POCACITO

european post-carbon cities of tomorrow

CASE STUDY ASSESSMENT REPORT

MILAN / TURIN

FONDAZIONE ENI ENRICO MATTEI- FEEM

POLITECNICO DI TORINO

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I INTRODUCTION

One of the main targets of the POCACITO project is to produce a mechanism to assess and monitor the transition process towards post-carbon cities. A Post-Carbon City Index (PCI) will be used to evaluate such transition. 10 European cities were selected and an initial assessment of these case study cities is produced based on a set of key performance indicators (KPI). The indicators cover three dimensions, namely an environmental, a social and an economic dimension. Globally, this conceptual model constitutes a holistic approach that allows the project partners to diagnose the situation of the case study cities with regard to their socioeconomic and sustainable dynamics. This tool will also allow cities to monitor the post-carbon transition process over the years.

II APPROACH AND METHODOLOGY

II.I MODEL AND CONCEPT

The Post-Carbon City Index is a tool oriented to measure the societal transformations occurring within the city in transition, which takes into account the interplay between different axes of diversity and the nexus between the social/spatial regimes. The index integrates a set of key performance indicators, which will allow a uniform collection of data, improve the comparison and support the identification of best practices in each case study city, covering environmental, social and economic aspects.

The Post-Carbon City Index is an input for the qualitative scenario building (conducted in WP4) and for the quantification and modelling of impacts in WP5. Additionally, it will enable the comparison and monitoring of the case study cities in their realistic achievements (rather than prescriptive standards) of low-carbon targets, through the use of a specific quantitative analysis of environmental and socioeconomic metrics.

The assessment based on the Post-Carbon Cities Index will culminate in the construction of an EU 2050 Post-Carbon City Roadmap for a common future of European cities.

II.II DATA COLLECTION PROCESS

To collect the data for the key performance the following two approaches have been followed:

- Top-down approach – completion of the indicators list (Post-Carbon City Index) according to a review of main statistical findings, existing relevant strategic and planning documents, and legislation to assure an accurate quantitative data collection;

- Bottom-up approach – discussions with local authorities and other selected stakeholders should be used to complement the collection of quantitative data and enrich the contents of the case study assessment reports.

National/regional statistical offices, government departments, environment and energy agencies, research institutes and non-governmental organisations represent the main sources of the data.

All the indicators are collected for various points in time, in order to compare their evolution throughout this period. Ideally all indicators should be collected at the city and municipality levels. However, if an indicator is not available at this geographical level, then it would be collected for the province or for the region. If the data is only available at the national level, it is considered that it is not representative of the city, so it should be discarded.

III OVERVIEW OF THE CASE STUDY CITY

III.I TERRITORY

MILAN

Milan is the administrative centre of the Lombardy region in the NUTS 1 area Nord-Ovest. It is Italy's second largest city, ranking after Rome. It is located in the Northern part of Italy, on the Lombard Plain, midway between the Po River and the foothills of the Alps. It is located at 122 meters above sea level. Due to its command of the rich plain of the Po and routes from Italy across the Alps, Milan has been one of the major cities of Europe since ancient times.

Milan displays a humid subtropical climate, with hot, humid summers with little rainfall and cool, winters. The average maximum temperature in July is around 28°C, and in January is 6°C. Snowfalls are relatively common in winter. Mean annual precipitation is around 1000mm. Moderate fog used to affect normal life in Milan. In recent years, however, the removal of rice fields from the southern neighbourhoods, the urban heat-island effect, and the reduction of pollution levels have made this phenomenon less common.

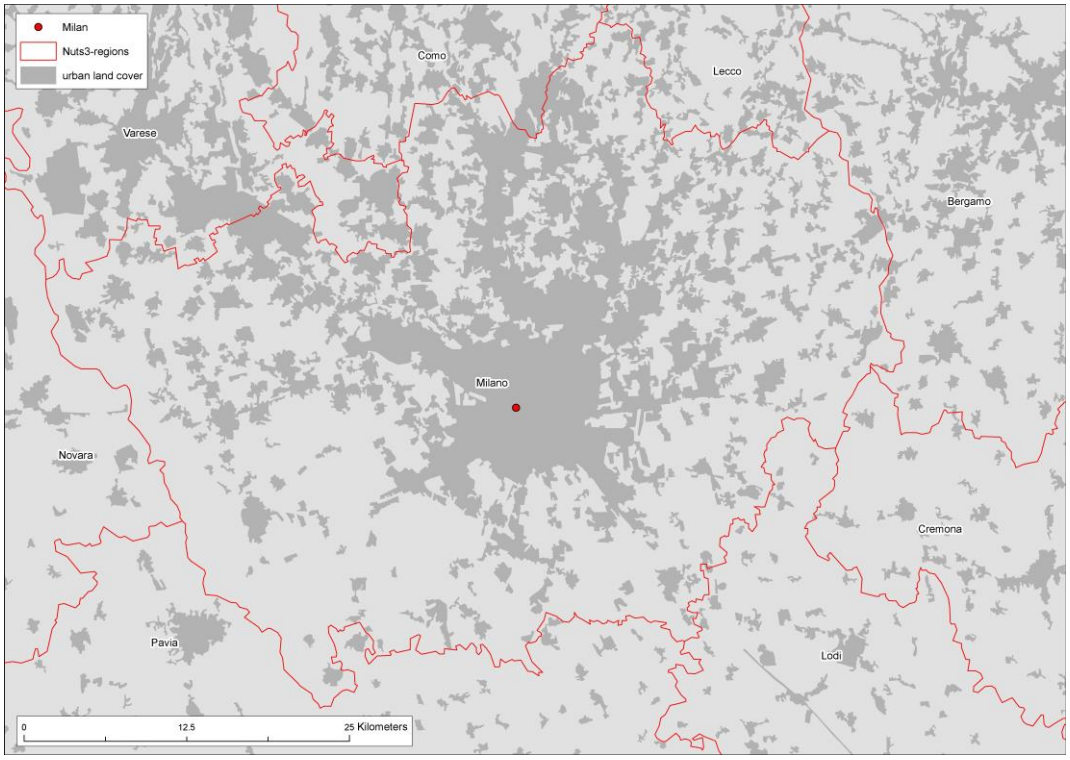
Three rivers, namely the Olona, the Lambro and the Seveso creek run through Milan—with the Olona and Seveso running mostly underground in artificial channels.

Milan is one of the main railway hubs in Italy and is served by numerous expressways. Milan has four subway lines, a rich tramway system with more than 20 lines, and a bus system with nearly 100 lines. Two international airports, Linate and Malpensa, connect Milan with the rest of the world.

Due to difficulties in finding the relevant statistical data, different levels of territorial aggregation had to be used throughout this report. The highest aggregation level is represented by the NUTS 2 Region “Lombardia”, which is a relevant unit within the Italian administrative and political system. The Italian Regions have considerable political, legislative and administrative autonomy. For example, they have competencies, inter alia, for urban development, including the urban planning legislation, environmental policies, local/regional transport systems at the level which is relevant for commuting and connectivity within metropolitan areas.

The NUTS 3 level is another level of aggregation used for this report. It corresponds, within the Italian administrative hierarchy, to the Provinces (abolished as to the 31st of December 2015) and substituted, in the case of Milan, by the Milan Metropolitan area, which has the same delimitation as the former Provincia di Milano. In this case data collected corresponds to the "Provincia di Milano". Finally data has been used referring to the municipality of Milan ("Comune di Milano").

For this report, we tried to collect the data at the most disaggregated level, namely, the municipality level. Whenever data was not available at this fine level, we collected data at provincial level. In few cases, when neither municipality nor provincial level data was available, we had recourse to regional data.



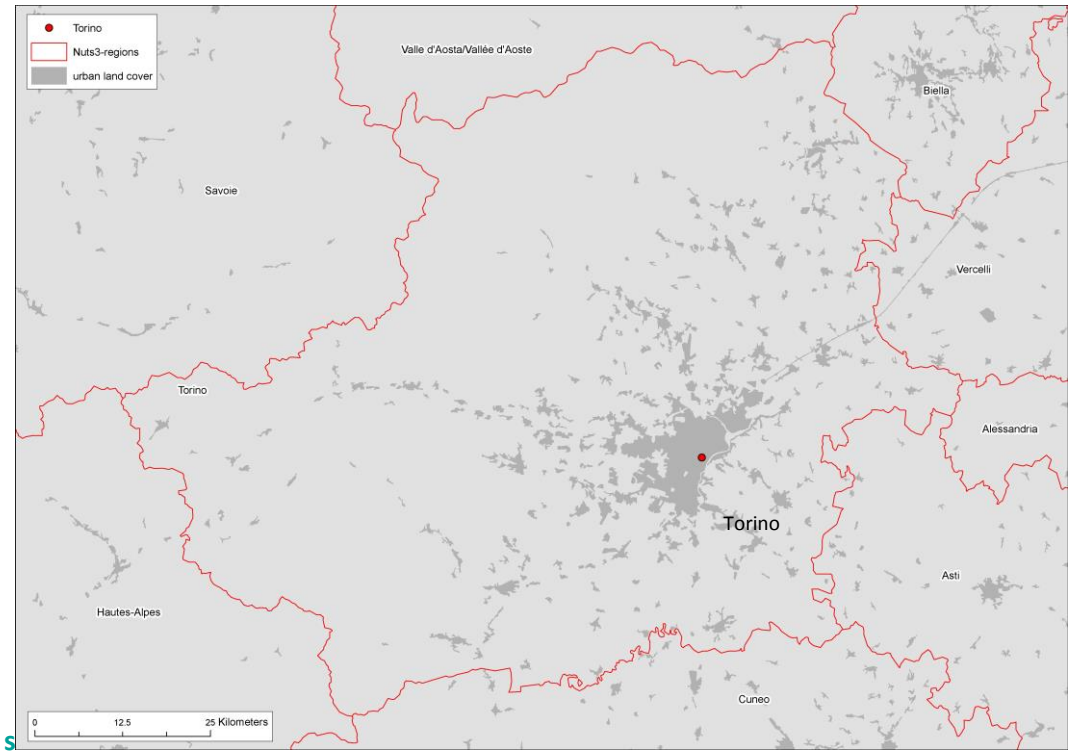


Figure1: Provinces (NUTS3) level)

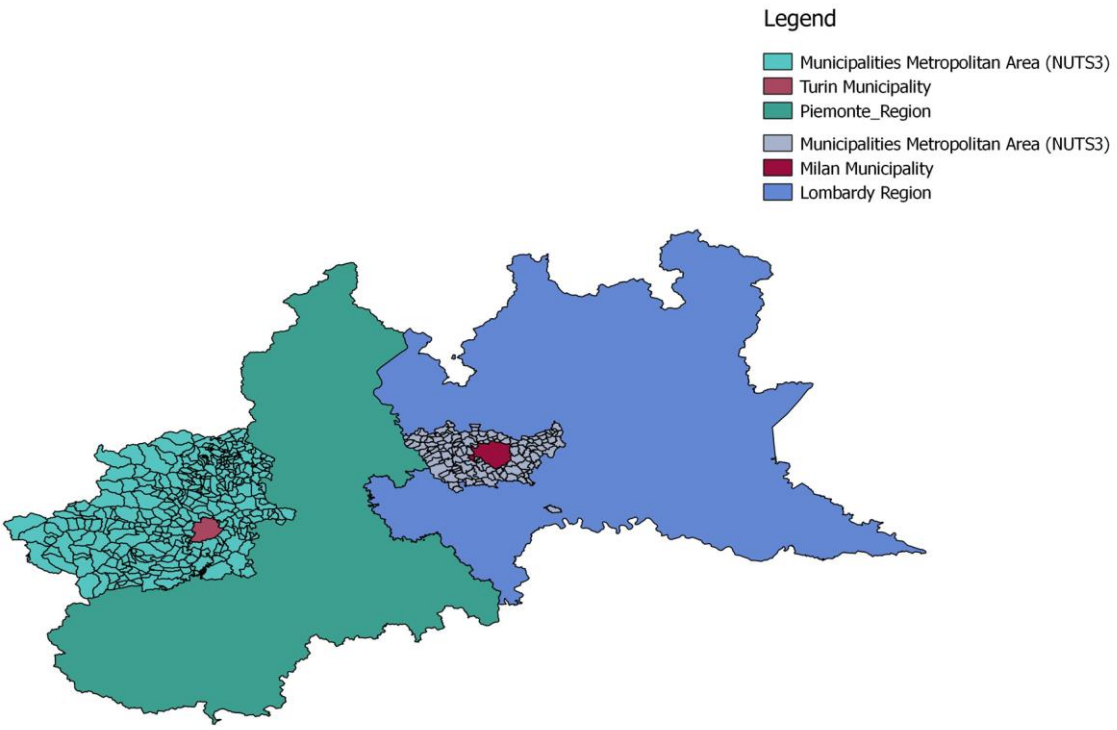


Figure2: Municipalities, Provinces (NUTS3) and Regions (NUTS2)

TURIN

Turin is the administrative centre of the Piedmont region in the NUTS 1 area Nord-Ovest. It is Italy's fourth largest city, ranking after Rome, Milan and Naples. It is located on the Western part of the Po valley, at the foothills of the Alps, at 239 meters above sea level.

Turin displays a humid subtropical climate, with hot, humid summers with little rainfall and cool, winters. The average maximum temperature in July is around 28°C, and in January is 6°C. Snowfalls are relatively common in winter. Mean annual precipitation is around 838mm.

The Po river crosses the city from South to North-East; two other rivers, Dora Riparia and Stura di Lanzo, flow through the territory of Turin into Po.

Turin is connected Eastward to Milan by a high-speed rail line, while Westward a similar infrastructure to Lyon in France is under construction. A metropolitan railway system connects Turin to the main cities of the province; the urban transport system is constituted by an automated subway, 9 tramway lines and about 100 bus lines. The airport of the city is Caselle, which ranks thirteenth in Italy for number of passengers.

The same warnings about statistical data for Milan are true for Turin. In this report data are collected at the municipal level whenever possible, otherwise at the level of Province (“Provincia di Torino”, NUT3) or Region (Regione Piemonte, NUTS2).Milano (NUTS3 level)

III.II POPULATION

MILAN

The city had a population of 1'324'169 inhabitants in 2013; it covers an area of 182 square Km, with a population density of 7'271 inhabitants per square Km. The province of Milan (NUTS 3) on the contrary hosts 3'176'180 inhabitants in area of 1'580 square Km.

As the rest of Italy, Milan is characterised by an ageing population. In 2013, there were 310'279 inhabitants aged 65 or older, accounting for 23 percent of the city's population. Those aged 15 or less, 187'809 inhabitants, represented 14 percent of the whole population.

As of 2013, the Italian national institute of statistics ISTAT estimated that 194'991 foreign-born immigrants live in the Milan Urban Area (city of Milan), equal to nearly 15 percent of the city's population. The origin countries most represented in the Milan area are the Philippines (17%), Egypt (12&), China (11%), Peru (9%), Sri Lanka (6%), Ecuador (6%) and Romania (5%).

TURIN

The city had a population of 902'137 inhabitants in 2013; it covers an area of 130 square Km; the population density is 6'939 inhabitants per square Km. The province of Turin (NUTS 3) hosts 2'297'917 inhabitants in an area of 6'827 square Km.

In 2013, inhabitants aged 65 or older in the city of Turin were 224'307 (25 percent of the total population); 119'424 inhabitants (13 percent of the whole population) were aged 15 or less.

Foreign-born immigrants in the city of Turin in 2013 were 138'214, equal to 15 percent of the whole population. The origin countries most represented in the Milan area are Romania (39%), Morocco (14%), Peru (7%), China (5%), Albania (4%), Moldavia (4%) and Nigeria (3%).

III.III ECONOMY

MILAN

Milan is the main industrial and commercial city in Italy. It hosts the nation's largest stock exchange and represents the country's main banking center. Milan is world-wide known for its fashion and design center, especially for clothing and home furnishings. Manufactured products include textiles, furniture, motor vehicles, power tools, machinery, and chemicals.

According to the Global Metro Monitor, Milan is ranked amongst the richest cities in the world in terms of GDP per capita. Commodities account for 1 percent of Milan's total output. Construction accounts for 5 percent, business and finance 33 percent, manufacturing 21 percent, local non-market 16 percent, trade and tourism 15 percent, transport 6 percent, and utilities 3 percent.

Milan is not only a leading economic centre but also an important artistic and cultural centre. Important architectural and cultural attractions are the "Duomo" cathedral; the world-renowned opera house "Teatro alla Scala"; the "Galleria Vittorio Emanuele II", which is a covered arcade linking the Duomo's piazza with the Teatro alla Scala; and the "Castello Sforzesco" which is a castle built in

the 15th century by Francesco Sforza, Duke of Milan. Moreover, Milan hosts many important churches, museums, art and design fairs (Triennale) and exhibitions.

TURIN

The Province of Turin is the third area in Italy in terms of GDP: it contributes to national GDP for 4.3%. According to Eurostat, gross value added is generated by manufacturing for 18%, construction (5%), wholesale and retail trade, transport, accommodation and food service activities (19%), ICT (7%), real estate (14%), financial and insurance activities (6%), professional, scientific and technical activities (10%), public administration, defence, education, human health and social work activities (14%), arts, entertainment and recreation (4%).

Turin is the most specialized area of Italy in industrial activities: it hosts design offices and factories of Fiat (now FCA – Fiat Chrysler Automobiles); other important industrial sectors are mechanics, aerospace, ICT, telecommunications.

Former a typical "one-company town" focused on the automotive sector, in the last twenty years Turin has greatly diversified its economy; it has maintained its industrial specialization, but at the same time it has increased its role as a cultural and touristic attractive pole in Italy. It has host the Winter Olympic Games in 2006, valorized its artistic heritage (in particular baroque monuments, and urban buildings of XIX century when Turin was the first administrative capital of the unified Italian Kingdom), increased its centrality as an international pole in contemporary arts. It hosts several fairs and events about food, books, and arts.

IV KEY STRATEGIES AND PROJECTS

IV.I STRATEGIES AND ACTION PLANS

Box 1: Milan Strategy/Action Plan for Sustainable Energy and Climate

STRATEGY/ACTION PLAN FACTSHEET	
Title	PAES (Action Plan for Sustainable Energy and Climate)
Dimension of KPIs	Environmental, Social, Economic
Period	2009-2020
Strategy/Action Plan description	
Objective	Curb CO2 emissions and increase renewable sources of energy
Measures	Interventions involve public and residential buildings, public lighting, transports, energy production, and waste
Targets	20-20-20 target

Links and Contacts	
Promoter	AMAT, Municipality
Document/website	http://www.amat-mi.it/it/ambiente/cambiamenti-climatici/
Contact E-mail	info@amat-mi.it

Box 2: Milan Strategy/Action Plan for Mobility

STRATEGY/ACTION PLAN FACTSHEET	
Title	Pums (Sustainable Urban Mobility Plan)
Dimension of KPIs	Environment
Period	2012-present
Strategy/Action Plan description	
Objective	Sustainable mobility, make Milan a more liveable city, improve security
Measures	Improve the local public transport in terms of number of lines and service efficiency. Boost the connections between the regional railway system and the city public transport. Direct individuals' means of transport towards public as opposed to private transport. Increase pedestrian, soot free, and low speed areas. Reduce the number of street parking spaces. Extend the cycling path. Improve car sharing. Improve smart technologies. Make parking more efficient. Increase goods transport on railways.
Targets	Less pollution; fewer accidents
Links and Contacts	
Promoter	AMAT, Municipality
Document/website	http://www.amat-mi.it/it/ambiente/cambiamenti-climatici/
Contact E-mail	info@amat-mi.it

Box 3: Turin Strategy/Action Plan for Energy

STRATEGY/ACTION PLAN FACTSHEET	
Title	TAPE – Turin Action Plan for Energy

Dimension of KPIs	Environmental, Social, Economic
Period	2010-present
Strategy/Action Plan description (short description – max 15 lines for each sub-section)	
Objective	Curb CO2 emissions and increase renewable sources of energy
Measures	Interventions involve public, industrial and residential buildings, public lighting, transports, energy production, and waste
Targets	20-20-20 target
Links and Contacts	
Promoter	Municipality
Document/website	http://www.comune.torino.it/ambiente/patto_sindaci/piano/index.shtml
Contact E-mail	informa.ambiente@comune.torino.it

Box 4: Turin Strategy/Action Plan for Mobility

STRATEGY/ACTION PLAN FACTSHEET	
Title	PUMS (Sustainable Urban Mobility Plan)
Dimension of KPIs	Environment
Period	2010-2020
Strategy/Action Plan description (short description – max 15 lines for each sub-section)	
Objective	Increase the sustainability of the local mobility system
Measures	Grant and increase the accessibility in the city for people and goods; improve air quality; improve the quality of the urban environment; promote public transport; increase efficiency and safety of the road network; promote ITS; improve the governance in implementing the plan.
Targets	More balanced modal split; less congestion; less pollution; fewer accidents
Links and Contacts	
Promoter	Municipality
Document/website	http://www.comune.torino.it/geoportale/pums/cms/
Contact E-mail	info.viabilitaetrasporti@comune.torino.it

IV.II KEY PROJECTS

Box 5: Milan Project: EXPO

PROJECT FACTSHEET	
Title	EXPO
Dimension of KPIs	Social, Economic
Area of implementation (city, neighbourhood, etc.)	City
Implementation period	2015
Project description	
Aims	Under the slogan "Feeding the Planet, Energy for Life": EXPO aims to open up a dialogue between international players to exchange views on the problems of nutrition and the resources of our planet. *It proposes examples for technical and strategic innovation.*
Activities	Projects: WE-Women for Expo; Short Food Movie; Laboratorio Expo; Feeding Knowledge; Childrenshare, children and sharing; School Project; E015 Digital Ecosystem. Thematic areas: Future Food district; Children' s park; Biodiversity Park; Arts and Food
Promoters/Beneficiaries; Partnership	Municipality; Ministero dell'Economia e delle Finanze; Regione Lombardia; Provincia di Milano; Camera di Commercio Milano; Official Participants include 11 Countries; European Union, United Nations; ActionAid, Alliance2015; Caritas; Don Bosco Network; Faitrade International, Fondazione Triulza; Inter Press Service; Lions Clubs International; Oxfam; PlaNet Finance; Save the Children; WWF; WAA-AMIA/CONAF; New Holland Agriculture; KIP International School China; Corporate United Pavilion; Vanke; JooMoo; Accenture; Enel; Fiat Chrysler Automobiles; CNHIndustrial; Intesa San Paolo; Samsung; Selex ES; TIM
Financing	State, region, local funding; chamber of commerce
Outcomes and impacts	The exhibition will provide solutions to guarantee water and food for the entire world population, to increase food security while taking into account biodiversity. It will offer visitors the tools for finding their own answers to such issues. It will increase awareness and sensibility on nutrition, health and

	sustainable eating.
Main factors of success	Global audience
Reproducibility and transferability	Innovative solutions aim at replication
Links and Contacts	
Promoter	n.a.
Website	http://www.expo2015.org/en/index.html
Contact E-mail	n.a.

Box 6: Milan Project: Congestion Charge

PROJECT FACTSHEET	
Title	AREA C
Dimension of KPIs	Environment, Social
Area of implementation (city, neighbourhood, etc.)	City
Implementation period	2012-present
Project description	
Aims	Low Emission Zone (LEZ)
Activities	Congestion charge for all private vehicles entering the city centre
Promoters/Beneficiaries; Partnership	Municipality
Financing	Local see City of Milan Area C Economics (costs in 2012 € 7'1 million; revenue € 20'3 million Euro, benefits were used for enhancing public transport, bikesharing, biking lanes, etc.)
Outcomes and impacts	Reduce car congestion within the city, make the public transport more efficient, improve sustainable mobility, improve life quality by reducing the incidence of car accidents, and reduce air and noise pollution.
Main factors of success	Reduction of car traffic in the core zone, increasing use of public transport
Reproducibility and transferability	Yes, relates to similar initiatives in London, Stockholm
Links and Contacts	

Promoter	Municipality
Website	City of Milan, Area C
Contact E-mail	n.a.

Box 7: Turin Project: High Speed Railway

PROJECT FACTSHEET	
Title	Turin-Lyon high-speed railway line
Dimension of KPIs	Environmental, Economic
Area of implementation (city, neighbourhood, etc.)	From the municipal to the international level
Implementation period	2015-2025
Project description	
Aims	Creating a new arch of the TEN-T railway corridor 5 from Lisbon to Kiev, upgrading the present "traditional" railway link Turin-Lyon to a high-speed connection status.
Activities	Building the new railway line through a new tunnel under the Alps
Promoters/Beneficiaries; Partnership	Italian and French State, European Commission, Piedmont and Rhone-Alpes Region, LTF
Financing	European Union, Italy and France: 24 billion euros
Outcomes and impacts	Reductions of journey times between the two cities, increase of the socioeconomic relations for the city of Turin with the Western European cities
Main factors of success	Deadline in construction, actual budget, interconnection with local rail systems
Reproducibility and transferability	The high-speed rail lines are not new, but the Turin-Lyon case can be adopted as a "best practice" in integrating the new infrastructure in a wide-area strategy for promoting the territories it crosses
Links and Contacts	
Promoter	LTF Lyon-Turin ferroviare
Website	http://www.ltf-sas.com
Contact E-mail	n.a.

Box 8: Turin Project: Metropolitan Railway

PROJECT FACTSHEET	
Title	Metropolitan railway system
Dimension of KPIs	Environment, Social
Area of implementation (city, neighbourhood, etc.)	Metropolitan area
Implementation period	2009-2018
Project description	
Aims	A more balanced modal split in the mobility at the provincial level
Activities	Incrementing the number of trains, activating a regular interval timetable, planning the railways lines as a whole coordinated system
Promoters/Beneficiaries; Partnership	Metropolitan Mobility Agency, Piedmont Region, Trenitalia, GTT
Financing	European Union, Italy and France: 24 billion euros
Outcomes and impacts	An increased weight of rail transport in the passenger mobility at the provincial level; reduction of pollution and road congestion
Main factors of success	A coherent regional planning according to a TOD (Transit oriented development) can be crucial to the real success of the metropolitan railway system
Reproducibility and transferability	Yes, it relates to similar initiatives in Stockholm, Copenhagen, Munich, etc.
Links and Contacts	
Promoter	Metropolitan Mobility Agency
Website	www.sfmtorino.it/
Contact E-mail	info@mtm.torino.it

V CASE STUDY CITY ASSESSMENT

V.I ENVIROMENTAL PERFORMANCE

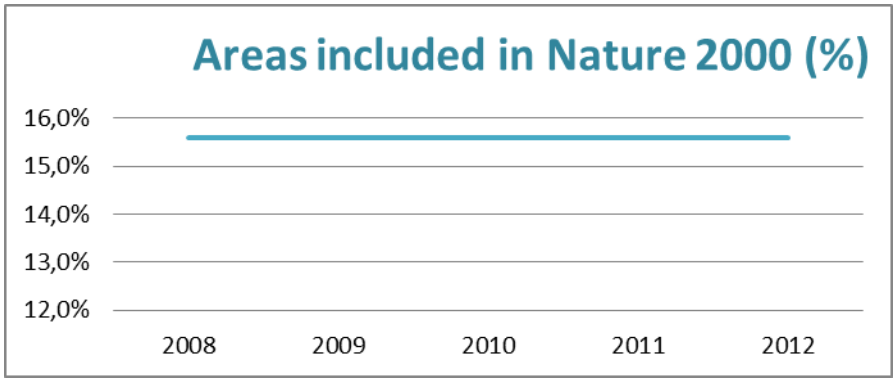


Figure 3: MILAN, Ecosystem protected areas (Source: Italian statistical office, ISTAT. Regional level (NUTS 2)

Nearly 16 percent of the total land area of the Lombardia region is included in protected natural areas of the Rete Natura 2000 network. This figure has held constant from 2008 onward. While Lombardia ranks only 14th among Italian regions for the percentage of territory placed under Rete Natura 2000 protection, it ranks first for the number of individual areas included.

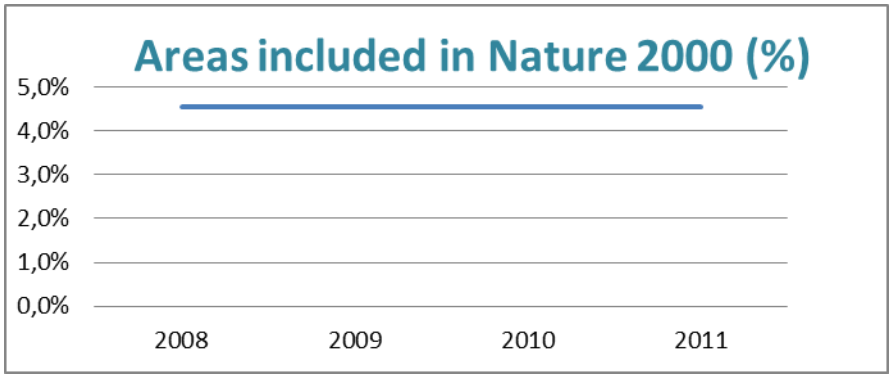


Figure 4: TURIN: Ecosystem protected areas (Source: Piedmont Region. Municipal level)

Nearly 5 percent of the total land area of the Municipality of Turin is included in Nature 2000 network: there are one Sites of Community Importance, one Special Protected Area, three natural reserves. This figure has held constant from 2008 onward. At the provincial level, over 15% of the surface is classified as Sites of Community Importance. Piedmont region ranks 16th among the 21 Italian regions in terms of percentage of total surface included in Nature 2000 network.

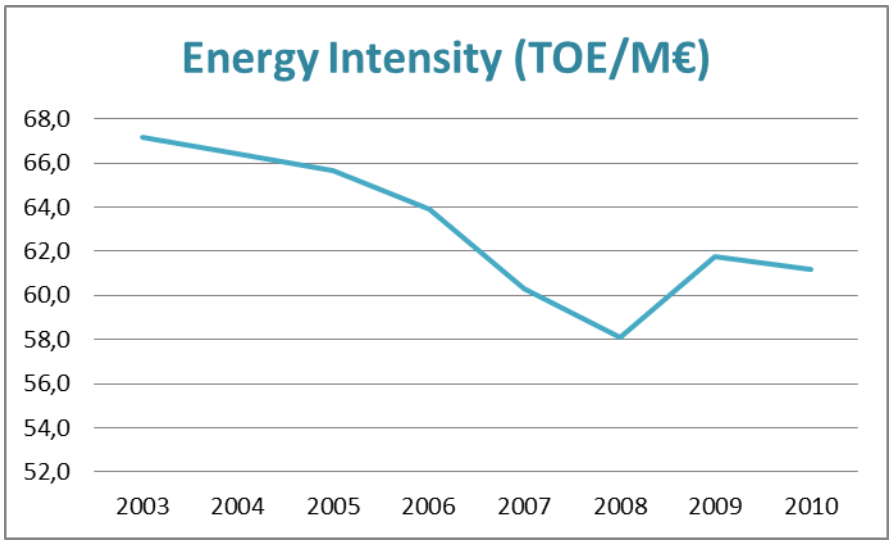


Figure 5: Milan, Energy Intensity Source: author's calculations based on data from Finlombarda (Sirena), Bank of Italy and Eurostat. Provincial level (NUTS 3)

The energy intensity in the province of Milan declined from 2003 until 2008, grew from 2008 to 2009, and declined from 2009 to 2010. Unfortunately more recent data is not available. The growth of GDP, more than the decline in energy consumption, is responsible for the overall declining trend of the index. The largest reduction in energy intensity occurred between 2006 and 2007, with the 2007 index being six percent lower than the index in 2006. In 2008 the energy intensity computed for Italy was 108.7, while the index for the Lombardia region (NUTS 2) was 93.8. Only few regions in Italy display lower energy intensity than Lombardia.

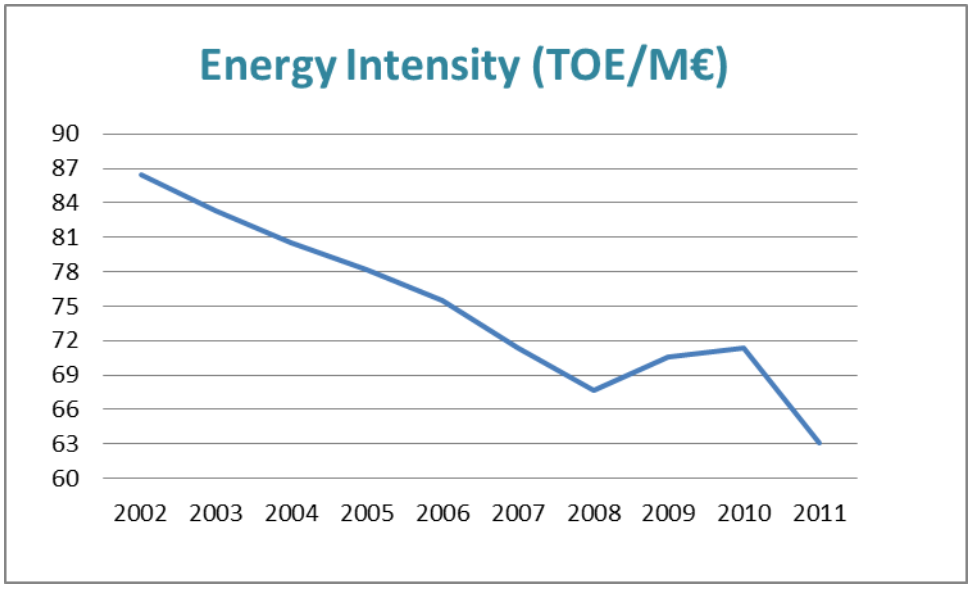


Figure 6: Turin, Energy intensity Source: author's calculations based on data from Province of Turin. Provincial level (NUTS 3)

The energy intensity in the province of Turin shows a trend similar to Milan: it declined from 2002

until 2008, grew from 2008 to 2010, and declined from 2010 to 2011. More recent data are not available. Between 2002 and 2011, the energy consumption declined by 13%, while GDP increased by 20%. The decreasing weight of the industrial sector in the local economy is probably the main cause of the increasing efficiency in energy consumption.

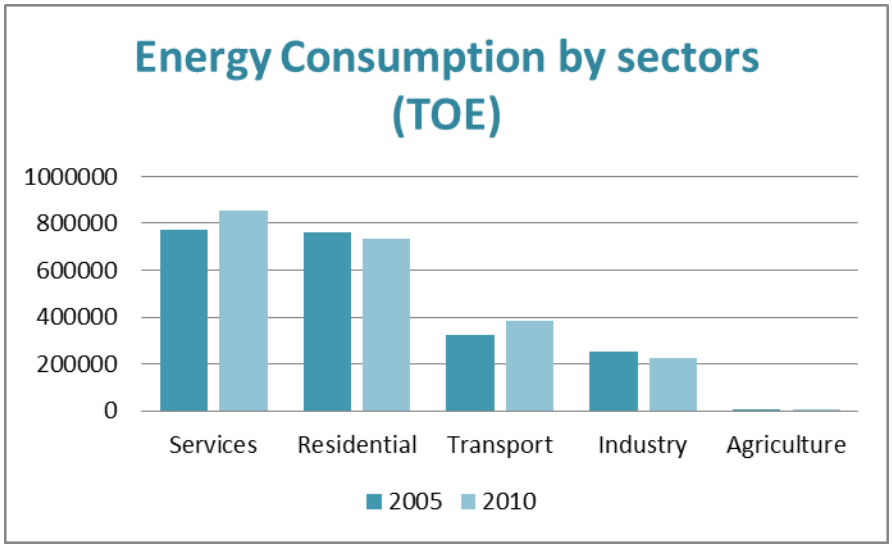


Figure 7: Milan, Energy consumption by sectors Source: Finlombarda (Sirena). Municipal level

Services and residential are the sectors that contribute the most to the total energy consumption. While the residential sector displayed a reduction in consumption between 2005 and 2010, the energy consumption of the services grew. The transport sector increased consumption between 2005 and 2010, the industry sector slightly decreased, while consumption in the agricultural sector remained constant. Services contributed to 36.6 and 38.9 percent of total energy consumption in 2005 and 2010, respectively. The residential sector contributed 36.1 and 33.3 percent in the two years respectively. Transport contributed 15.2 and 17.5; industry 12 and 10.3 percent. Finally agricultural share was 0.04 percent in both years.

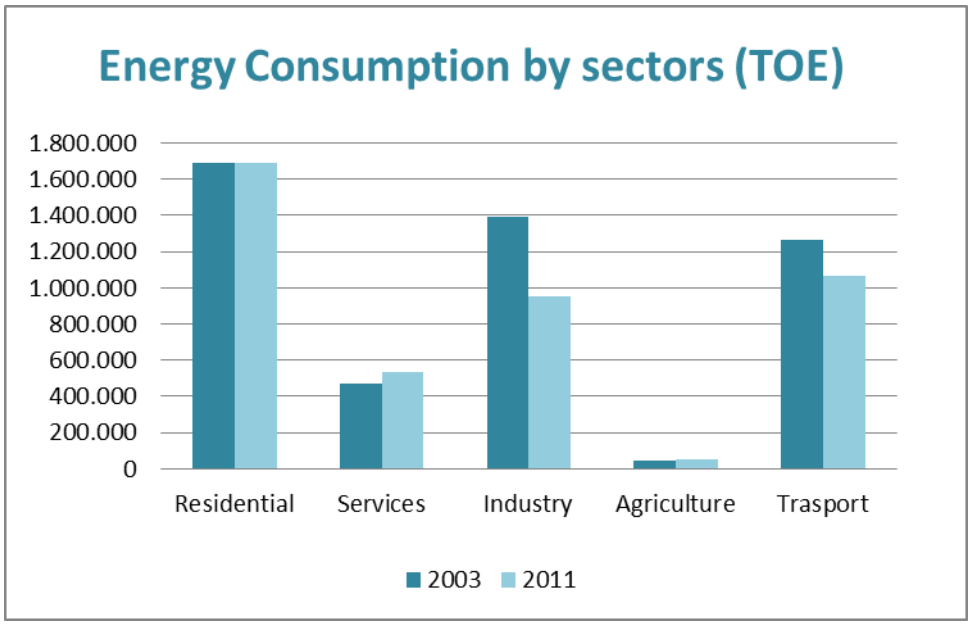


Figure 8: Energy consumption by sectors Source: Province of Turin. Provincial level (NUTS 3)

Between 2003 and 2011, in the province of Turin energy consumption increased in agriculture (+18%) and in the tertiary sector (+14%), stayed stable for the residential sector and decreased in industry (-32%) and transport (-16%). 39% of the energy is consumed by residences, 25% by transport, 22% by industry, 12% by services, only 1% by agriculture.

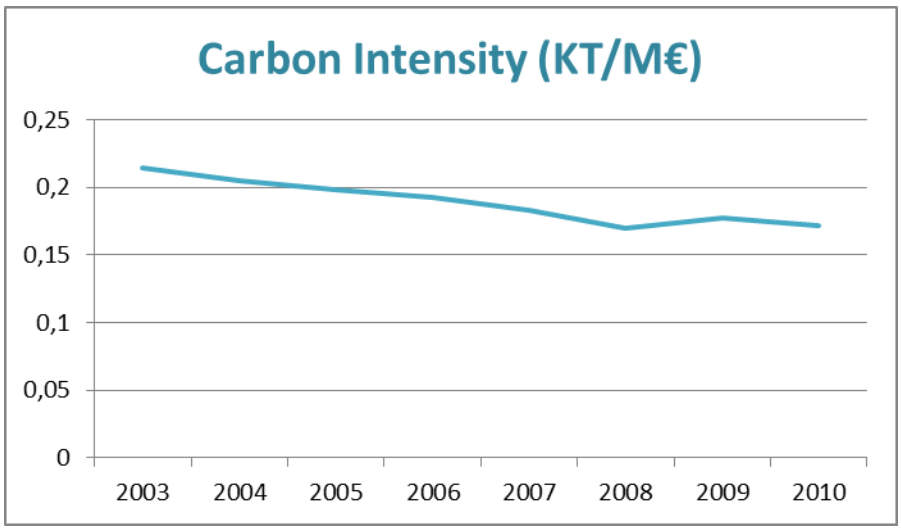


Figure 9: Milan, Carbon emissions intensity

The declining trend in energy intensity is reflected in a declining trend in carbon intensity. The index is computed as the ration of greenhouse gas emissions and GDP. In Lombardia the carbon intensity in 2010 was 0.23, while the average index for Italy was 0.3. Except for the year 2009, when the index displayed an increase compared to the previous year, the index declined every year on average by four percent.

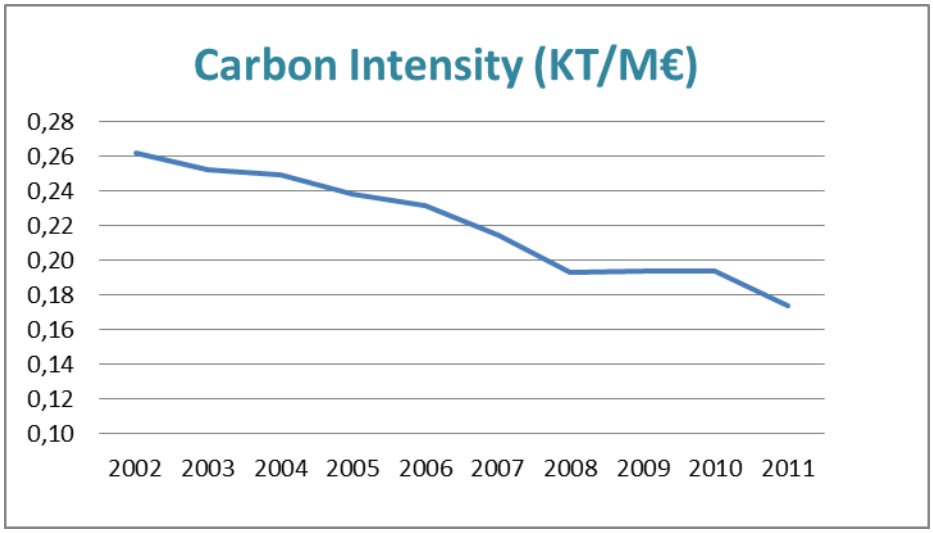


Figure 10: Turin, Carbon emissions intensity Source: Province of Turin. Provincial level (NUTS 3)

Like Milan, also Turin shows a declining trend in carbon intensity. Between 2002 and 2011, emissions were reduced by 21%; because of the contemporary growth of GDP, carbon intensity in the same years decreased by one third.

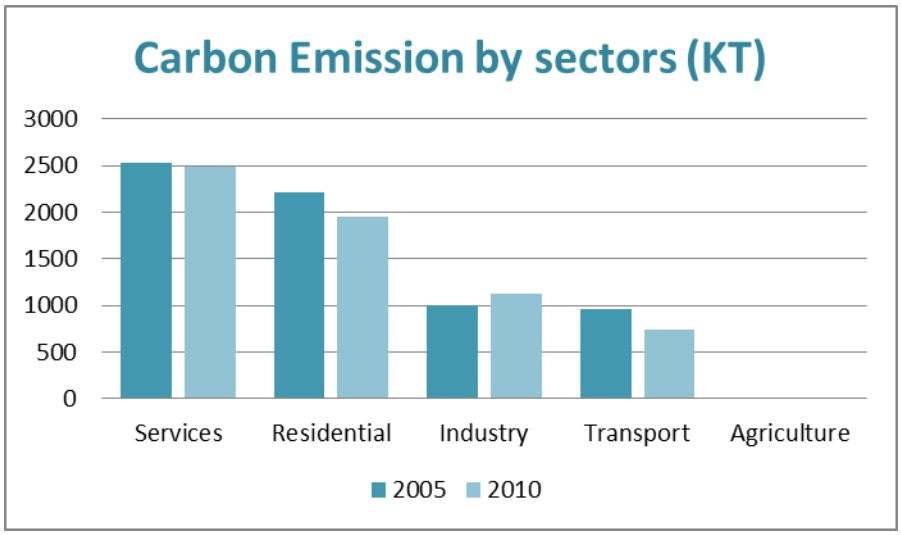


Figure 11: Milan, Carbon emissions by sector Source: Finlombarda (Sirena). Municipal level

The service sector is the largest emitter of greenhouse gases, followed by the residential, the industry, the transport and the agriculture sectors. All sectors but industry display lower emissions in 2010 compared to 2005.

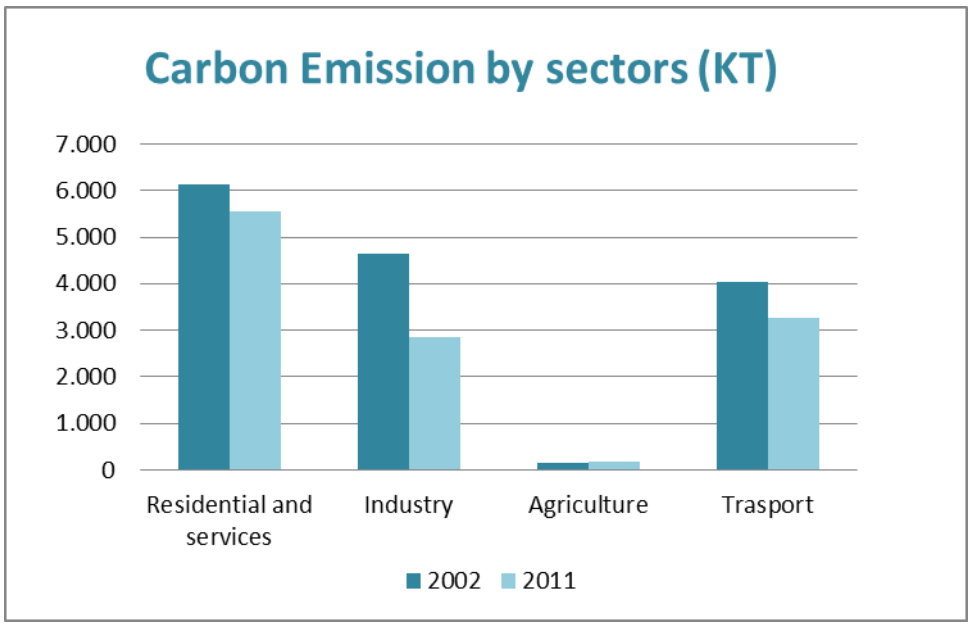


Figure 12: Turin, Carbon emissions by sector Source: Province of Turin. Provincial level (NUTS 3)

Carbon emissions by sectors reflect the weight of the sector in energy consumption: residences and services contribute to almost 50%, 28% of the emissions is due to industry, 24% to transport, 1-2% to agriculture. All sectors have reduced their emissions between 2002 and 2011, except agriculture.

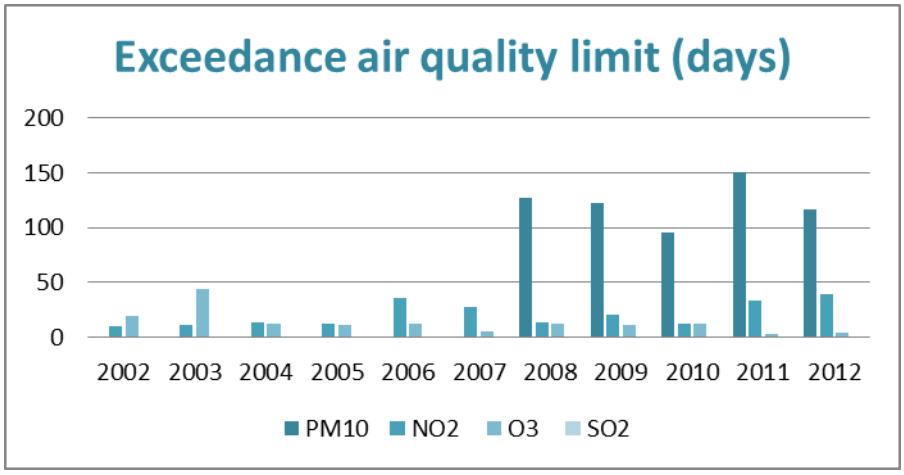


Figure 13: Milan: Exceedance rate of air quality limit values Source: ARPA Lombardia, Rapporto sullo Stato dell'Ambiente in Lombardia. Municipal level

The air quality in Milan is a critical issue, in particular as the PM10 is concerned. During 2008 127 days were detected in which the concentration of PM10 exceeded the threshold limits established by the Directive 2008/50/CE. The days of exceedance were 123, 95, 151 and 117 in 2009, 2010, 2011, and 2012, respectively. A clear trend does not appear, indicating that much has still to be done to solve this problem in Milan. Exceedance of the threshold limits for both NO2 and O3 were registered in more than one time over the years. But while the peak of exceedance for S02 traces back to 2002, the

value for O3 in 2012 is the highest recorded in the previous 10 years.

Milan is among the most polluted cities in Italy. According to the most recent report on environmental quality in Italian cities for 2013, Milan ranks 78 out of 83 cities considered with regards to the concentration of PM 10, and 59 out of 86 cities with regards to the number of days in which the threshold for O3 of 120 ųg/mc is exceeded.[1]

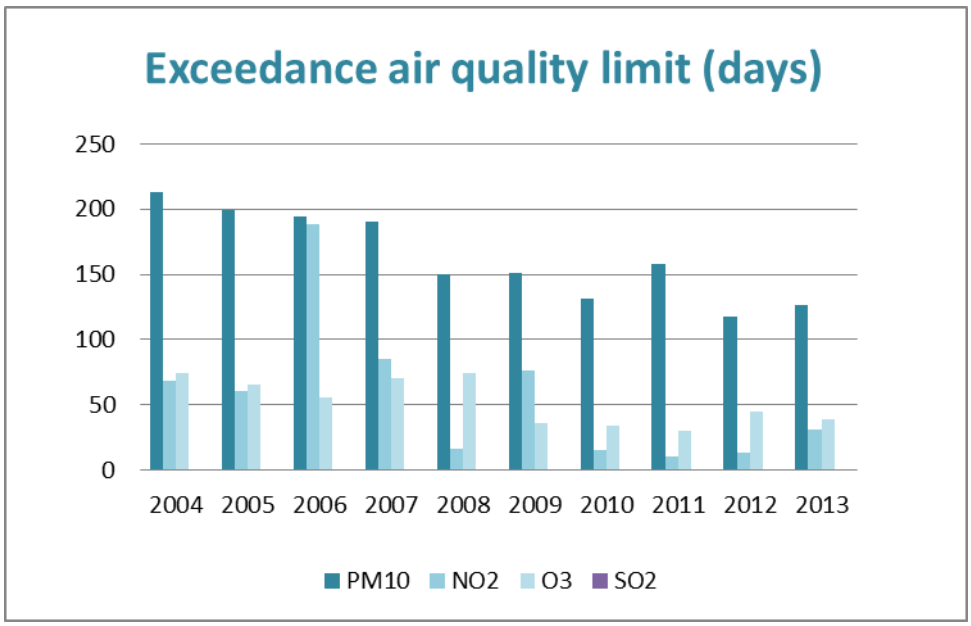


Figure 14:Exceedance rate of air quality limit values Source: ARPA Piemonte. Municipal level

As for Milan, also for Turin air quality is a critical issue: both cities are in the Po valleys, where air stagnates because of the Alps and pollution concentrates at high level. Air quality is generally improving in Turin, but the situation is still critical: during 2013, 126 days (instead of 35) were detected in which the concentration of PM10 exceeded the threshold limits established by the Directive 2008/50/CE; the days were 31 (instead of 18) for N02 and 38 (instead of 25) for O3 (in this case, calculated as the average of the last three years).

According to the European Airbase, Turin is one of the most polluted great cities in Europe; according to Ecosistema urbano, Turin ranks 81 out of 83 cities considered with regards to the concentration of PM 10, 81 out of 82 for NO2, and 69 out of 86 for O3.

[1] Ambiente Italia (2014) Ecosistema Urbano; XXI Rapporto sulla qualità ambientale dei comuni capoluogo di provincia, pp 29,30

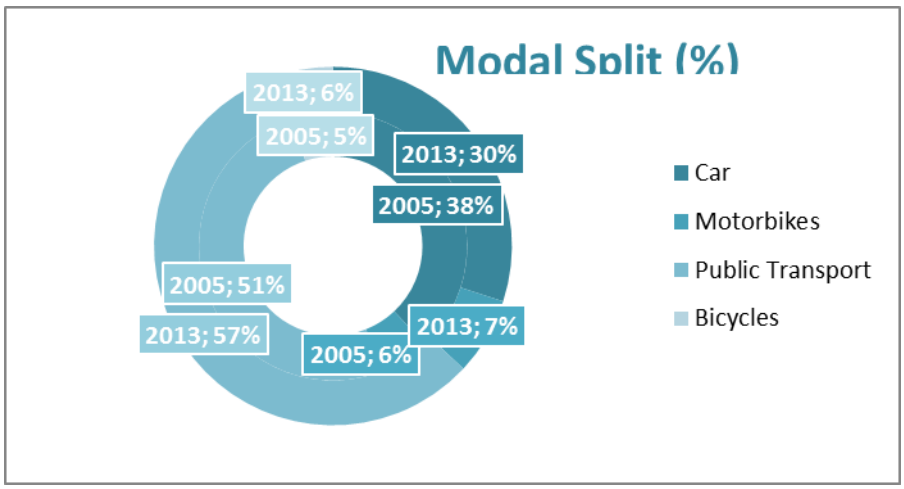


Figure 15: Milan: Share of sustainable transport means (Source: AMAT. Municipal level)

Connections within the city are mainly done using the local public transport. Not only is public transport the most important means of connections, but its contribution has increased in the last decade, with the share being 51 percent and 57 percent in 2005 and 2013, respectively. The usage of cars has decreased between 2005 and 2013, while the use of private motorbikes has slightly increased. The use of bikes is still modest in Milan and increased only marginally between 2005 and 2013.

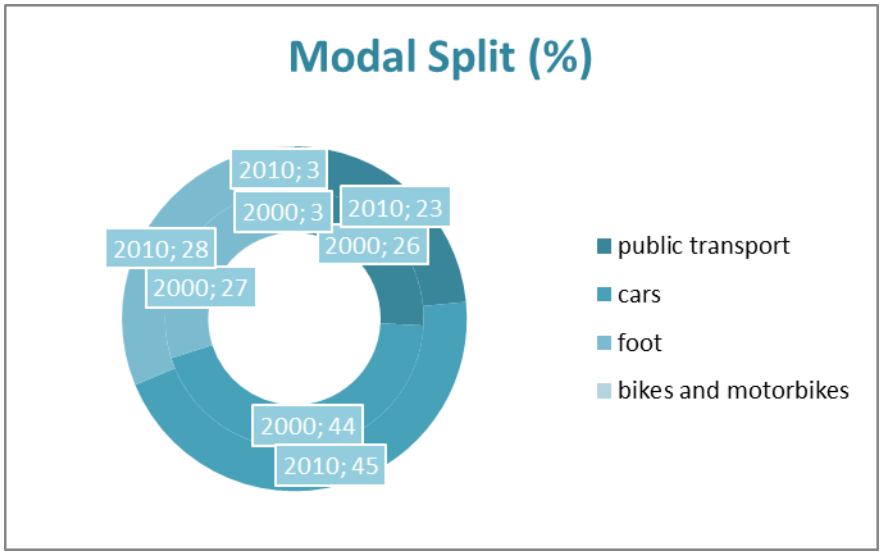


Figure 16: Turin, Share of sustainable transportation Source: Metropolitan Mobility Agency. Municipal level

Between 2000 and 2010, private motorized mobility nearly accounted for half of the trips within the city of Turin. One fourth of journeys are made by foot, another fourth by public transport. Two-wheels (motorized and not) are nearly negligible.

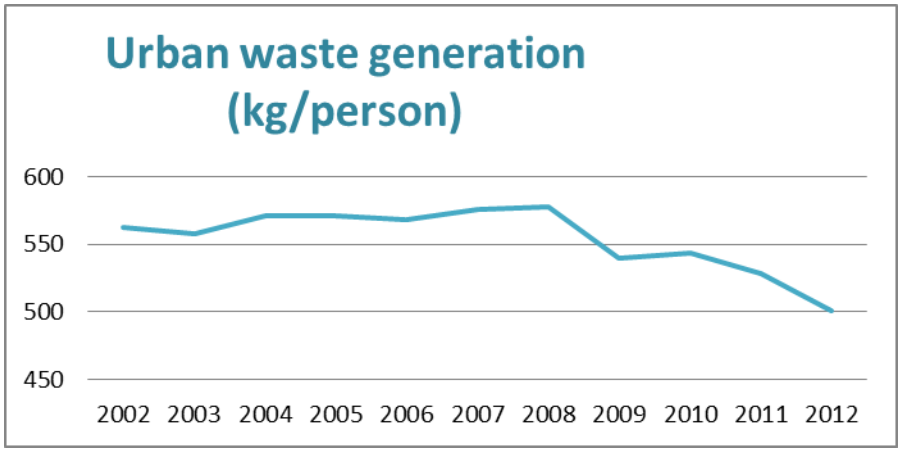


Figure 17: Milan, Urban waste generation (Source: Italian statistical office, ISTAT. Municipal level)

Waste generation registered a certain decline in particular between 2008 and 2012. Waste production in 2012 was 11 percent lower than production in 2002.

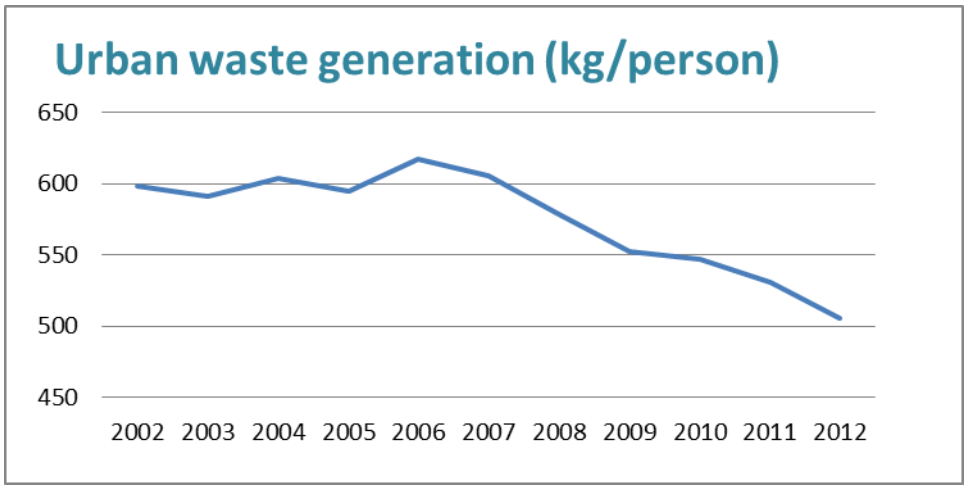


Figure 18: Turin, Urban waste generation (Source: Italian statistical office, ISTAT. Municipal level)

Waste generation in Turin was nearly stable between 2002 and 2006, then begun to decline: in 2012, it was 16% lower than in 2002.

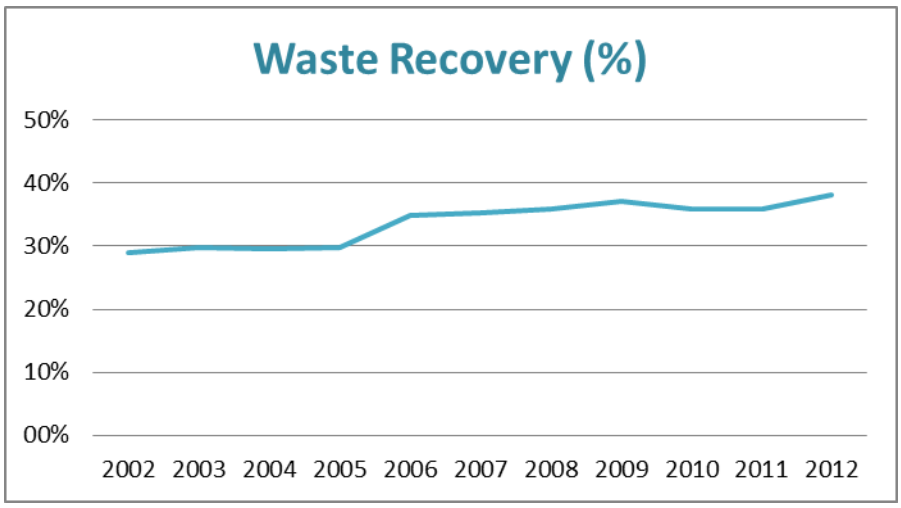


Figure 19: Milan, Urban waste recovery Source: Italian statistical office, ISTAT. (Municipal level)

Waste recovery increased between 2002 and 2012. While in 2002 only 28 percent of waste was recycled, the share in 2012 reached 38 percent. For Italy overall, in 2012, 35 percent of waste was recovered, making Milan better than average. However, compared to some virtuous cities, such as Pordenone, Verbania, Novara, and Belluno, where more than 70 percent of waste is recovered, Milan lags behind.

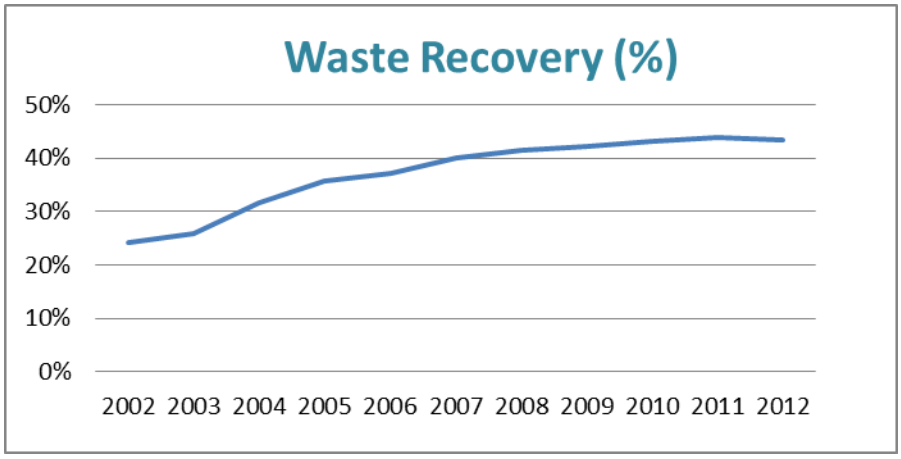


Figure 20: Turin, Urban waste recovery Source: Italian statistical office, ISTAT. Municipal level

Waste recovery in Turin increased between 2002 and 2012, when it reached 43%, 23 percentage points higher than in 2002.

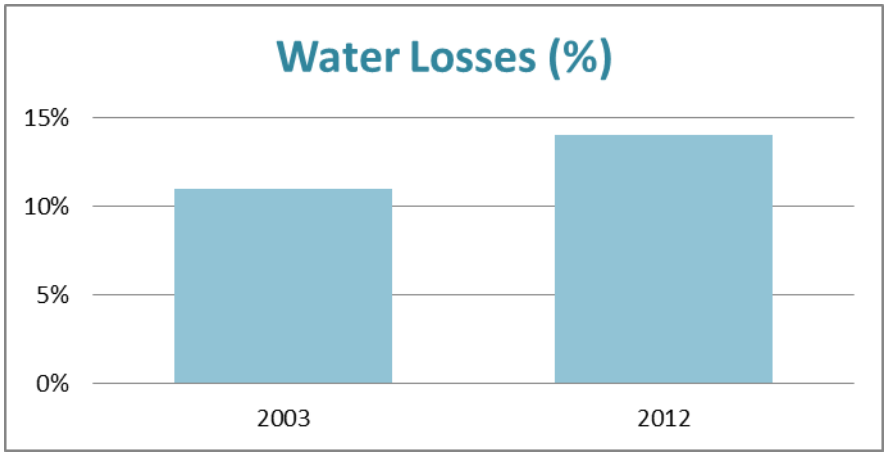


Figure 21: Milan, Water losses rate Source: Legambiente, Rapporto Ecosistema Urbano. Municipal level

Leaking water is another major issue in Italy. Milan lost 14 percent of water in 2012, but it is among the cities where leaks are more contained. Unfortunately the statistics worsened between 2012 and 2014. There are cities, in particular in the Southern part of Italy, where leaks represent more than 60 percent of total water inflows.

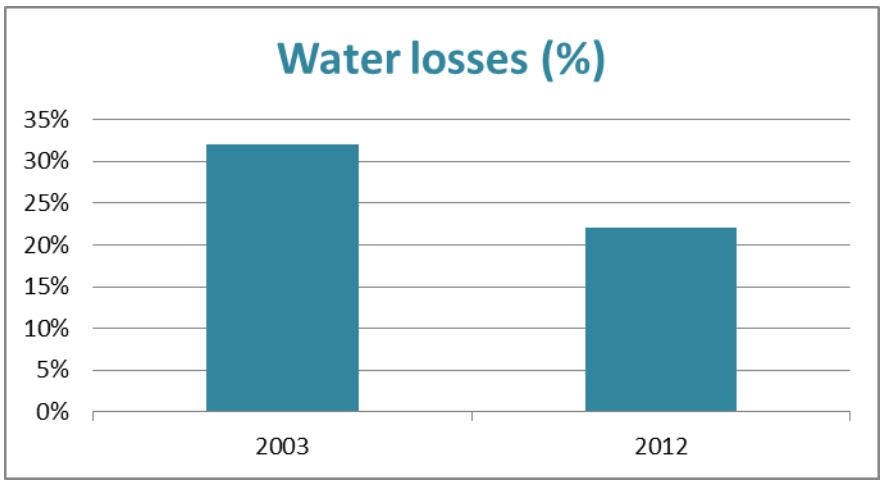


Figure 22: Turin, Water losses rate Source: Legambiente, Rapporto Ecosistema urbano. Municipal level

Water losses decreased in Turin since 2003, but in 2012 are still much higher than in Milan: leaks represent 22% of total water inflows.

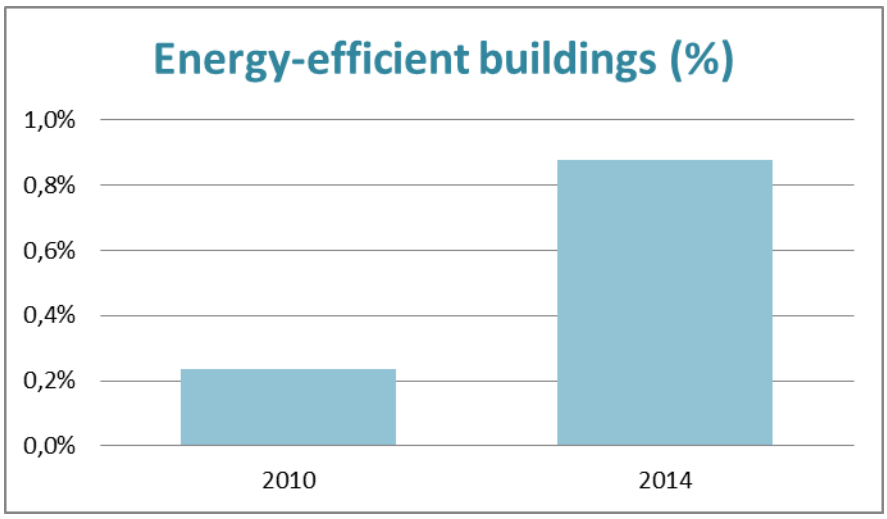


Figure 23: Milan, Energy-e Efficient buildings (Source: author's calculations based on data from Finlombarda (Cened). Municipal level)

Despite being only a limited share of total buildings, the number of buildings rated A and A+ increased between 2010 and 2014. In 2010 energy-efficient buildings were only 0.25 percent of total, while in 2014 the percent increased to nearly 0.9.

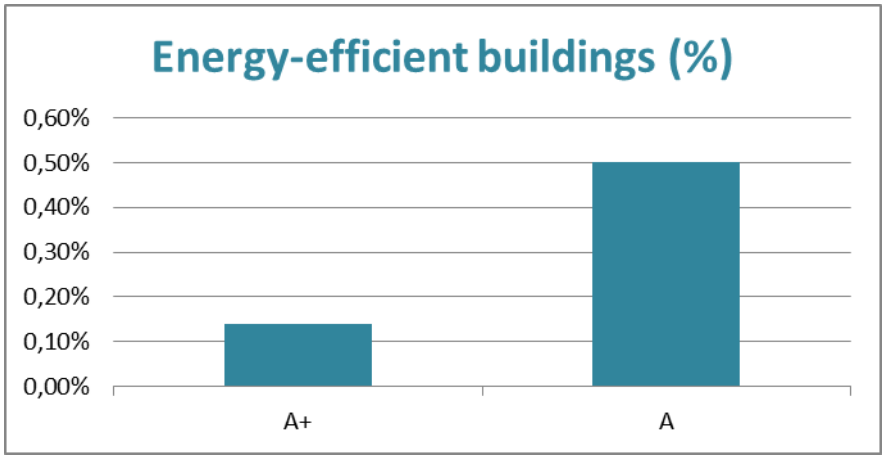


Figure 24: Turin, Energy-efficient buildings Source: City of Turin. Municipal level

Buildings rated A and A+ represents less of 1% of total buildings in Turin. Data before 2014 are not available.

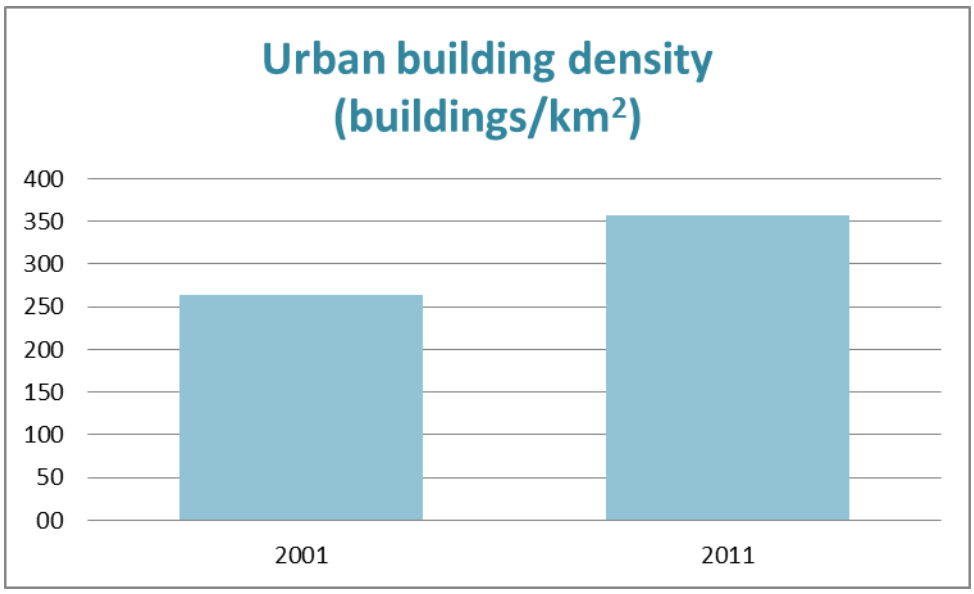


Figure 25: Milan, Urban building density Source: author's calculations based on data from the Italian statistical office, ISTAT. Municipal level

Milan is a highly dense city as far as urban buildings are concerned, and density increased from 2001 to 2011. In 2001, about 250 buildings per square km were reported in the Census, while in 2011 the number increased to 350.

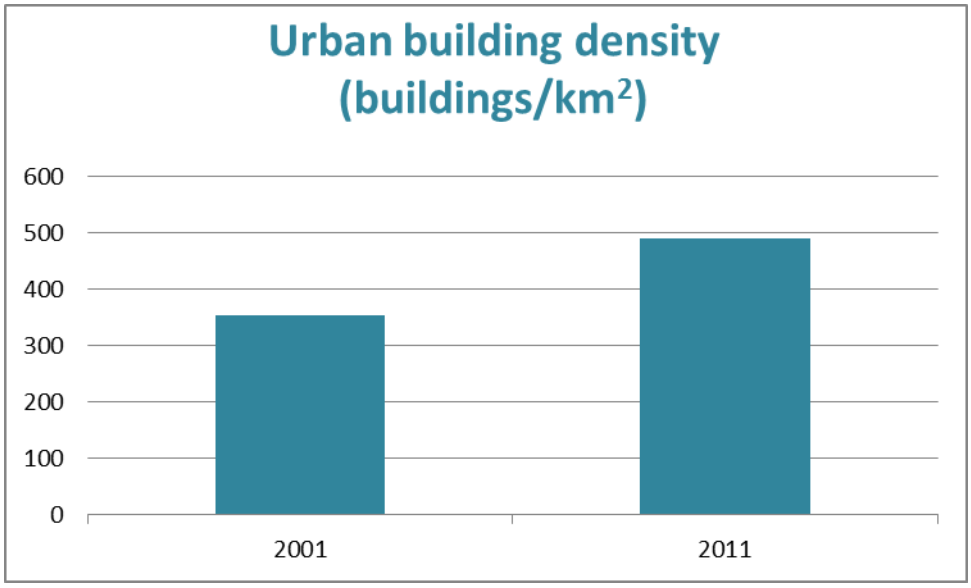


Figure 26: Turin, Urban building density Source: author's calculations based on data from the Italian statistical office, ISTAT. Municipal level

Turin is even denser than Milan: in 2001, there were 353 buildings per square, in 2011 they increased to 490.

V.II SOCIAL PERFORMANCE

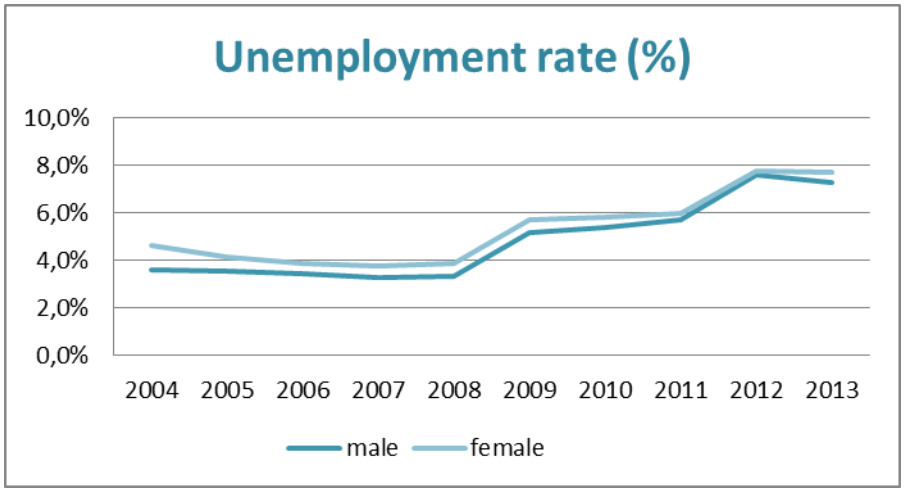


Figure 27: Milan, Unemployment Rate by Gender (Source: Italian statistical office, ISTAT. Provincial level (NUTS 3))

The unemployment rate both for men and women increased gradually from 2004 onward. Males are better off than females even if the gender gap reduced during the period. In 2004, the male unemployment rate was 2.4 percentage points lower than female rate, while in 2012 it was only 0.4 of a percentage point lower. Despite being on a rising trend, the unemployment rate in Milan province is much lower than the average national rate, being 11.5 and 13.1 for males and females respectively in 2013. Only few provinces in Italy have lower unemployment rates.

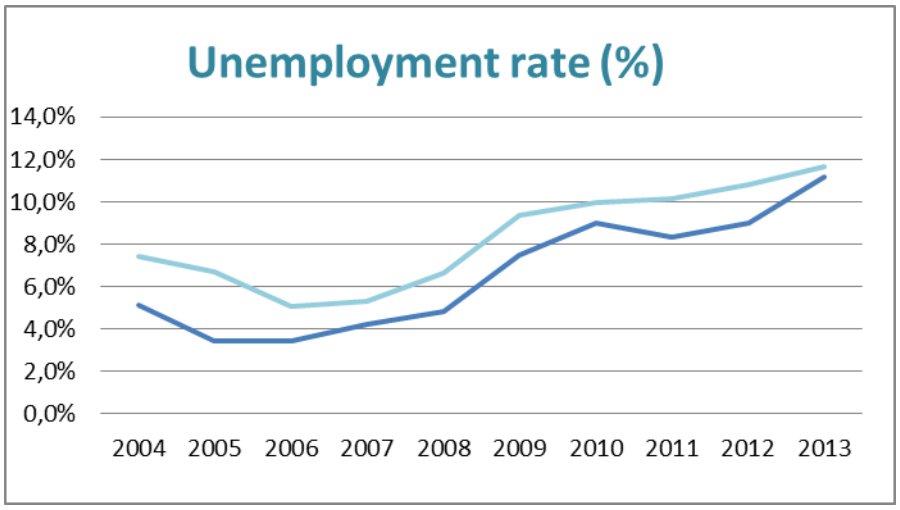


Figure 28: Turin, Unemployment Rate by gender

The unemployment rate in Turin slightly decreased from 2004 to 2006, then gradually increased to 11.1% for males and 11.7% for females: these are very high values, similar to those of most cities in

Southern Italy. The gender gap reduced from 2.3 percentage points in 2004 to 0,6 points in 2013.

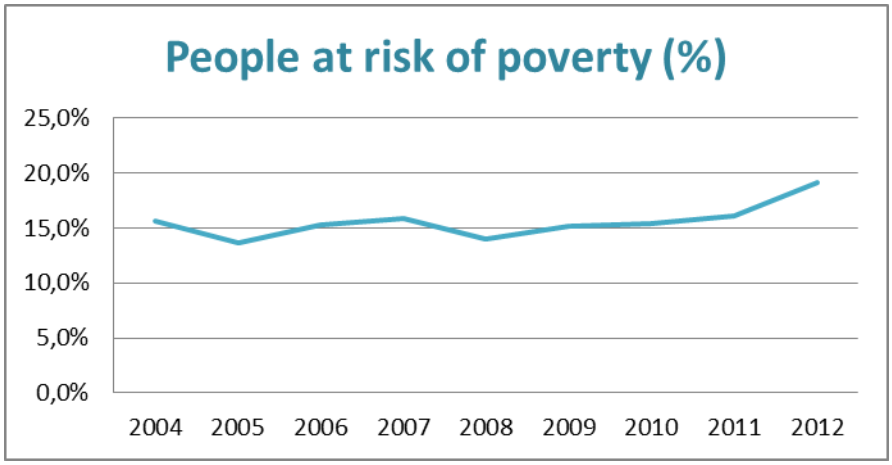


Figure 29: Milan, Level of Poverty (Source: Italian statistical office, ISTAT. Provincial level (NUTS 3)

The level of poverty has gradually increased in the Lombardia region (NUTS2). From 2004 to 2008 the trend was not monotonic, with some years experiencing a growth and some years experiencing a decline in the percentage of people at risk of poverty. From 2008 onward, on the contrary, the rate was on an increasing trend. From 2011 to 2012, the rate displayed the largest positive growth, with the rate in 2012 3 percentage points higher than the rate in 2011. The level of poverty in the Lombardia region is low compared to the rest of Italy. The average national poverty rate was 30 percent in 2012, and only few regions display lower rates than in Lombardia.

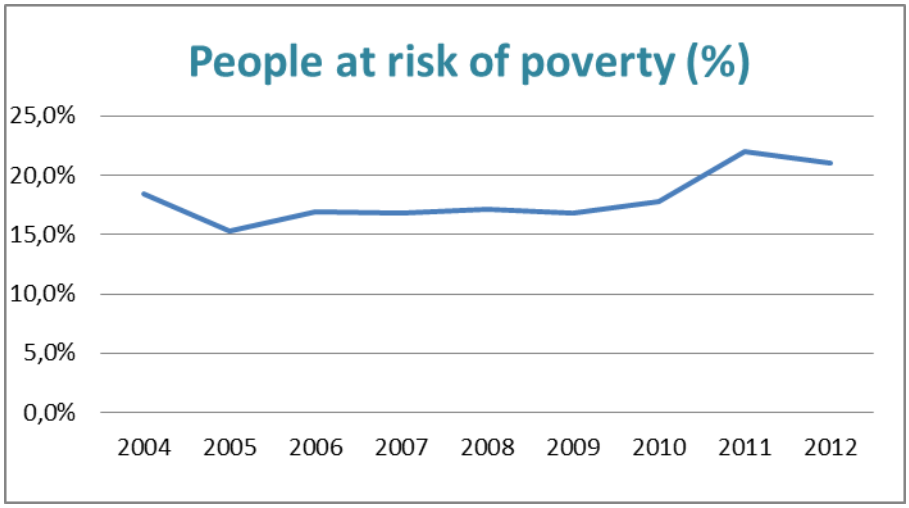


Figure 30: Turin, Level of poverty

The level of poverty in Piedmont was quite stable from 2004 to 2009, then increased over 20% as a consequence of the economic crisis that hit hard this industrial region: in 2012 21% of people was at

risk of poverty.

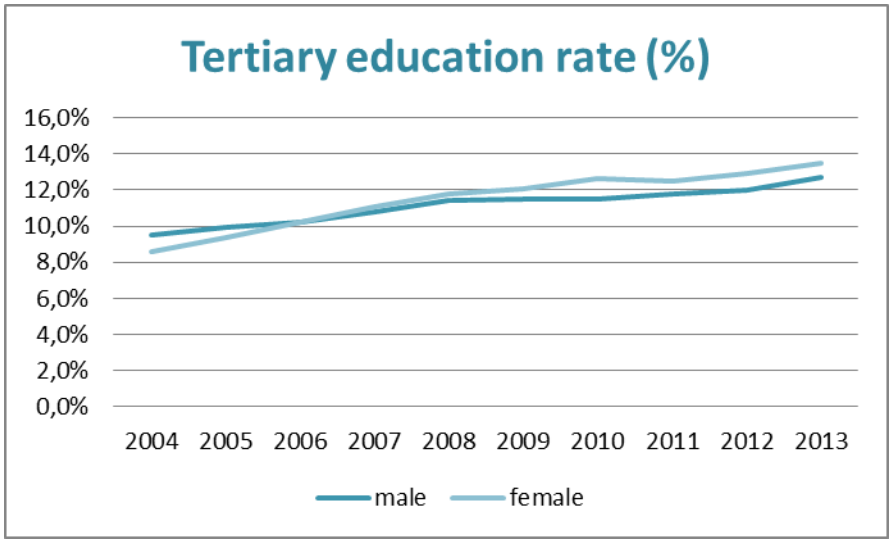


Figure 31: Milan, Tertiary Education by Gender (Source: Italian statistical office, ISTAT. Regional level (NUTS2))

The tertiary education rate increased from 2004 to 2013. Until 2005 the male rate was higher than the female rate while in 2006 the trend crossed and the female rate overcome the male one.

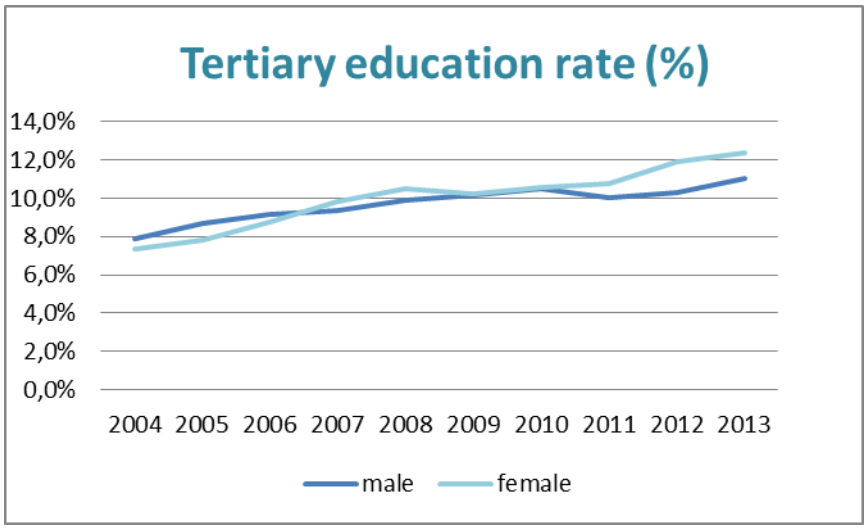


Figure 32: Turin, Tertiary education by gender Source: Italian statistical office, ISTAT. Regional level (NUTS2))

The tertiary education rate shows in Turin a trend similar to Milan: it increased from 2004 to 2013, and in 2007 the female rate overcame the male one.

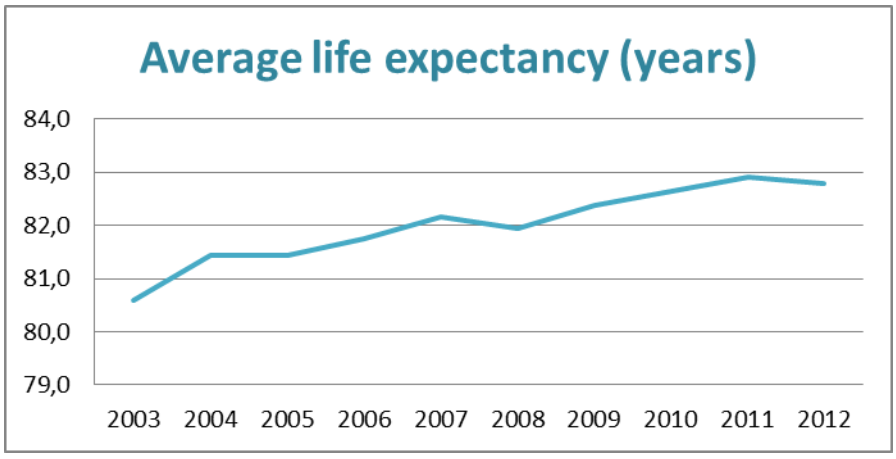


Figure 33: Milan, Average life expectancy (years) (Source: Italian statistical office, ISTAT. Provincial level (NUTS3)

Life expectancy is high and is on a rising trend in the province of Milan.

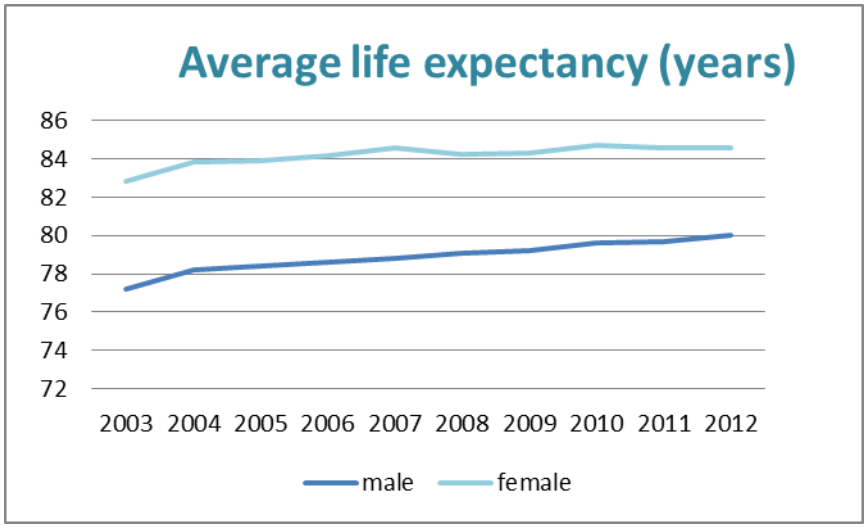


Figure 34: Turin, Average life expectancy

Life expectancy in Turin is a little shorter than in Milan; for females is higher of 4 years than for males.

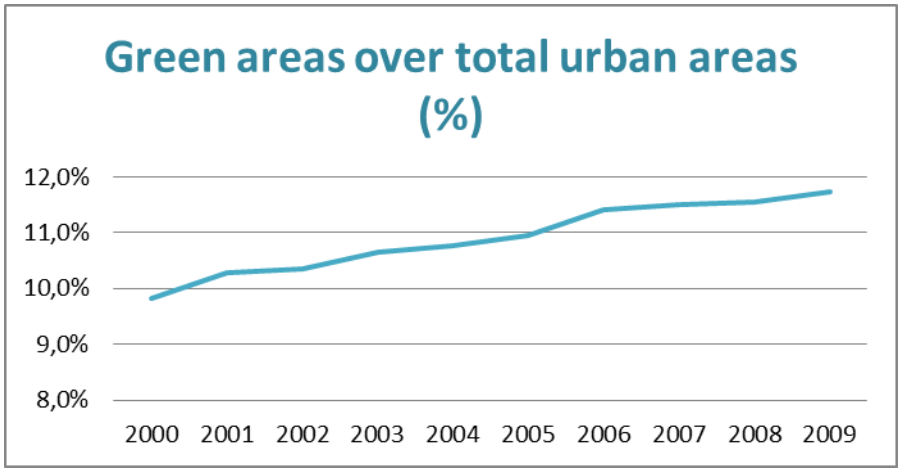


Figure 35: Milan, Green space availability Source: Italian statistical office, ISTAT. Municipal level

The percentage of green areas within the municipal area increased from 2000 to 2009. In 2009 green areas occupied 9.8 percent of the whole urban area of Milan, while in 2009 the percentage increased to 11.7. Italian cities display huge disparities, as the rates range from 72 percent in Pisa to only 0.001 in Taranto and Olbia in 2009. Although the size of the green areas is limited, Milan is among the cities offering the largest size of green areas.

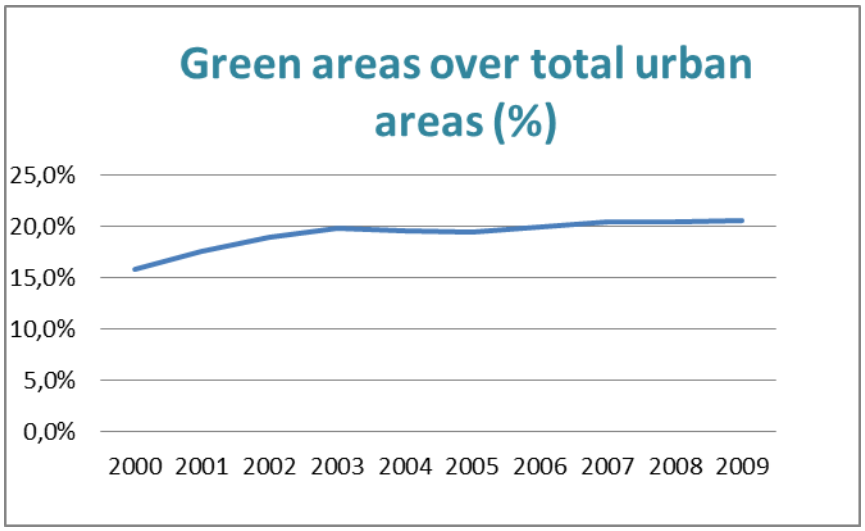


Figure 36: Turin, Green Space Availability (Source: Italian statistical office, ISTAT. Municipal level)

The percentage of green areas within the municipal area of Turin increased from 2000 to 2003, then maintained stable. It is quite double than in Milan: Turin is recognized as one of the greenest major cities in Italy.

Monitoring system for emissions reductions

Since 2005, Milan has owned a monitoring system for emissions reductions. In 2003, an assessment of the environmental situation for Milan was produced, and emissions tracing back to 1998 have been reported. However, a consolidated system of emission monitoring was put in place only after 2005.

(Source: AMAT9

In Turin, the monitoring system for emission reduction has been implemented by the Province since 2000, and it has been enhanced since the adoption of PAES in 2010. (Source: Province of Turin, City of Turin.)

V.III ECONOMIC PERFORMANCE

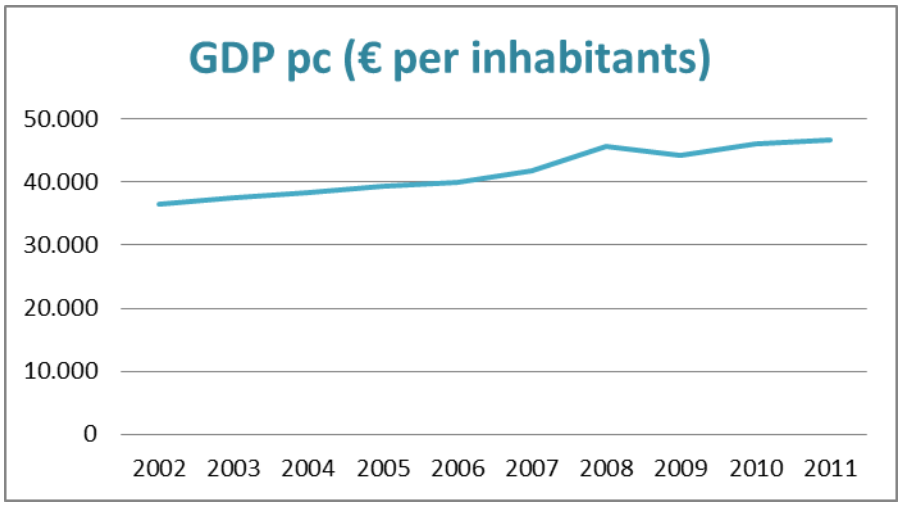


Figure 37: Milan, Level of Wealth (Source: Eurostat. Provincial level (NUTS3))

The province of Milan is among the richest, not only with respect to the rest of Italy, but also compared to other European cities. The GDP per capita expressed in a comparable purchasing power parity (PPP) was 45'600 euros in the province of Milan in 2011, while it was 25'500 for Italy and 25'100 for Europe overall. GDP per capita grew steadily in the province of Milan from 2002 to 2011, even if the rate of growth between 2010 and 2011 was much lower compared to the previous periods.

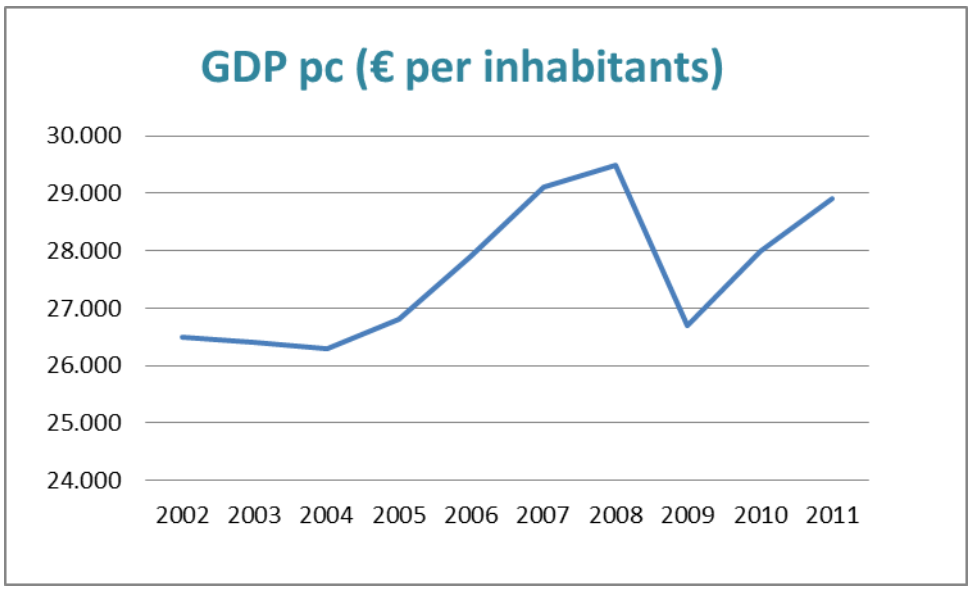


Figure 38: Turin, Level of wealth

The GDP per capita expressed in a comparable purchasing power parity (PPP) in Turin increased till 2008, then because of the global economic crisis decreased of 9% in 2009; afterwards it increased again, but in 2011 it was still under the maximum level reached three years before. In 2011, it is less than two thirds of the GDP in Milan.

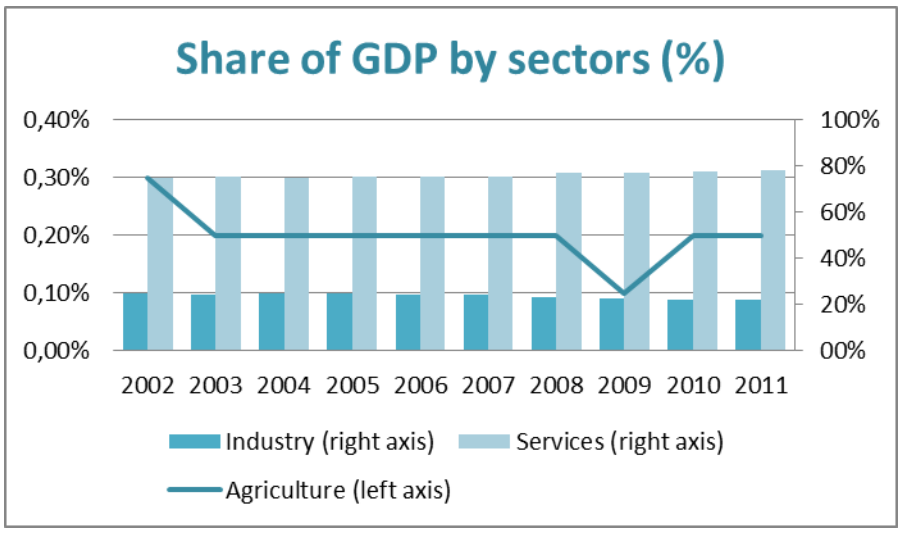


Figure 39: Milan, GDP by Sectors (Source: Eurostat. Provincial level (NUTS3))

In the province of Milan, services make the largest contribution to total GDP. The service sector is responsible for more than 70 percent of GDP, and the percentage has been growing since 2002. Industry is the second largest sector. Its contribution has been slightly declining over time, with 25 percent in 2002 and 22.8 in 2011. The agricultural sector is only marginal, with a share varying around

0.2 percent.

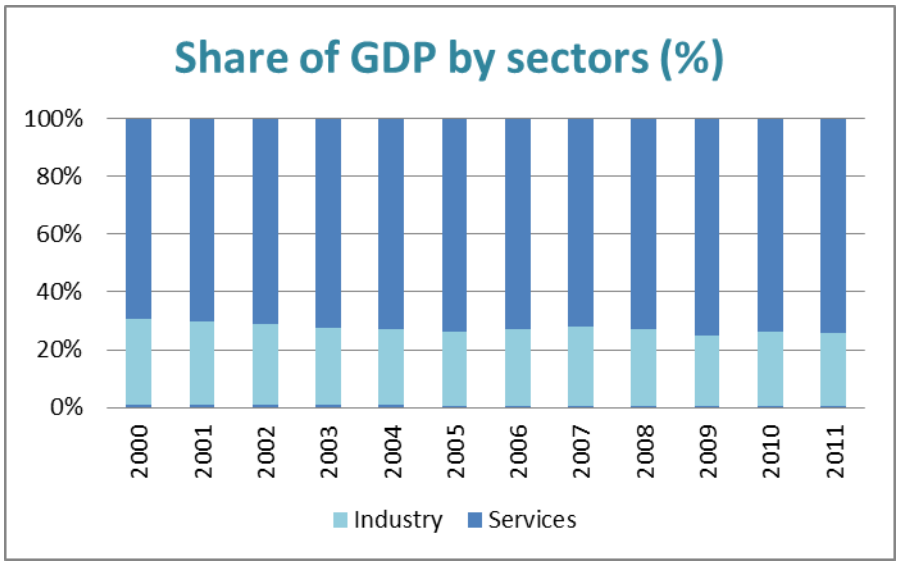


Figure 40: Turin, GDP by Sectors (Source: Eurostat. Provincial level (NUTS3))

In the province of Turin, services are responsible of three quarters of local GDP. The industrial sector contribution decreased between 2000 and 2011 from 30% to 25%, but it is still the most relevant in Italy. Agriculture weights for 0.6%.

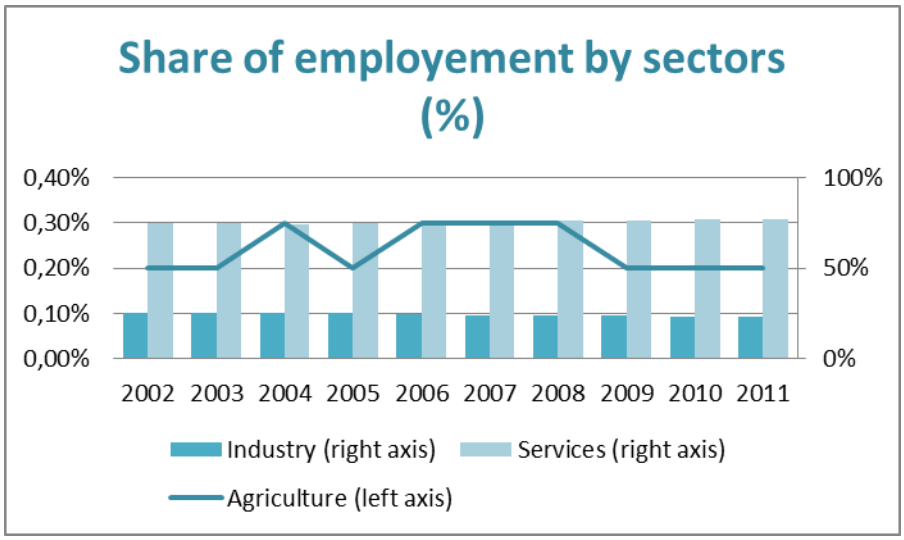


Figure 41: Milan, Employment by sectors Source: Eurostat. Provincial level (NUTS3)

The different sectoral contribution to GDP is reflected in the allocation of employment among the different sectors. Services in the province of Milan account for more than 70 percent of total employment, industry around 25 percent, and agriculture only 0.2 percent. While the employment share in the service sectors has been growing, the share in the industry sector has been declining.

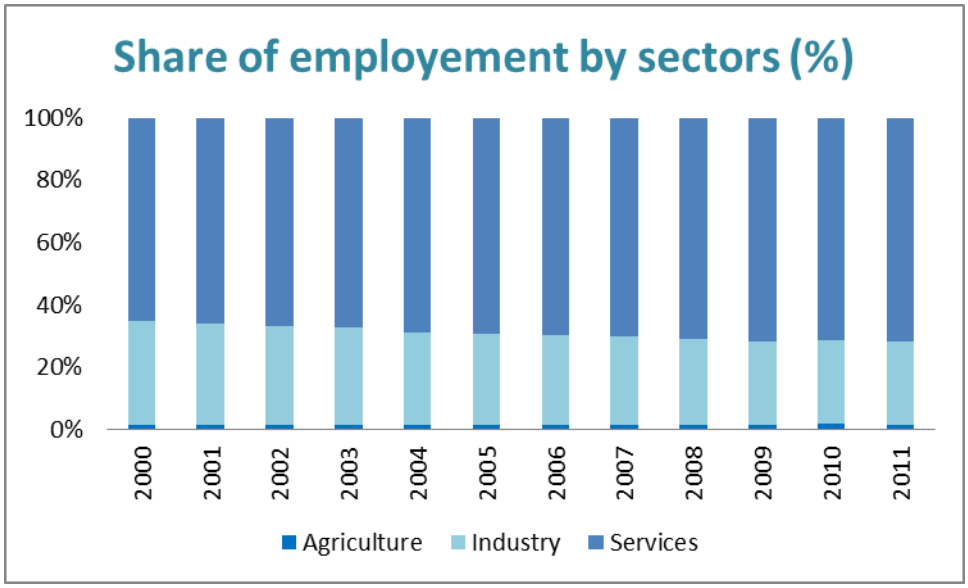


Figure 42: Turin, Employment by Sectors (Source: Eurostat. Provincial level (NUTS3)))

Also in the province of Turin, employment reflects the different sectoral contribution to GDP. Services account for 72% of total employment, industry for 27%, and agriculture for 1.5%.

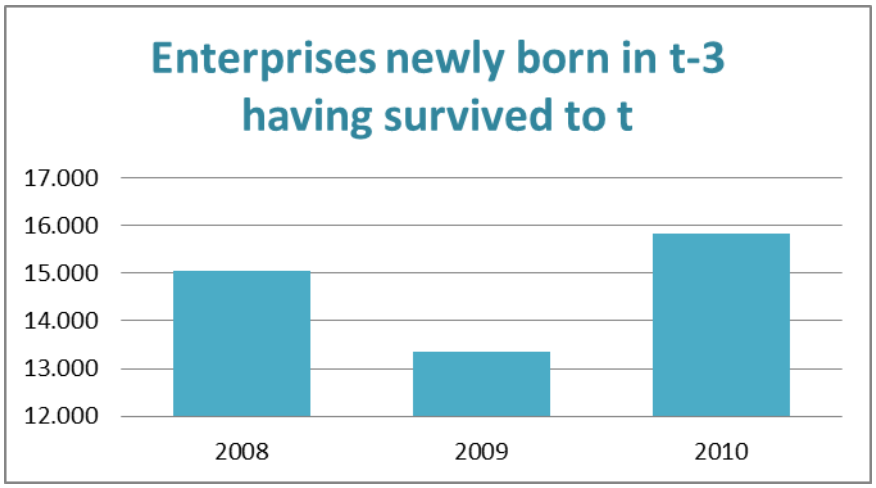


Figure 43: Milan, Business survival Source: Eurostat. Provincial level (NUTS3)

The survival rate of enterprises in the province of Milan does not show a trend. In 2008, the number of enterprises that survived for at least 3 years was 15’000. The number declined to around 13’000 in 2009 and reached nearly 16’000 in 2010. In Italy, only Rome displays a larger number than Milan, followed by Naples and Turin. These figures indicate that big cities attract the largest number of (successful) enterprises.

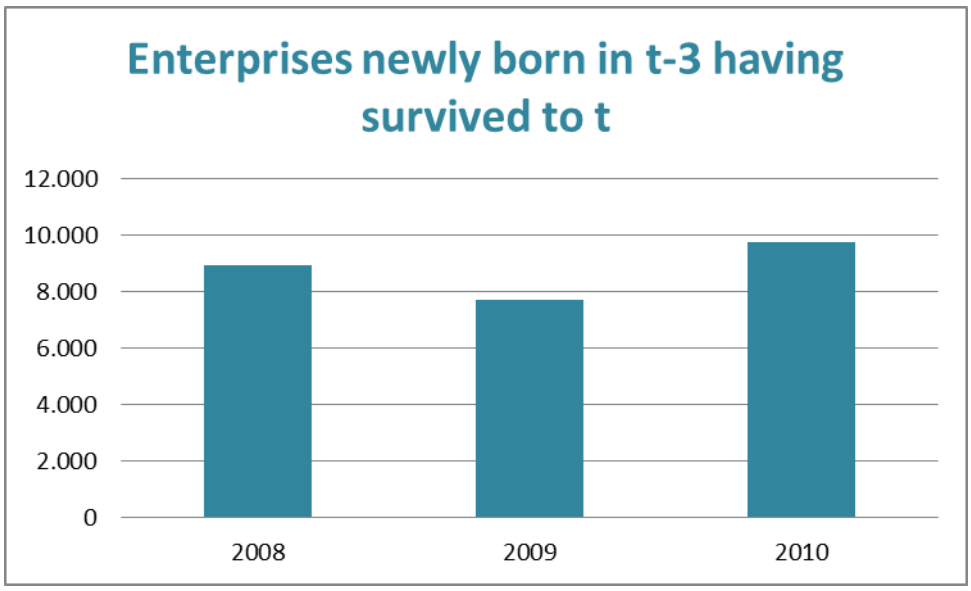


Figure 44: Turin, Business survival (Source: Eurostat. Provincial level (NUTS3)

As in Milan, the survival rate of enterprises in the province of Turin shows a reduction in 2009, but a reprise in 2010. In absolute number, in 2011, the number of enterprises that survived for at least 3 years was nearly 10'000, two thirds of the value in Milan.

MILAN

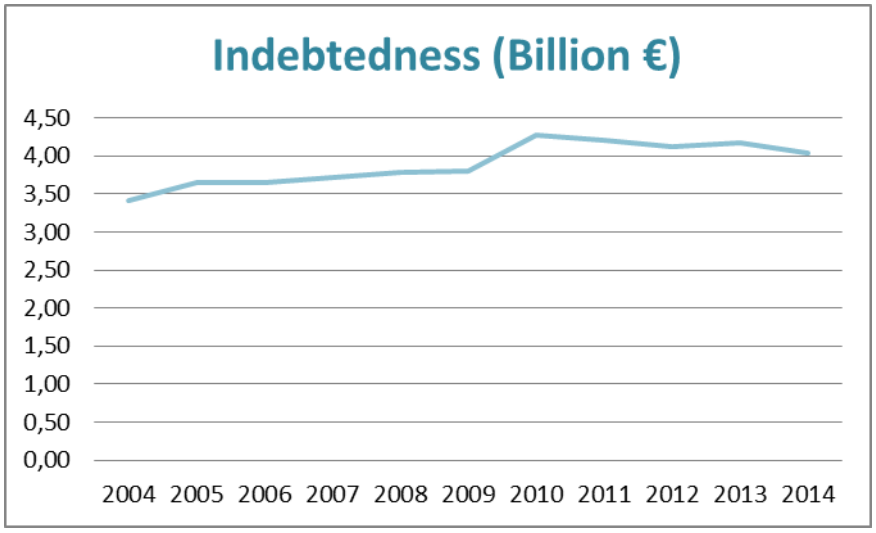


Figure 45: Milan, Indebtedness level Source: Municipality. Municipal level

The stock of debt of the municipality of Milan has been growing from 2004 onward. In 2004, Milan displayed a debt of 3.4 million euros, and this figure increased to 4 million in 2014. This evolution must be interpreted on the background of recent national austerity policies reducing the flow of funding from the central state to local authorities and redistribution of tax revenues between local authorities and central state.

TURIN

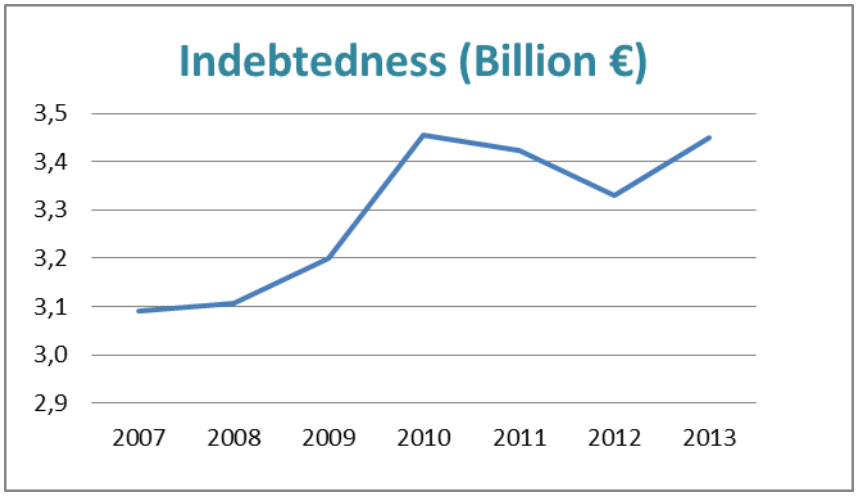


Figure 46: Turin, Indebtedness level Source: Municipality. Municipal level

The stock of debt of the municipality of Turin is the highest in Italy per person (over 3.500 euros per inhabitant) and the second after Milan in absolute terms: nearly 3.500 million euros. It increased from 2007 to 2010; then it begun to decrease, but in 2013 this virtuous trend diverted again.

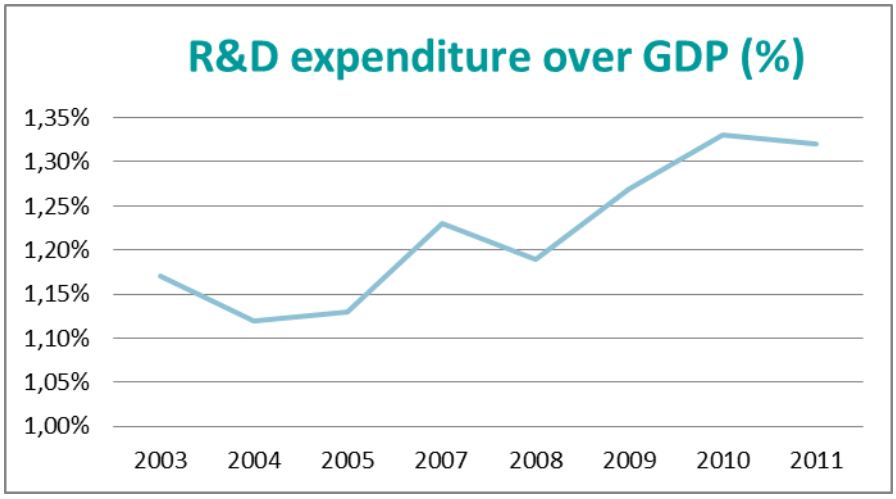


Figure 47: Milan, R&D intensity Source: Eurostat. Regional level (NUTS2)

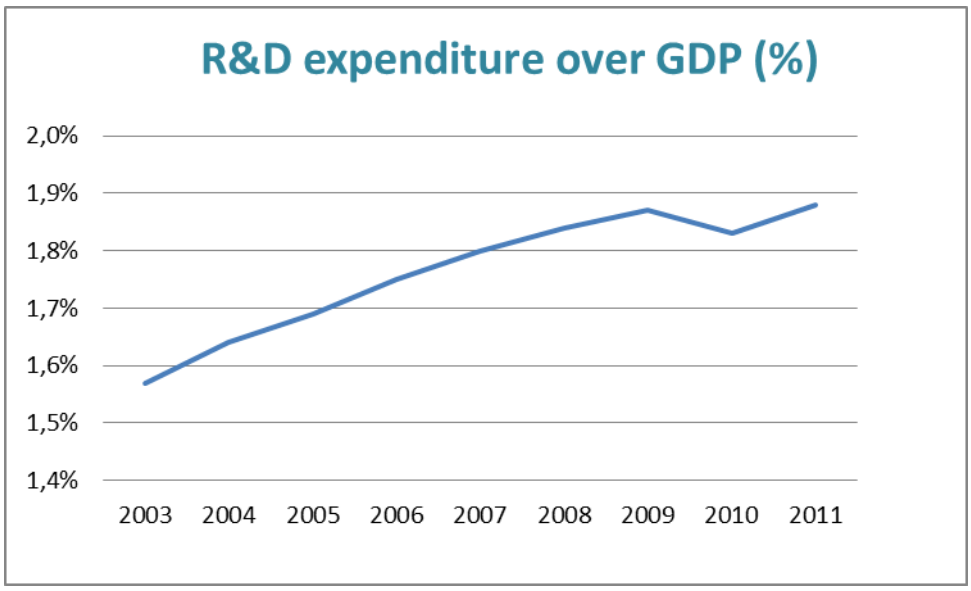


Figure 48: Turin, R&D intensity Source: Eurostat. Regional level (NUTS2)

Only a marginal share of GDP is used to finance R&D in Italy in general, but also in the Lombardia region, despite Lombardia being the region where the largest number of innovations are made. The percentage is slightly more than 1 percent, with peaks of 1.3 percent in 2010 and 2011. The variation rates were both positive and negative during the period even if a general upward trend can be identified. The average R&D intensity of Italy was 1.25 in 2011. Piemonte is the region with the largest percentage, namely 1.88 in 2011, followed by Lazio (1.67) and Liguria (1.45). Only few other regions have higher percentages than Lombardia.

VI FINDINGS AND KEY CHALLENGES

The analysis shows that Milan is a leading city as far as both innovation and wealth are concerned. In terms of environmental issues and efforts towards post carbon solutions, Milan has an advantage compared to the majority of Italian cities.

If compared to the rest of Europe, Milan can be still considered a leader with regard to social but in particular to economic indicators. However, as for the environmental indicators, not only does Milan lag largely behind the cities in the Northern Europe, but has still much to do to achieve the average European standards in this area. For example, according to the European City Ranking conducted for the "Soot-free for the Climate!" campaign, Milan seems to be at the bottom end of the ranking, together with another Italian city, namely Rome. Nine environmental indicators have been collected and 17 cities located in Western Europe have been considered to define the ranking. The indicators take into consideration the effort put in place by the cities in the last years toward the improvements of the environmental quality. The first indicator measures the success in reducing PM10 and soot concentrations. The second considers the existence and extension of Low Emission Zones and Bans of High Emitters. The third and fourth consider the investments towards clean public transport and clean non road mobile machinery, through retrofitting existing vehicles with diesel particulate filters (DPFs)

or furnishing new ones with effective filters or other clean technologies. The fifth measures the use of economic incentives to support the transition of private vehicles towards clean ones or to support new forms of mobility. The sixth looks at the modal split trend, and the seventh considers measures to raise the share of public transport, such as investments for expansion of public transport networks and other tools promoting public transport. The eighth considers measures to promote the use of bikes and legs, through both hard measures such as cycling paths, and soft measures, such as communication campaigns. Finally the ninth indicator looked at the quantity and quality of information which the city made available to the public in order to raise civil awareness and participation.

As regards Turin, the present economic crisis has hit the city and its metropolitan area very hard, mainly because of the persistent strong specialization in the industrial sector: since 2008 GDP has decreased and unemployment has increased; at the same time, Piedmont is the Italian region which invests the larger share of its GDP in R&D. Social inclusion must deal with severe problems: the stock of debt is high (with consequent difficulties in granting services for population), 20 people out of 100 are at risk of poverty, tertiary education is still. From the environmental point of views, the city offer a relevant share of green areas, some of them are natural reserves; on the contrary, air quality is still very poor, and it is improving too slowly, and energetic efficiency of buildings must be enhanced.

VII RECOMMENDATIONS AND CONCLUSIONS

Looking at the Milan case, it is clear that economic constraints are not the sole obstacles toward a post carbon model. Milan ranks very high in terms of economic indicators, but it scores poorly when environmental indicators are considered. Efforts to increase civil awareness, and the ability to shift strategies from a carbon toward a zero-carbon paradigm are crucial.

Technological advancement is another important ingredient for post carbon cities, and Milan is clearly one of the leading cities in Italy, together with Turin, in terms of innovation.

With regards to sectors to which improvements should be targeted, air quality appears as one of the major problems in Milan. Main sectors producing carbon emission are heating and cooling (services and residence), followed by transport. Recent local strategies for traffic limitations have not yet yielded substantial improvements in terms of reduction of PM 2.5 or PM 10; but just limited improvements with regards to the generation of black carbon within the LEZ zone.

Further to extending the efforts for limiting emissions from fuels in the transport sectors, tackling the issue of heating (and cooling) in the residential and services sector appears most promising, considering the share of contributions to the overall emissions. According to expert opinion, some improvements will be possible improving energy efficiency within buildings, although in the extended aged building stock in the city of Milan, these strategies will soon find some limits. A more promising strategy in this sense could be found in introducing renewables and/or increase the efficiency of centralised energy generation, using forms of co-generation and centralizing heating and cooling facilities for both residences and the services sector.

Most of these recommendations can be taken into consideration also for Turin. Transport, residential, tertiary and industrial consumption and emissions should be object of policies for improving efficiency, mainly to deal with the major problem of air pollution. The level of municipal debts makes it difficult for the city to invest in long term environmental policies; as a consequence, it is necessary that private stakeholders, which play a relevant role in regional R&D investments, cooperate with public administrations and local universities in smart city projects. Social innovation is also required to grant inclusion of an important bracket of the population, which is at risk of poverty, digital divide, lack of higher education.

In the first workshops, when the result of this initial assessment were discussed, local stakeholders both in Turin and in Milan could not find significant opportunities of implementing post carbon policies through a collaboration between the two cities. At the moment, the high speed rail line that connects the two cities has mainly reduced journey times, but has not determined new environmental strategies or projects for a common action. Most post carbon policies seem to be effective if implemented at a city or metropolitan level, while an intercity scale does not seem to offer opportunities for increasing the efficiency of these policies. Chances for collaboration are mainly economic, in terms of complementarities between industrial specialization of Turin and services in Milan, between universities and innovation and research centres, between multi-utilities.