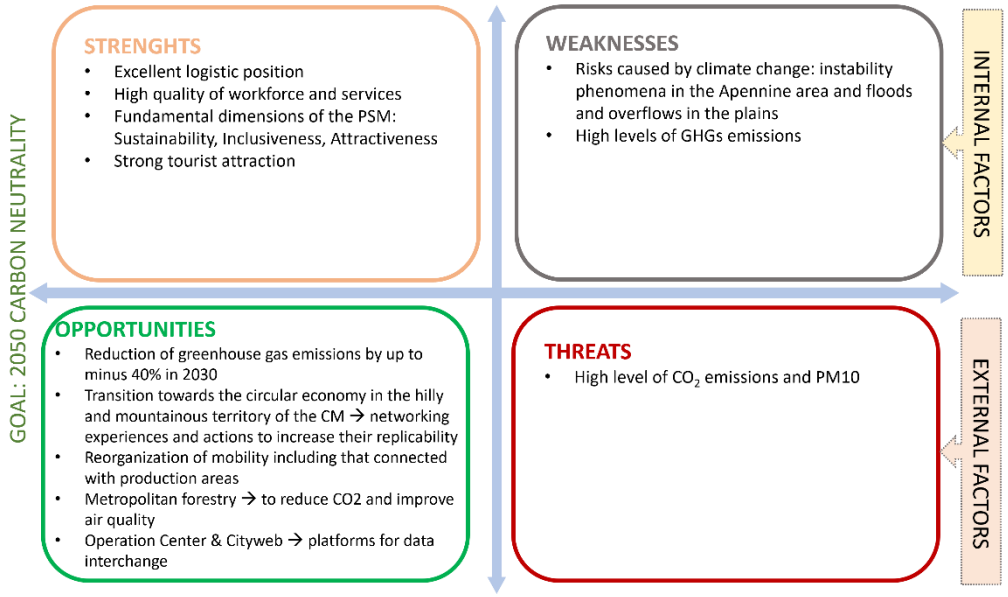



*Table 28 - Swot Analysis of PSM 2.0. Source: Author, 2021*

The stakeholder analysis, on the other hand, made it possible to identify the main players for each of the strategic lines.

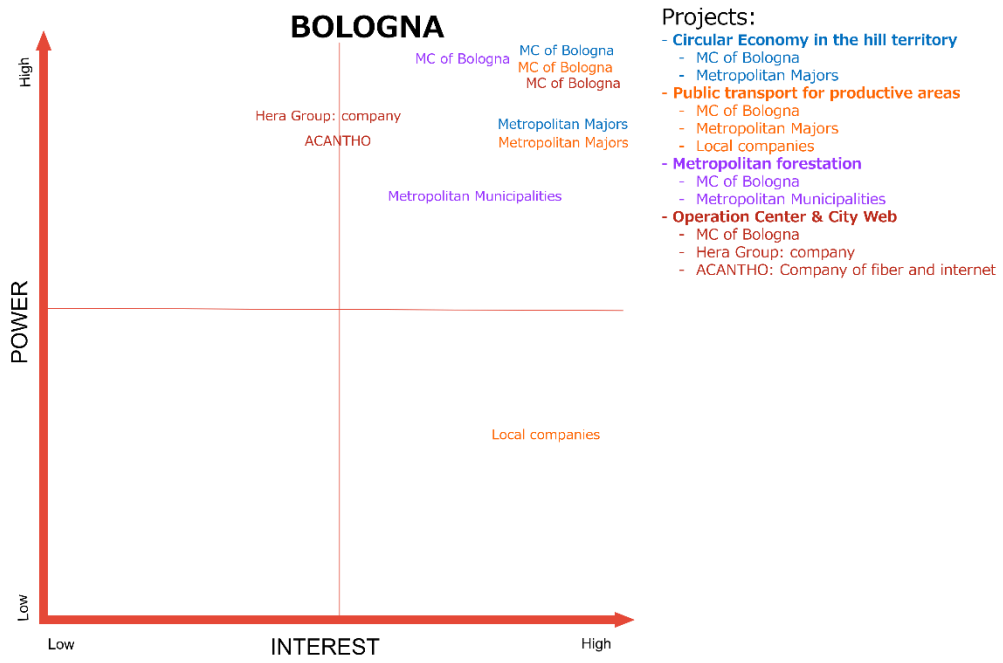



*Table 29 - Stakeholders Analysis of PSM 2.0. Source: Author, 2021*

The metropolitan city of Bologna is among the actors with the greatest interest and greater power in the projects envisaged by the respective strategic plans; the metropolitan mayors and municipalities of the metropolitan city are also involved.

| | PSM BOLOGNA 2.0 | | |
|---|---|---|---|
| Actions and strategic lines | Circular economy in hill territory | Reorganization of public transport in production areas | Metropolitan Forestation |

*Table 30 - Brief summary of the actions that the plan provides. Source: Author, 2021*

## ITALIAN CASE STUDIES: VENICE

***PSmVE – Piano Strategico Metropolitano triennio 2019-2020-2021 Città Metropolitana di Venezia (PSmVE - Three-year Metropolitan Strategic Plan 2019-2020-2021)***

The plan chosen in the filtering step for this thesis work for the Metropolitan City of Venice is the *Piano Strategico Metropolitano triennio 2019-2021* (Metropolitan Strategic Plan 19-21) approved with a resolution of the Metropolitan Council in December 2018 (CM Venezia, 2018).

It is built in line with the objectives of the Italian SNSvS and articulates its strategic lines following the 5P model, therefore not only the environmental component is involved but the social and economic one. Thanks to the filtering process already implemented for the other case studies, for the purposes of this master's thesis, the projects envisaged by this PSM in the field of environment, energy and mobility have been taken into consideration.

The general lines provided for in the plan are:

- Identity
- Development
- Resilience

Thirteen program lines and five projects have been developed from these towards achieving the objectives of the Agenda 2030 which would see the process of territorialisation of the sustainable development objectives, in the environment, energy and mobility, concretized. The whole strategic plan, like the others, is the result of an important participatory process that involved many stakeholders, which allowed for the creation of an integrated and functional plan.

First of all, to ensure that the Metropolitan City of Venice has all the necessary tools to implement an effective ecological transition is "P.AGE.S - from the Strategic Plan to the AGEnda for the sustainable development of the metropolitan city of Venice" which aims to give the Metropolitan City of Venice, with the collaboration of the Ministry of Ecological Transition (MiTE), the Metropolitan Agenda of Venice. Its implementation involves the participation of local actors and institutions, a context analysis, the monitoring of a set of indicators and the study of the related SDGs.

The project "AMICA-E – Azioni metropolitane intercomunali per l'ambiente e l'energia" (Inter-Municipal Metropolitan Actions for the Environment and Energy), promoted by the CM itself and financed by the European Commission, belongs to the energy sector with the aim of creating energy efficiency works and for the production of energy from renewable sources.

The main objective of the project is to give a significant boost to all energy regeneration interventions, thanks to significant funding, interventions that alone would give much lower results than expected. In fact, the goal is to achieve a significant reduction in $CO_2$ in the atmosphere; to do this, interventions are planned on public buildings and public lighting systems. The stakeholders involved are CM of Venice and twenty-five municipalities belonging to the same CM. The metropolitan city of Venice, but in particular the municipality of Venice, has a very strong climatic and environmental vulnerability due to the normal conformation below sea level, which exposes it to serious consequences following current and future climate changes.

With the project "Central Veneto Cities netWorking for ADAPTation to Climate Change in a multi-level regional perspective" CM of Venice in collaboration with the IUAV University of Venice, the Municipality of Treviso and Vicenza and SOGESCA Srl, a consulting company, intends to develop a methodology together with operational tools that can be replicated on different territorial realities for the adaptation to climate change at metropolitan and regional level. The project also wants to create a monitoring system that allows measuring the actions envisaged in the plans that will be approved to determine the mitigation and

adaptation measures with particular attention to issues related to hydrogeological risk. The project started in July 2017 and will end in March 2022.

Another project related to the energy field is "SECAP - Action Plans for Sustainable Energy and Climate" which provides for the transition from Action Plans for Sustainable Energy, “SEAP, to Action Plans for Sustainable Energy and Climate” thanks to support to the municipalities of the metropolitan area for the implementation of sustainable energy and climate adaptation policies. The main objective of the project is to ensure better energy planning of local authorities aiming at the development of renewable energy, energy saving and to ensure lower emissions of greenhouse gases into the atmosphere. The project initially envisages a study on the effects of climate change on the area affected by the project in order to then be able to define strategies and projects that can be applied to different territorial realities in order to increase the resilience of urban areas. Finally, the “SPROUT - Sustainable policy response to urban mobility transition” project, given the centrality of the port and the territory of Venice, focuses on the sustainable movement of goods and passengers. It is a project still under validation and was developed within the European Horizon EU 2020 project; it envisages defining new ways of mobilizing goods and people through more sustainable mobility systems. Through initial monitoring it will in fact be possible to define new and innovative policies for the movement of goods and people in a more sustainable way and with a lower level of greenhouse gas emissions into the atmosphere.

Venice, together with Genova, is the Italian metropolitan cities most vulnerable to the effects of climate change given its position respectively on a strip of land between the sea. A city that rises mainly below sea level and is therefore strongly affected by high tide waves that make connections difficult. In addition, with the increase in temperatures and therefore the consequent melting of the glaciers that causes the sea level to rise, some areas would be completely submerged by water.

In the Swot analysis, among the opportunities, all the projects to mitigate the effect of climate changes are listed.

VENICE

PLAN: PIANO STRATEGICO METROPOLITANO PSM TRIENNIO 19-21 (Metropolitan Strategic Plan Three-year period 19-21)
YEAR OF ADOPTION: 21/12/18

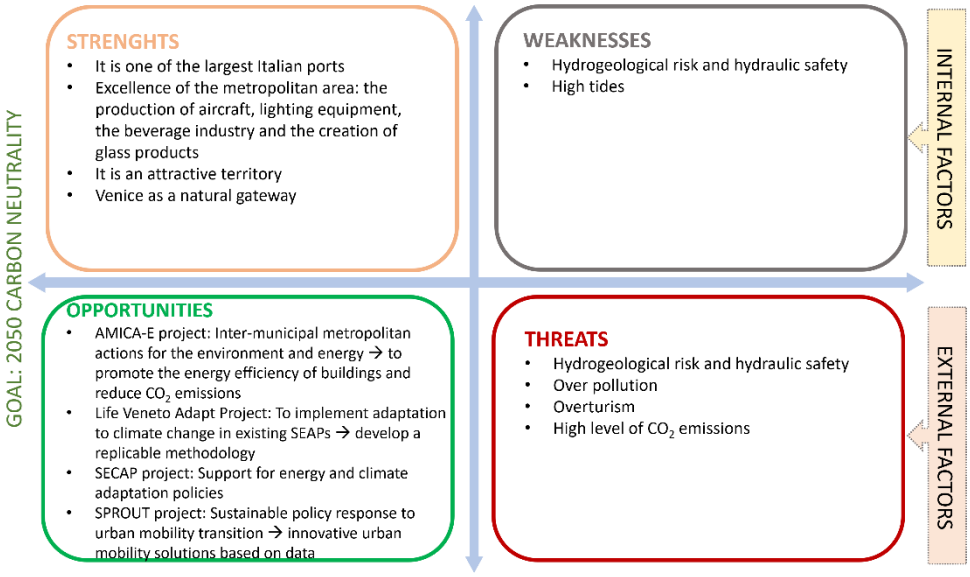



*Table 31 - Swot Analysis PSM Triennio 19-21. Source: Author, 2021*

In the Stakeholder analysis all the actors involved in the mitigation projects are included.

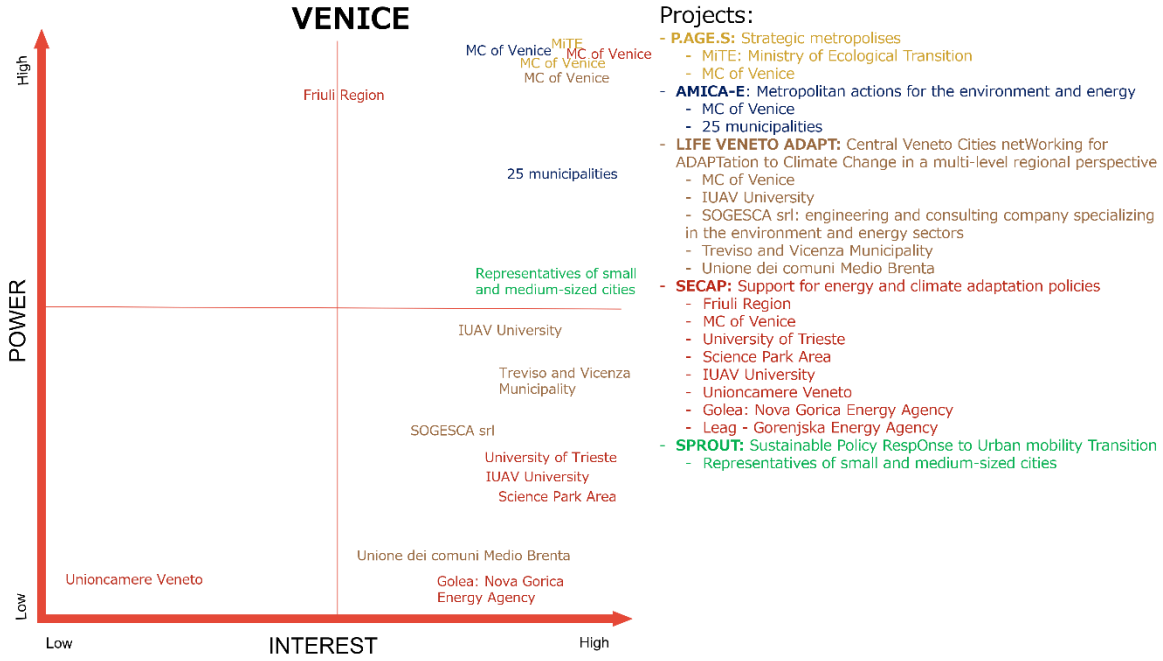



*Table 32 - Stakeholders Analysis of PSM Triennio 19-21. Source: Author, 2021*

| | PSM VENICE | | |
|---|---|---|---|
| Actions and strategic lines | AMICA-E - Energy investment | Life Veneto Adapt - tools for adapt to CC | Energy Renovation projects |

*Table 33 - Brief summary of the actions that the plan provides. Source: Author, 2021*

In some cases, only the actions relevant in the field of ecological transition are reported in the brief summary.

Phase 2: Analysis of the plans that not follow the 5P model

In order to determine what are the good practices and the determining factors for the ecological transition for cities, starting from the analysis of the case studies, the thesis also examined the plans drawn up on the basis of the Circular Economy and Doughnut Economy model. The European case studies that have drawn up plans relating to the Circular Economy are Amsterdam, the leader in the entire sector, and Paris, which is also moving towards this model to guarantee the ecological transition of the city. Furthermore, Turin too, with the plan approved in February 2021, places among its objectives the "Circular Turin Metropolis" with new measures and strategies to be implemented (CM Torino, 2021).

***Amsterdam Circular 2020-2025 Strategy***

The City of Amsterdam drafted the *Amsterdam Circular 2020-2025* plan in 2020 in collaboration with Circle Economy (City of Amsterdam, 2020b).

The goal of the city of Amsterdam with the drafting of this plan is to be completely circular by 2050 and to halve the use of raw materials by 2040. The circular model in fact provides that everything is recycled and reused in order to eliminate the amount of energy necessary to produce new objects and to dispose of used ones. The plan distinguishes five main areas in which to achieve circularity derived from the National Raw Materials Agreement:

- Food and Organic waste streams
- Consumer goods
- Built environment
- Manufacturing industry
- Plastics

Only the first three have been taken into consideration in detail given their importance also from an economic point of view. The first sector aims to reduce the excess of material produced and minimize the impact on the production of food needs; in general, in fact, the focus is on a regional production of food consumed or directly in the cities as well as maturing in the inhabitants of Amsterdam the awareness of how important it is to change their eating habits towards a more sustainable and less ecologically impacting model as well as promoting campaigns against food waste so that surplus food is donated to the families who need it most.

Furthermore, the city of Amsterdam plans to better organize the waste collection system for each of the city's districts, so that reusable objects are directly extracted from the waste produced. An important role is played by the administration itself, which must sensitize its citizens to separate collection and correct waste separation in order to facilitate recycling operations. The promotion campaign and awareness of the importance of this process will be carried out through meetings and discussions in schools, thanks to industry associations and initiatives promoted by individual neighbourhoods. In addition, the city has provided for the construction of special places designed for the collection of waste by type in order to encourage the recycling process.

The second sector under analysis, on the other hand, aims to create an efficient infrastructure for sharing, reusing, repairing objects considered differently by now waste; however, these steps are subordinated to a good graphic design that allows reuse over and over again. The city has the goal by 2022 at the latest to return to managing the collection and disposal of waste. To achieve circularity in this sector, the city intends to favour the reuse of products rather than the creation of new ones. To do this, it is necessary to encourage dialogue and collaboration between various entities interested in developing circular production. In this field it is necessary to promote good practices towards reuse and reuse and raise awareness among people of its importance. Finally, the city intends to equip itself with new infrastructures useful for reuse and sharing.

The companies of Amsterdam also play an important role; they, together with educational institutions and public authorities have established “waste to new materials”, a set of city bodies that promote the recycling of used material into new products.

Especially for electrical objects, the reuse of those devices that are thrown away but still functional is envisaged.

For the third sector, the built environment, aims to establish precise criteria to achieve circularity in this sector as well; in particular, the use of recycled or natural material as a building raw material is envisaged. A municipal competence centre will also be established

to provide technical advice on good practices that can be put into use to achieve circularity. Among the actions to achieve circularity, the city of Amsterdam wants to decrease the number of new buildings built and on the contrary, promote the reuse of dimes yes already existing.

The city foresees the creation of a “circular toolbox” which includes technical, financial and social information for the achievement of circularity.

In general, by applying the principles of the circular economy in all the aforementioned sectors, an abundant reduction in emissions of greenhouse gases into the atmosphere would be possible.


*Figure 31 - Summary of the effects and benefits of sustainability in Amsterdam. Source: (City of Amsterdam, 2020a)*

***Paris Circular Economy Plan 2017-2020***

The other European city that aims to achieve circularity is Paris, which in 2017 approved the *Paris Circular Economy Plan* (City of Paris, 2017).

Achieving circularity is the goal of many European countries, but Paris in particular wants to achieve this result; among the objectives it sets itself is the extension of the separate collection network and in particular the definition of a special procedure for the collection of plastic by 2022 and the recovery of 70% of construction waste. It is also foreseen that the landfill will be used only as a final stop for products that in no way can be reused.

The plan therefore reports the main challenges that the city of Paris has set itself with the achievement of circularity are:

- Control of the food chain
- Recovery of sources of organic
- The fight against food wastage
- Visibility of the goods supply
- Impacts of the construction industry
- Support for innovation and new economies
- Solutions facilitating access to and sharing of premises and property
- Priority to short production and distribution chains

Achieving total circularity would guarantee, in addition to environmental benefits, as $CO_2$ emissions would be greatly reduced with all the positive effects that derive from it, but also the creation of numerous jobs in the sector.

To achieve this goal, the city of Paris has prepared numerous actions in different sectors which are summarized in this table in the *Paris Circular Economy Plan* (City of Paris, 2017).

For example, the city of Paris wants to recover wood waste present in green spaces, recycle road materials, develop urban agriculture and recover heat from data centres. Furthermore, decrease the degree of heating of public buildings and limit water consumption in green spaces. The city also plans to create a fleet of shared city vehicles and encourage separate collection, especially organic waste.

| | | |
|---|---|---|
|  | **Recovery of green waste** | • Recycling of wood waste from green spaces<br>• Recovery of Christmas trees |
|  | **Recovery of materials** (from construction and public works) | • Recycling of products of funerary monument dismantling<br>• Recycling of road materials<br>• Recovery of materials during large-scale renewal works<br>• Digital inter-departmental exchange platform |
|  | **Ecodesign of venues and events** | • Green space ecodesign reference<br>• Charter of eco-responsible events |
|  | **Sustainable and responsible supplies** | • Supply of organic and sustainable products in canteens<br>• Socially and environmentally responsible public procurement scheme<br>• Development of urban agriculture |
|  | **Energy:** recovery and reuse of heat and cold | • Recovery of heat from wastewater to heat public buildings<br>• Recovery of heat from data centres<br>• Cooling of public buildings |
|  | **Water management** | • Development of the non-potable water network and uses<br>• Rational water management in green spaces |
|  | **Mobility and goods transport** | • Development of urban logistics spaces<br>• Shared municipal fleet (cars and bicycles) |
|  | **Organic waste:** separate collection for recovery | • Collection of organic waste (municipal restaurants and markets)<br>• Launch of separate collection of household food waste<br>• Support and assistance for collective composting |
|  | **Consumer goods:** facilitating extension of the lifecycle | • Recovery of IT and telephony equipment<br>• Reuse of furniture<br>• Experimentation with sharing kiosks<br>• Support for reuse actors (recycling centres, repair cafés, etc.) |
|  | **Zero waste path:** facilitating sorting | • Deployment of Emmaüs Eco-Systems solidarity collections<br>• Improving the proximity of bulky waste collection points |
|  | **Fight against food wastage** | • Fight against food wastage in municipal canteens<br>• Recovery of unsold items on food markets<br>• Support to non-profit organisations to collect unsold food items |

*Figure 32 - Actions planned to make Paris Circular. Source: (City of Paris, 2017)*

### 4.2.2 Possible implementations in the case of the Metropolitan City of Turin

Thanks to the critical reading of the chosen plans get through the initial filtering process, the Swot analysis which highlighted the strengths, weaknesses but above all the opportunities for each case study and, finally, and by the analysis of the actors involved in the projects of transition towards achieving climate neutrality, it was possible to carry out a comparative analysis between the actions that are envisaged by the *Piano Strategico Metropolitano – Torino Metropoli Aumentata* (Turin Metropolitan Strategic Plan 21-23) in axes 2 and 3, respectively Green revolution and ecological transition and Infrastructures for sustainable mobility, and all the actions, pilot projects or strategic lines envisaged by the other case studies.

To determine which good practices envisaged by the different case studies are not in the Strategic Plan of Turin, all the measures for each case studies have been collected in some tables that allow the comparison between the good practices.

The actions already included in the metropolitan strategic plan of Turin are shown in yellow; in green, on the other hand, those that could be implemented. For the latter, the sector of action is also reported: ENV = Environment, EN = Energy, MOB = Mobility.

| | PSM TORINO METROPOLI AUMENTATA 21-23 | | | | |
|---|---|---|---|---|---|
| AXIS | AXIS 2 - GREEN REVOLUTION AND ECOLOGICAL TRANSITION | | | | |
| STRATEGIES | MORE GREEN | REUSE DISPOSED AREAS | RENEWABLE ENERGIES | GREEN BUILDING | CIRCULAR METROPOLIS |

| | PSM TORINO METROPOLI AUMENTATA 21-23 | | | |
|---|---|---|---|---|
| AXIS | AXIS 3 - INFRASTRUCTURE FOR A SUSTAINABLE MOBILITY | | | |
| STRATEGIES | MULTIMODAL MOBILITY | ENHANCE PUBLIC TRANSPORT | POLYCENTRIC NETWORK | CONNECTION TO NEAR POLES |

*Table 34 a,b - Strategies included into Axes 2 and 3 of the PS Torino Metropoli Aumentata. Source: Author, 2021*

The following tables, 35,36,37,38, report the comparison among all the planned actions.

| | STRATEGIC LINES AND GOOD PRACTICES EXPECTED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEW AMSTERDAM CLIMATE | | | | | CPH 2025 CLIMATE PLAN | | | | | | |
| Actions and strategic lines | Energy Renovation project | Heat Decarbonisation | Green Hydrogen | Charging point | Zero emissions from taxis | Energy renewable consumption | Energy efficiency buidings | Increased use of solar cells | Wind turbines for energy production | Improve safe conditions for cyclists | Conversion of car fleet to electricity or hydrogen | Electric engine in Copenhagen |
| PSM TORINO METROPOLI AUMENTATA AXES 2 & 3 | EN | EN | EN | | MOB | EN | | EN | EN | MOB | MOB | MOB |

*Table 35 - Good practices comparison table PSM Turin - Amsterdam - Copenhagen Source: Author, 2021*

| STRATEGIC LINES AND GOOD PRACTICES EXPECTED | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PARIS ACTION CLIMATE PLAN | | | | | | | | | | | |
| Actions and strategic lines | Use roofs for energy production | Limit night time lightning of non-residential buildings | Urban green on roofs and walls and urban agriculture | Tax on printed advertising materials | Exploit geothermal resources | Replace lightning system with LED | Participatory production of renewable energy | New Infrastructures for cycling mobility | Emission-based parking rates | New style of driving | Buildings should have versatility | Energy renovation in buildings |
| **PSM TORINO METROPOLI AUMENTATA** AXES 2 & 3 | | ENV | ENV | ENV | EN | EN | EN | | MOB | MOB | EN | |

*Table 36 - Good practices comparison table PSM Turin - Paris. Source: Author, 2021*

| STRATEGIC LINES AND GOOD PRACTICES EXPECTED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | BRISTOL ONE CITY PLAN | | | | | | BASQUE ENERGY STRATEGY | | | | |
| Actions and strategic lines | Increase the use of ultra-low emissions vehicles | Energy renovation in buildings | Heat decarbonisation with electric heat pumps | Install solar and PV panels on roofs | Reduction in waste production through reuse | Restoration of natural environment | Increase the use of biomass for energy production | Promotion of electrical transport | Promotion of energy sustainability | Energy production from sustainable resources | Promotion of soft mobility |
| **PSM TORINO METROPOLI AUMENTATA** AXES 2 & 3 | MOB | | EN | | | | EN | | | | |

*Table 37 - Good practices comparison table PSM Turin - Bristol - Basque Country. Source: Author, 2021*

| STRATEGIC LINES AND GOOD PRACTICES EXPECTED | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PSM MILANO METROPOLITANA AL FUTURO | | | | | | PSM GENOA | | | | PSM BOLOGNA 2.0 | | | PSM VENICE | | |
| Actions and strategic lines | NBSs | Energy Renovation project | Natural treatment SOlutions in URban water CyclEs | Limiting emissions using biomass | NBSs Platform | Mapping data on climate vulnerability and socio-ec function | NBSs | Electric mobility in systematic travel | FORCE - Cities cooperating for Circular Economy | GEN-IUS - Energy renovation of pubblic building | Circular economy in hill territory | Reorganization of public transport in production areas | Metropolitan Forestation | AMICA-E - Energy investment | Life Veneto Adapt - tools for adapt to CC | Energy Renovation project |
| **PSM TORINO METROPOLI AUMENTATA** AXES 2 & 3 | ENV | EN | | EN | ENV | ENV | ENV | MOB | | | | MOB | | EN | ENV | EN |

*Table 38 - Good practices comparison table PSM Turin - PSM Milan, Genoa, Bologna and Venice. Source: Author, 2021*

In the following paragraphs, 4.2.2.1, 4.2.2.2 and 4.2.2.3, all the actions that in the previous tables are in green are grouped, therefore not foreseen in the Metropolitan Plan of Turin divided, by sector: Environment, Energy and Mobility.

The actions are collected through a narrow-down approach, therefore from the European to the Italian level; the main actors are also reported.

#### 4.2.2.1 Environment

For the environment sector, various actions have been identified that aim to improve environmental quality but above all to increase the ability to adapt to climate changes which unfortunately are increasingly frequent and intense.

Strongly connected with the environment is light pollution for which buildings are often unnecessarily responsible, as well as causing electricity consumption. The Paris plan (City of Paris, 2018) provides that the night lighting of non-residential buildings is limited and that the new buildings are designed and built in such a way as to be versatile for future new uses without the need for renovation.

The plan also provides for an increase in the proportion of urban green in cities for new or existing buildings; this measure therefore provides for the inclusion of green surfaces such as green roofs or walls on buildings.

Closely linked to the environment is also the issue of waste for which the city of Paris provides for the establishment of a tax on printed advertising material to ensure less use and waste of resources.

Finally, Paris envisages the creation of eco-friendly urban agriculture in the open spaces of the city and on the green walls and roofs that are planned to be created. In this way, a lower use of energy for the production and transport of food would be guaranteed. The actors most involved in these lines of action, in addition to the city of Paris itself, are the energy suppliers, associations that deal with sustainable agriculture and the management body for the collection of urban waste.

The *Piano Strategico della città di Genova* (Strategic Plan of the city of Genoa) provides for the use of Nature Based Solutions to increase the resilience of the sites and in the same way the PS of Milan aims to create a database that collects all the information for the implementation of these solutions, reporting methods and technical tools so that experiences can be shared in order to guarantee a better organization.

The PS of Milan also provides for the mapping of the climatically most vulnerable areas and most exposed to the effects of climate change, both living and working areas, in order to foresee immediate interventions and make them "climate-proof" (CM Milano, 2019).

Venice in its Metropolitan Strategic Plan, thanks to the Life Veneto Adapt project, plans to develop a methodology and operational tools for adaptation to climate change that can be replicated in different territorial contexts. The major players involved are the Metropolitan City of Venice, the IUAV University, companies specialized in the environmental and energy sectors and the municipalities of Treviso and Vicenza.

The table below shows the identified actions, not present in the Turin Strategic Plan, with reference to the cities where their implementation is planned and the main actors involved are listed (Table 39).

| GOOD PRACTICES THAT CAN BE APPLIED IN TURIN | | | | |
|---|---|---|---|---|
| **SECTOR** | **REFERENCE PLAN** | **ACTION & SECTOR** | **DESCRIPTION** | **STAKEHOLDERS** |
| **ENVIRONMENT** | PARIS CLIMATE ACTION PLAN | Buildings emissions | Night time lighting of non-residential buildings is limited. Also new buildings will be designed to have versatility | City of Paris; Private property owners; Citizens; Energy companies |
| | PARIS CLIMATE ACTION PLAN | Urban Planning | Increase the proportion of urban greening in the new or existing built environment (green roofs or walls) in order to get carbon neutral and 100% renewable energy city | City of Paris: urban planning office<br>Energy provider |
| | PARIS CLIMATE ACTION PLAN | Waste | A tax on printed advertising materials is expected to be introduced to limit the paper production | City of Paris<br>Recycling collection company<br>Citizens |
| | PARIS CLIMATE ACTION PLAN | Food | City will develop ecofriendly urban agriculture in the city in areas of open ground and on the walls and roofs of municipal buildings. | City of Paris<br>Citizens<br>Community Supported Agriculture: association<br>Restaurant owners |
| | PSM GENOVA | Natural resources: Green Spaces | Urban Nature Labs: Design and project spaces that uses nature to increase the resilience of a site using NATURE BASED SOLUTIONS | Consortium of 28 partners which includes municipalities, research bodies, private bodies |
| | PSM MILANO | Natural resources: Green Spaces | Metro Adapt Platform: Climate change adaptation strategies and measures using Nature Based Solutions to develop climate change adaptation governance in metropolitan areas | **CAP Holding**: Hydric Service for Milan<br>**MC of Milan**: Metropolitan City of Milan<br>**ALDA**: European Association for Local Democracy; **Ambiente Italia srl**: Environment consulting company; **E-GEOS SpA**: Leader in information system; **Legambiente Lombardia** |
| | PSM MILANO | Natural resources: Air | Profile Pizza: Identify the contribution of furnace emissions to air quality and reduce them | **MC of Milan**; **ENEA**; **Lombardy Region**; **ARPA AMAT**: Environment and Territory Mobility Agency; **University of Milan** |
| | PSM MILANO | Natural resources: Green Spaces | N4C - Nature for Cities: Use of NBSs in urban and territorial planning by creating a platform to provide solutions, methods and technical tools. | **NOBATEK** - French Research Institute; **Metropolitan city of Milan**; 5 **research institutes** and technological organizations, 4 **Universities**; **Industries**. |
| | PSM MILANO | Resilience and Adaptation | Paesaggi dell'abitare e del lavorare a prova di clima: Raise awareness among citizens on the issue of adaptation at the territorial level by mapping and cross-referencing data on the climatic vulnerability and socio-economic exposure of the territories. | MC of Milan; Municipality of Milan ; IUAV University; Planning & Climate Change Lab |
| | PSM VENICE | Resilience and Adaptation | Life Veneto Adapt : Develop a methodology and operational tools for adapting to climate change that can be replicated in different territorial situations | **MC of Venice**; **IUAV** University; **SOGESCA srl**: engineering and consulting company specializing in the environment and energy sectors; **Treviso and Vicenza Municipality**; **Unione dei comuni Medio Brenta** |

*Table 39 - Good practices applicable to the MC of Turin in the Environment sector. Source: Author, 2021*

#### 4.2.2.2 Energy

In the Energy sector, the measures identified that could be applied to the Metropolitan City of Turin derive mainly from European case studies such as the Amsterdam, Bristol and Copenhagen plans with the exception of the *Piano Strategico Metropolitano di Milano* (Strategic Plan of the City of Milan) which through two pilot projects intends to renew the energy field by reducing consumption and using only renewable sources.

Starting from European context, Amsterdam envisages various measures to reduce the amount of energy consumed and the consumption of energy from non-renewable sources. In particular, it wants to make all municipal buildings energy efficient: the city plans to replace all old lighting systems with new LED systems that guarantee better performance and lighting as well as lower electricity consumption. The replacement of all lighting systems in sports facilities is also planned.

Another relevant measure for the city of Amsterdam, also envisaged by the city of Bristol, is to disconnect all buildings from the natural gas supply network, so as to make each district no longer dependent on fossil fuels thanks to the inclusion of pump systems of electric heat powered with energy produced from renewable sources. Amsterdam also provides for the inclusion of green hydrogen as a source of electricity production, especially for use in industrial processes where high temperatures are required.

In line with the Milanese pilot project, the Basque Country is also planning to increase the use of renewable energy from the primary sector, such as natural biomass.

Copenhagen and Paris instead envisage the use of different types of renewable sources for the production of electricity; the Danish capital foresees a high use of solar panels on private buildings but above all on public buildings as well as for the production of energy thanks to wind turbines. In the first case, both the owners of the buildings, public or private, and the electricity supplier play a key role.

Paris, in line with the actions envisaged by Copenhagen, precedes to incentivize citizens to participate in the production of energy from renewable sources thanks to the installation of solar panels on the roofs and reduce energy consumption by replacing all existing lighting fixtures with LED systems. Finally, the French capital plans to increase the production of geothermal energy, another renewable energy source, thanks to the opening of new extraction plants. Paris is the only case study to foresee the use of this renewable source. In all the latter cases cited, the citizens themselves play a key role as well as the electricity supply companies or the bodies managing energy production systems.

Going into Italian context, instead, Milan, with the Deciwatt project aims to reduce $CO_2$ emissions thanks to an energy renewal project in which the environmental and territorial

protection area of the Metropolitan city of Milan and ENEA, Ente Nuove tecnologie per l'Energia e l'Ambiente.

Furthermore, thanks to the Metro Pizza project, the Metropolitan City of Milan wants to reduce the consumption of energy from non-renewable sources, such as natural gas to power the pizza ovens and replace them with sources fuelled by wood or biomass.

The table below, Table 40, provides a summary of all the measures envisaged for the Energy sector.

| GOOD PRACTICES THAT CAN BE APPLIED IN TURIN | | | | |
|---|---|---|---|---|
| **SECTOR** | **REFERENCE PLAN** | **ACTION & SECTOR** | **DESCRIPTION** | **STAKEHOLDERS** |
| **ENERGY** | NEW AMSTERDAM CLIMATE Climate Neutral Roadmap 2050 | Energy renovation | Making social and civic buildings energy-efficient: All light will be replaced with LED included the lighting systems with LED lighting systems in sports facilities | Central government; City of Amsterdam; Housing corporations; Research institutes; Electricity suppliers and distributor |
| | NEW AMSTERDAM CLIMATE Climate Neutral Roadmap 2050 | Heat Decarbonisation | A natural gas-free built environment: Disconnect buildings from the natural gas network, district by district | City of Amsterdam; Residents; Companies; Corporations and energy companies; Private property owners |
| | NEW AMSTERDAM CLIMATE Climate Neutral Roadmap 2050 | Renewable energy | Green Hydrogen: Develop hydrogen infrastructures as sustainable fuel especially in the industrial processes in which very high temperatures are required | Central government, the Harbour, Companies, Energy provider, Researchers |
| | BRISTOL - ONE CITY CLIMATE STRATEGY | Heat Decarbonisation | Install electric heat pumps to support the phase out of gas heating | Electricity provider<br>City of Bristol |
| | BASQUE ENERGY STRATEGY 2030 | Renewable energy | Encourage efficiency and harness existing resources in the primary sector: Increase the use of biomass in the production of energy | Department of economic development and infrastructure |
| | CPH 2025 - CLIMATE PLAN | Renewable energy | Energy Consumption: Increase the use of solar cells to reduce heat consumption | City of Copenhagen; Building's owners; Citizens; Private constructions companies ; Green organisations |
| | CPH 2025 - CLIMATE PLAN | Renewable energy | Energy Production: Introduce the use of Wind Turbines | City of Copenhagen ; Energy provider; Citizens |
| | CPH 2025 - CLIMATE PLAN | Renewable energy | City Administration Initiatives: Install solar panels on municipal buildings | City of Copenhagen; Knowledge institution; Energy providers; City lab: institution of research |
| | PARIS CLIMATE ACTION PLAN | Renewable energy | Encourage citizens to partecipate in the production of renewable energy and install solar panels on buildings roofs | Energy companies; City of Paris; Private buildings owners; Citizens |
| | PARIS CLIMATE ACTION PLAN | Renewable energy | Exploit geothermal resources opening new plants | Energy companies; City of Paris; Citizens; Geothermal energy companies |
| | PARIS CLIMATE ACTION PLAN | Energy renovation | Replace lightning system with LED | Energy companies; City of Paris; Private buildings owners; Citizens; Public lighting providers |
| | PSM MILANO | Energy renovation | Deciwatt: Reduce $CO_2$ emissions and consumption by putting into practice a real energy renovation project | Mc of Milan: Environment and territorial protection area<br>ENEA: Ente Nuove tecnologie per l'Energia e l'Ambiente |
| | PSM MILANO | Renewable energy | Metro Pizza: Reduction of energy consumption from non-renewable sources by replacing it with biomass-fired ovens | MC of Milan ; Lombardy Municipalities; ENEA: Ente Nuove tecnologie per l'Energia e l'Ambiente, Confcommercio; Anfus: National Association of smokers and chimney sweeps; Assocosma: National Association of Stove Manufacturers |

*Table 40 - Good practices applicable to the MC of Turin in the Energy sector. Source: Author, 2021*

#### 4.2.2.3 Mobility

The mobility sector has developed measures aimed at achieving zero emissions of greenhouse gas from all forms of transport, guaranteeing in the same way efficiency in travel. Among the measures proposed to make the transport sector zero emissions, starting from European cities, the city of Amsterdam has predicted that by 2025 all taxis will be zero emissions, as is partly the case for local public transport thanks to the use of electric buses.

Copenhagen plans to incentivize the use of bicycles to reach the workplace or study so that at least 50% of these trips take place with zero emissions; to do this, it planned to improve the travel conditions of these vehicles thanks to the construction of dedicated cycle paths, covered parking spaces and services for cycling in general.

The Danish capital also plans to convert the entire fleet of administration vehicles into electric or hydrogen vehicles, guaranteeing zero emissions from this sector and plans to let only electrically powered vehicles into the city centre.

Paris wants to permanently eliminate diesel as a fuel for vehicle operation by 2024; this policy must necessarily be supported by a national policy that promotes the replacement of diesel with other renewable fuels. In addition, the city of Paris provides, in order to encourage the abandonment of the use of diesel, a differentiated parking fee based on the amount of greenhouse gases that the vehicle emits. The actors most involved in this action are the managing body of the public transport service, the citizens and the city of Paris itself.

With the aim of limiting the amount of greenhouse gases emitted into the atmosphere, the city of Paris wants to promote a new driving style, starting with teaching in driving schools as the driving style can strongly influence the amount of emissions produced. In this case, in addition to the city of Paris, the participation of citizens and Parisian driving schools is necessary.

Among the measures envisaged by the Italian metropolitan cities is the pilot project Elviten - Electrificied L- category vehicles integrated into transport and electricity networks, promoted by the Metropolitan city of Genoa which wants to encourage the use of electric vehicles also for systematic travel and more. for the occasional ones. Bristol also plans to incentivize the use of electric vehicles.

Bologna instead plans to reorganize the public transport system in the production areas so that they are effectively connected even with low environmental impact public transport. Among the actors involved in the two aforementioned cases there are also sector associations, local businesses and the metropolitan city itself.

The table below, Table 41, shows the measures envisaged for the Mobility sector.

| GOOD PRACTICES THAT CAN BE APPLIED IN TURIN | | | | |
|---|---|---|---|---|
| **SECTOR** | **REFERENCE PLAN** | **ACTION & SECTOR** | **DESCRIPTION** | **STAKEHOLDERS** |
| **MOBILITY** | NEW AMSTERDAM CLIMATE Climate Neutral Roadmap 2050 | Zero emission transport | Clean taxis: All taxis would be emissions free by 2025 | Amsterdam Metropolitan Region; Residents; Research institutes; Taxi companies; Public transport providers |
| | BRISTOL - ONE CITY CLIMATE STRATEGY | Zero emission transport | Get primarily ultra-low emission vehicles | City of Bristol; Public services provider; Citizens; Commercial vehicles manager; Private sector of mobility |
| | CPH 2025 - CLIMATE PLAN | Green Mobilty | Increase the use of electric bicycles and improve the conditions for cycling to get that al least 50% of all jurneys to the place of work or study must be by bicycle | City of Copenhagen; Citizens ; Public transport provider |
| | CPH 2025 - CLIMATE PLAN | Zero emission transport | City Admistration: Achieve the conversion of car fleet to electricity and hydrogen; in this way all city of Copenhagen vehicles will run on new fuels. | City of Copenhagen; Knowledge institutions; Public/private actors; Energy providers; Employees of transport; City lab: institution of research |
| | CPH 2025 - CLIMATE PLAN | Zero emission transport | In the city, only electric and non-thermal motors will be used | City of Copenhagen; Public/private actors; Energy providers |
| | PARIS CLIMATE ACTION PLAN | Zero emission transport | Eliminate the diesel powered mobility by 2024 also supporting who stop using its old vehicles. To do this different parking price are expected to be paid according their emissions | Public transport providers; City of Paris; Citizens of Paris; Car sharing companies; Energy providers |
| | PARIS CLIMATE ACTION PLAN | Zero emission transport | Teach new kind of driving styles that can have a significant impact in terms of pollution | City of Paris; Citizens of Paris; Driving schools |
| | PSM GENOVA | Zero emission transport | Elviten - Electrificied L- category vehicles integrated into transport and electricity networks: Encourage the use of electric vehicles for occasional and systematic urban travel | Six cities; Amici della bicicletta: Association; CESCOT: Association; Confesercenti Liguria; Le bighe del bigo: Tourist reception and rental service; GMC Solar Solutions; Yenergy charging stations; Losi & Losi: electric bikes shop |
| | PSM BOLOGNA | Public transport | Reorganization of public transport services in production areas: Formulate a detailed framework for the implementation of new local public transport services for industrial areas | MC of Bologna<br>Metropolitan Majors<br>Local companies |

*Table 41 - Good practices applicable to the MC of Turin in the Mobility sector. Source: Author, 2021*

### 4.2.3 Validation

After determining the best practices that the Metropolitan City of Turin could implement to complete the ecological transition process that is already underway, brief interviews were carried out with key actors, experts in the three sectors in which the actions were clustered and engaged on the territory of the metropolitan city in question.

They were given a short interview, through the use of an online platform or by person, in which, after a brief general introduction on the objectives of the thesis and the process carried out, some questions were submitted to verify the validity and concreteness of implementation of the identified practices.

#### 4.2.3.1 Environment

Thanks to the interview carried out with an expert in the Environment sector who work in the Municipality of Turin, it was possible to validate and discuss the results obtained from this thesis. It is important to underline that the analysis was made considering the entire Metropolitan City of Turin and its new regulation tool (CM Torino, 2021).

In general, it emerged how important it is to consider mitigation interventions with those of adaptation to climate change at the same time; they cannot in fact be considered separately. It is also necessary, in order to obtain significant results, to ensure continuity over time in order to see the results of the actions undertaken.

The actions envisaged in this sector are many and in many cases have already been carried out, but to date they mainly concern the territory of the City of Turin. In fact, after lengthy works, the *Piano di Resilienza Climatica* (Climate Resilience Plan) (Città di Torino, 2020) was drawn up and approved in July 2020 by the city of Turin, which reports the mitigation and adaptation actions planned and partly already implemented by the City of Turin.

By studying the Plan, it is possible to note that the greatest risks to which the city of Turin is exposed are the urban heat island and the risk of flooding given that the territory is crossed by four major rivers. To address these two critical issues, the municipality envisages, as already proposed by other case studies being analysed, the use of Nature Based Solutions which are "solutions that provide for the introduction of nature in the urban context for urban and territorial regeneration and to restore functionality in previously altered ecosystems, but also to cope with the new needs dictated by climate change "as reported in the *Piano di Resilienza Climatica* (Climate Resilience Plan) (Città di Torino, 2020).

Among the projects already launched in this direction is the one that plans to "increase the number of trees in the city" which involves the planting of new trees also thanks to the

involvement of citizens and private companies. The greenery and in particular the planting of new trees also find space in Urban Regeneration projects where, thanks to the “Urban Acupuncture” project, the creation of new draining green areas is foreseen. Another important mitigation measure is represented by the will of the Municipality of Turin to replace the waterproof flooring of the parking lots of shopping centres with draining surfaces that help to reduce the risk of flooding as water can be absorbed but at the same time can alleviate the effects of urban heat island: greenery in general therefore guarantees drainage and shading, in the case of the planting of new trees.

Another important project that has seen the city of Turin as a protagonist is the Life Derris EU - DisastEr Risk Reduction InSurance Project, which is the first European project aimed at small and medium-sized enterprises, SMEs, to reduce the risks caused by extremely intense climatic events.

Finally, the Municipality of Turin has obtained the UNI ISO 20121 certification "Event sustainability management systems - Requirements with guidance for use" in order to guarantee a certain level of sustainability to be achieved during every single event of a different nature organized in Turin.

In general, therefore, it is useful to learn that the Municipality of Turin has planned and partially implemented the use of solutions for the mitigation and adaptation to climate change, but the Metropolitan City, a scale to which the Metropolitan Strategic Plan 21-23 refers - Turin Metropolis Augmented, needs tools to be able to guarantee the achievement of climate neutrality results even outside the Municipality of Turin.

#### 4.2.3.2 Energy

Following the interview carried out with some experts in the energy sector and who deal with energy policies for the City of Turin, it was possible to validate the results obtained in this sector and define what mitigation tools and actions could be that the Metropolitan City of Turin can implement to concretize the ecological transition process.

Turin had previously joined the Covenant of Mayors in 2009 and with the TAPE project it reduced emissions of greenhouse gases into the atmosphere by 35% by 2020. By joining the new Covenant of Mayors, Turin, on the other hand, aims to reduce emissions by 40% by 2030. Turin is particularly exposed to urban heat island phenomena and floods as reported in the plan *Torino 2030 a prova di futuro* (Future-proof Turin 2030) (Barbera et al., 2021).

In the energy field, most of the emissions come from buildings and transport; a small percentage from the industry which, however, has seen its weight in the emissions inventory decrease significantly in recent decades as the sector is drastically contracting.

The buildings sector consists of residential buildings and buildings dedicated to the tertiary sector, public or private; the first type also includes condominiums which, in order to obtain a reduction in energy consumption, are difficult to manage.

Urban areas, in fact, as already highlighted previously in the thesis, are the areas with the highest density of population and buildings and therefore could represent the ideal place to implement policies to reduce energy consumption, but at the same time they are difficult to manage unlike the more external, less dense areas, such as the metropolitan city, where by morphology and given the type of buildings present it is easier to implement measures to save and reduce consumption.

With the aim of reducing emissions and consumption in energy terms, municipalities with a lower population density, such as those in the metropolitan area, could potentially act as producers and exporters of energy produced from renewable sources to the main city which, despite a reduction in terms of demand, requires more energy than the smaller centres, thus making sure that the energy surplus produced is exploited.

Renewable sources, in general, have a greater spatial diffusion than fossil sources which require a very complex energy system; in this way, a decentralized use of renewable resources is therefore possible in the various phases of production, distribution or consumption of energy (Barbera et al., 2021).

With the aim of eliminating the use of natural gas to satisfy the need to heat buildings, it is possible to guarantee the production of electricity, the demand for which will be tripled by eliminating $CO_2$ producing sources, thanks to the use of photovoltaic panels and heat pumps.

In general, for the Metropolitan City of Turin, the renewable source on which to focus to eliminate the use of fossil sources is photovoltaics, not with the extensive use of panels or by consuming soil, but by installing panels on the roofs of inhabited or abandoned buildings.

In fact, hydroelectricity has already been widely exploited and no further expansions are possible in this sector; wind power, for the Metropolitan city of Turin, could be installed at high altitudes to achieve adequate energy production, but the costs for installation and maintenance are too high.

Turin, as well as Copenhagen, are the European cities with the largest existing district heating network. The Danish capital has already planned and is carrying out the

decarbonisation of the heating system by replacing it with natural gas with the thermal use of woody biomass.

In Turin today the system provides for the use of natural gas but one of the strongest measures to reduce greenhouse gas emissions is to replace natural gas with biomass from external areas, which has also decreased the energy requirement they can allocate the resource for energy production to power heat pumps.

Biomethane, on the other hand, which is completely renewable, could replace biogas to cover the energy needs of agricultural machinery; in the transport sector, electrification and the contraction of the demand for transport is expected in general thanks to the spread of the concept of proximity for services, work and education.

In conclusion, therefore, by decreasing the required energy demand thanks to strong maintenance interventions of the buildings, the remaining energy requirement can be produced with the current renewable sources already in use.

The obstacles to the spread of this new energy transition policy can be the decision-making processes, which often turn out to be long and complex in the face of problems and solutions already available, the economic funds that, through decisions from above, must be allocated to this sector and the availability of materials to implement the conversion of the existing system. In fact, today there is a need to import all devices, photovoltaic panels, heat pumps from abroad, increasing the price and having to submit to the exportable quantity.

#### 4.2.3.3 Mobility

From the interview carried out for the validation of the results obtained in the mobility sector with an expert in the sector and who work in the context of Turin, it emerged that micro-mobility, i.e. the exclusive use of electric scooters or bicycles, is not the only solution to limit and eliminate emissions of greenhouse gases especially in context of the Metropolitan City of Turin. In general, gradual change must be promoted so that it is lasting and effective.

Among the best practices that can be implemented in the territory of the Metropolitan City of Turin, a solution that can guarantee the reduction of emissions but at the same time does not require electricity or soft mobility is an approach defined as Flexible Multimodal in which each movement can be carried out with the best means able to guarantee efficiency, economic convenience and low or zero greenhouse gas emissions.

With this type of mobility system, which partly recalls the concept of Movicentro, a place that allows the connection between two or more types of mobility and means of transport, it is possible to structure large interchange areas equipped with low-cost charging systems for electric vehicles with plug-in technology thanks to long and slow charging. In this way, once the private electric car has been parked, which will be recharged at a low cost during the parking time, it will be possible to move by other means according to the place of destination thanks to an integrated ticket that allows you to use various services.

This solution would guarantee an efficient network, especially for those coming from outside Turin and its entire metropolitan area and who have to reach the capital.

To encourage movement with electric technology and therefore reduce emissions in central areas of cities, such as Turin, would be possible to use the virtual Geo-Fencing which, installed for example on the gates already present in the Limited Traffic Zone they can, through a portal or temperature detection systems, check that the car at the entrance is using only the electric motor and not the thermal one.

Another measure that could be used to limit emissions of greenhouse gases into the atmosphere is a winning system in the use of time: these are in fact fixed-system vehicles which therefore are not affected by traffic. Called People Movers, these systems are based on point-to-point transport and are highly effective in limited contexts such as airports or large health centres. This system could however be integrated into the urban mobility system through the installation of an urban cableway system.

In general, however, it is useful to follow a hierarchical approach in the type of travel that can be used: this type of hierarchy, which between city and city prefers the use of the high-speed train, is then declined in systems of minor mobility, such as, for example, for the city of Turin, the Metropolitan Railway System, SFM.

Turin is a virtuous city from the point of view of public transport as a valid alternative to private transport thanks to the preferential lanes for buses and trams; in addition, the preference for traffic lights for TPL (Local Public Transport) can increase the efficiency of the service and the construction of Line 2 of the Metro would greatly reduce the number of cars in the Turin area.

# CHAPTER 5: CONCLUSIONS

## 5.1 Key Findings

The process of ecological transition towards sustainable cities and in line with the possibilities that our Planet offers is necessary and must be implemented quickly. The effects of climate change are becoming more evident every day and cause damage directly or indirectly to things and people. The measures that can be implemented at the urban level, the level to which the thesis referred, are many in different sectors and involve the local population in their way of moving, eating, producing and working, in general, of living.

Each territorial reality is different in terms of morphology, demography and socio-economic context but it is necessary today to plan for tomorrow for future generations by taking inspiration and often imitating what is good, in each sector, the single case study is putting into practice in its own territorial context.

Any transformation or modification to the way of working or living is necessary, following the analyses carried out and the interviews carried out, that it is gradual so that its usefulness and necessity are shared not only by the competent bodies but above all by those who have to put it practically. In any case, it is necessary to provide a guide "from above" that can regulate its transformation.

The thesis has analysed and compared in detail ten case studies, European and Italian that are putting into practice the principles dictated in 2015 by the Agenda 2030 and are trying to reach the goals of the Paris Agreement and of the European Green Deal, each in its own territorial context by adapting and modifying the good practices already provided by the most virtuous ones.

The research method proposed in this thesis has focused attention mainly on the sphere of the reduction of greenhouse gas emissions and has left out the sphere of policies more focused on social and peace, two other key principles of the 5P Model proposed by Agenda 2030. This method was applied to the ten case studies chosen at the beginning of the research process thanks to the material provided, but it can be developed in other Italian, European or global contexts.

In general, having all the technical and informatic technology skills necessary to implement the transition, it will in any case be a cultural transformation that will allow the success of this fundamental transition process, in all sectors, to guarantee a world of tomorrow for future generations in line with the possibilities that the planet can offer without further affecting an already heavily compromised system.

### 5.1.1 Ecological transition and Urban Planning

Territorial planning and ecological transition: it is perhaps the first to be able to consistently systematize all the actions envisaged to ensure the ecological transition of a city. Often, as in the case of Turin, the new plans drawn up take into account this great process that will change many of the cities and planning rules, but focus attention on newly built buildings or neighbourhoods, not transforming the existing ones. This is strongly in contrast with the cardinal principle of avoiding land consumption; therefore, it is necessary to think and plan interventions of ecological transition, in all its nuances, also and above all on the existing heritage. The adaptation of the existing one is in fact necessary from a morphological point of view but also from a regulatory point of view, so that there are no bureaucratic obstacles to the transition process and to the implementation of solutions that guarantee a significant result and to do this, forms of concrete collaborations of the public-private system.

It is also necessary that spatial planning provides tools for implementing what are the regulatory tools towards achieving the ecological transition. It is the system of interests, public or private, ethical or economic, that guides territorial planning: it is therefore necessary to build an effective one that guarantees the achievement of objectives thanks to a participatory process, derived from a bottom-up approach that brings to light the real problems from the community and proposes a solution to identify the tools that guarantee a felt and participatory implementation.

## 5.2 Limitations

The thesis analysed and studied the measures that various territorial realities have envisaged to ensure the ecological transition and achieve the climate neutrality target set for the next decades. To do this, it took into consideration Strategic or Action Plans drawn up after the adoption of the Agenda 2030 which resulted in a turning point in development models in order to ensure a sustainable one.

One of the main limitations of this paper and of this methodology applied for research purposes is the difference between the measures that could have been conceived and implemented before the Covid-Sars 19 pandemic, which broke out at the beginning of 2020 and is still in progress, which today, at the date of writing of the thesis, they could hardly be implemented and indeed it marked a drastic step backwards compared to the good results achieved in terms of emission reduction as we returned to prefer private cars to public transport, in the sector of mobility for example or not to use shared means of transport.

The thesis also took into consideration only one plan for each of the case studies, highlighting the main measures in the sectors of environment, energy and mobility and leaving out all the social aspects of the new development model: they could be the subject of inspiration for future processed.

The major critical point that emerged during the development of this thesis but especially during the final validation phase is the lack of action capacity that the Metropolitan City administrative structure can really implement on the issues of ecological transition. The issue is in fact dealt with at the level of the Metropolitan Strategic Plan, as envisaged by the implementation of the SNSvS, but the Metropolitan cities are in fact unable to guarantee the implementation of mitigation measures.

In fact, as in the case of Turin, often the chief town has foreseen and implemented some of the forms of mitigation that virtuous European realities have already put into practice, unlike all the municipalities that make up the metropolitan city in which this type of action is not expected or realized. It is therefore necessary to think of a local dimension of the ecological transition, concretely guided and coordinated by a higher body that supports the ranks of all mitigation interventions.

## 5.3 Future Development

As has already been pointed out previously, the thesis investigated good practices towards ecological transition in ten case studies, five European and five Italian, in order to determine good practices applicable to the case study of the Metropolitan City of Turin. The research field was therefore strongly delimited both in terms of the realities analysed and in terms of sectors in which to limit emissions by focusing on the environment, energy and mobility. The same research method can therefore be extended and used for:

- New case studies: Investigating other territorial realities in Italy, Europe or other continents, such as the Americas, Africa or Asia;
- New emission sectors: Analyse other sectors from which greenhouse gas emissions come and propose their reduction thanks to good practices already used by more virtuous territorial realities.

The application scenario may also be different: in this thesis it was chosen to apply the measures to the Metropolitan City of Turin as it was extensively analysed throughout the course of study, but the same methodology can be repeated for other cases study thus involving other actors, experts from the various sectors and the specific territorial reality in order to strengthen the results obtained and verify their validity.

# BIBLIOGRAPHY


Amsterdam Rainproof. Available at: https://www.rainproof.nl/jouw-rainproofnl (accessed 10.14.21).

Arzà, C., Garibaldi, P., Lonati, M.G., Davoli, C., de Vita, E., Veglia, V., Galetto, C., Gattolin, M., Pizzato, M., 2020. Le Agende per lo Sviluppo sostenibile delle città metropolitane di Genova, Milano, Torino e Venezia. URBAN@IT.

ASVIS Italia, 2020. I territori e gli Obiettivi di sviluppo sostenibile - Rapporto ASVIS.

Barbera, F., Bocco, A., de Rossi, A., Guerzoni, M., Lombardi, P., Mellano, P., Quarta, A., Serni, G., 2021. TORINO 2030 A prova di futuro. Turin.

batchgeo, n.d. Largest city parks. Available at: https://blog.batchgeo.com/largest-city-parks-in-world/ (accessed 10.14.21).

Capuzzimati, G., Ferroni, L., Mazzanti, C., 2020. Le strategie di sviluppo sostenibile della città metropolitana di Bologna. URBAN@IT.

Center for creative land recycling, n.d. Creative Land Recycling. Available at: https://www.cclr.org/ (accessed 10.12.21).

Città di Torino, 2020. Piano di Resilienza Climatica. Turin.

City of Amsterdam, 2020a. New Amsterdam Climate - Roadmap Amsterdam Climate Neutral Roadmap 2050.

City of Amsterdam, 2020b. Amsterdam Circular 2020-2025 Strategy.

City of Bristol, 2021. A Plan for Bristol to 2050.

City of Bristol, 2019. One City Climate Strategy. Strategy for a carbon neutral, climate resilient Bristol by 2030.

City of Copenhagen, 2012. CPH-2025 Climateplan.

City of Paris, 2018. Paris Climate Action Plan.

City of Paris, 2017. Paris Circular Economy Plan.

CM BO, ANCI, ASVIS, Urban@it, 2017. Carta di Bologna per l'ambiente. Le Città metropolitane per lo sviluppo sostenibile.

CM Bologna, 2018. Piano Strategico Metropolitano di Bologna 2.0.

CM Genova, 2017. Piano Strategico della città metropolitana.

CM Milano, 2019. Piano Strategico 2019_2021.

CM Torino, 2021. Piano Strategico Metropolitano - Torino Metropoli Aumentata.

CM Venezia, 2018. Piano Strategico Metropolitano.

Consiglio dei Ministri, 2021. Piano Nazionale di Ripresa e Resilienza Presentato 12/01/21.

Consiglio dei Ministri, Italia domani, 2021. Piano Nazionale di Ripresa e Resilienza #NEXTGENERATIONITALIA.

Crutzen, P., 2005. Benvenuti nell'Antropocene.

Doughnut Economics Action Lab (DEAL), 2020. The Amsterdam city Doughnut_a tool for transformative action.

ETRES, 2017. La transizione ecologica, accompagnare dinamiche di cittadinanza attiva e l'educazione ambientale per lo sviluppo sostenibile nel quadro del progetto.

European Commission, 2019. The European Green Deal.

European Commission, n.d. NextGenerationEu. Available at: https://ec.europa.eu/info/strategy/recovery-plan-europe_it (accessed 11.10.21).

European Commission. Directorate-General for Research and Innovation., 2021. Horizon Europe: strategic plan 2021-2024.

Eve - ENTE VASCO DE LA ENERGIA, 2016. Basque Energy Strategy 2030.

Hopkins, R., 2008. The Transition Handbook - from oil dependency to local resilience.

Legno Energia Nord Ovest, n.d. LENO. Available at: https://www.legnoenergia.org/progetto/ (accessed 10.14.21).

Lombardi, P., Gruenig, M., 2016. Low-carbon Energy Security from a European Perspective. Elsevier.

Lombardini, G., Risso, A., 2019. L'Agenda 2030 nel caso di Genova: l'innovazione tra sperimentazione e coordinamento. URBAN@IT.

MATTM, MISE, MIT, MiPAAF, 2021. Strategia italiana di lungo termine sulla riduzione delle emissioni dei gas a effetto serra.

Meadows, D., 1972. The limits to growth.

Ministero dell'Ambiente, 2017. SNSvS ITALIA.

Ministero dell'Economia e delle Finanze, 2021. Allegato - Relazione del Ministro della Transizione Ecologica sullo stato di attuazione degli impegni per la riduzione delle emissioni di gas ad effetto serra.

MISE, MITE, MIT, 2019. Piano Nazionale integrato per l'Energia e il Clima.

Natural Walking cities, 2019. GREEN CORRIDORS. Natural Walking Cities. Available at: http://naturalwalkingcities.com/green-corridors-essential-urban-walking-and-natural-infrastructure/ (accessed 10.13.21).

OECD, 2020a. A Territorial Approach to the Sustainable Development Goals.

OECD, 2020b. Managing Environmental and Energy Transitions for Regions and Cities.

Raworth, K., 2017. Doughtnut Economics. Seven ways to think like a 21 st-century economist.

Rewilding Europe, n.d. Rewilding. Available at: https://rewildingeurope.com/our-story/ (accessed 10.14.21).

Senato della Repubblica, 2021. Proposta di Piano per la transizione ecologica.

Siragusa, A., Vizcaino, P., Proietti, P., Lavalle, C., European Commission. Joint Research Centre., 2020. European handbook for SDG voluntary local reviews.

Smart Rural Transport Areas, n.d. SMARTA. Available at: https://ruralsharedmobility.eu/ (accessed 10.14.21).

TOD, n.d. Transit Oriented Development Institute. Available at: http://www.tod.org/ (accessed 10.14.21).

Torino fa Scuola, n.d. Scuola Eco. Available at: https://www.torinofascuola.it/ (accessed 10.14.21).

Treccani, n.d. Enciclopedia Treccani. Available at: https://www.treccani.it/enciclopedia/ricerca/transizione/ (accessed 9.5.21).

TreesAI, n.d. TreesAI. Available at: https://treesasinfrastructure.com/ (accessed 10.13.21).

UNFCCC, 2021. Four key Achievements of COP26. Available at: https://unfccc.int/news/4-key-achievements-of-cop26 (accessed 11.18.21).

United Nations, 2015. Transforming our World: The 2030 Agenda for Sustainable Development.

United Nations Environment Programme (UNEP), n.d. COP 26. Available at: https://www.unep.org/news-and-stories/story/cop26-ends-agreement-falls-short-climate-action (accessed 11.18.21).

United Nations, Unfccc, 2015. Paris Agreement.

URBAN@IT, 2021. Sesto rapporto sulle città - Le città protagoniste dello sviluppo sostenibile.

World Commission on Environment and Development, United Nations, 1987. Our Common Future.