



Department of Business and Management

Master Thesis in International Business

SMART CITIES AND SUSTAINABILITY

SUPERVISOR
Prof. Luigi Laura

CO-SUPERVISOR
Prof. Massimo Bernaschi

CANDIDATE
Gaia Marullo
701701

ACADEMIC YEAR
2018/2019

INDEX

Introduction	iv
Chapter 1: The Smart City Model	1
1.1 Definition and Concept.....	1
1.2 Features and requirements	4
1.3 Measuring “smartness” levels.....	8
1.4 Planning 2013	12
1.5 Worldwide smart cities experiences	18
Chapter 2: Italy and Smart Cities	21
2.1 Italian Smart Cities	21
2.1.1 Analysis of the Italian situation with respect to the <i>Smart City</i> project.....	21
2.1.2 The ICRate 2018	23
2.1.3 The five ICity Rate 2018 Dimensions and the related indicators	25
2.1.4 The three leader metropolitan cities	34
2.1.5 The Seven Small Innovating Cities	35
2.1.6 The Small Capitals	36
2.1.7 The South: The Need for New Developing Strategies	37
2.2 A Study Case: Cagliari.....	37
2.2.1: Cagliari and the Pula district. The IOC. A focus on TDM	37
2.2.2. The role of Huawei in Italy	41
2.3 An international frame to Italian smart cities	42
2.3.1 Italian Smart Cities and the Objectives for the Future: The UN Agenda 2030	42
2.3.2 Europe 2020	44
2.3.3 Seven proposals to help Italy become smarter.....	47
2.3.4 The Italian Digital Agency	51
Chapter 3 The Miracle of Medellin	53
3.1 A study case: The miracle of Medellin.....	53
3.1.1 The vision of Medellin. Its beginning: The SIMM.....	53
3.1.2 Medellin: an all dimensions smart city.....	59
Chapter 4 Green Economy and Sustainability	63
4.1 Green Economy for a global change.....	63
4.1.1 Definition of Green Economy	63
4.1.2 Green Economy Sectors	64
4.1.3 Climatic Changes	74

4.1.4 The biodiversity crisis	78
4.1.5 The role of technology: focus on three innovation cases around the world.....	82
Chapter 5 The role of ICT: London Datastore	90
5.1 London Datastore.....	90
5.1.1 A portal at the service of Londoners	90
5.2 Data Analysis.....	95
5.2.1 Correlations	100
Conclusion.....	102
References	105
Sitography.....	107
Executive Summary	110

Introduction

During time metropolitan cities have always had a role of great centrality as to the process of political, social and economical development, but a strong accent is today put on their environmental sustainability as their presence is becoming more and more invasive. Since the second half of the twentieth century, as a consequence of urbanization and the increase of built-up areas, cities have registered a great rise of their inhabitants. In 1960 the world urban population figured up to 36% of its total and in 2014 it was more than its half, that is 53%. Even if this process of urbanization is imposing at an overall view, there are great regional differences, with developing countries presenting urbanization levels below the average, and areas like Northern America, Latin America and Europe where about 75% of the population lives in cities.

Although urban areas are just an ephemeral portion of the globe, their impact on the environment is relevant, since they are responsible for 75% of carbon dioxide emissions, consuming 80% of the global energy supply and 75% of the natural resources. Therefore, a growing need of protection and preservation of the natural environment and a reassessment of urban areas organization – that is a more rational management of the resources with the aim of a more efficient provision of services to the citizens – is now to be taken into consideration and to be planned. The urgency for that new assessment originates from the necessity of fighting not only the problems and issues our globe is at present facing, but above all those in store for the future.

When considering the above framework, *Smart Cities* appear to be a clever answer to the humankind new emergent needs that are becoming more and more urgent because of the fast and ineluctable global dynamics. *Smart Cities* present themselves as the strategic solution to face the challenges related to urban expanding areas, sensible natural resources management, planning and realization of new transport models and citizens' quality of life improvement.

Innovation is by no means the essential element in smart planning: it can be defined as the thread running through *Smart Cities*, the element their development and the take-off of all the projects and initiatives depend on. Never as today have we been aware of the enormous value the technological progress has got in city planning; this is why it is absolutely necessary to reconsider the shape and life of cities without of course forgetting the traditional structures and features that have grown in time inside urban centres. The

role of ICT (*Information and Communication Technology*) is thus essential as a tool for managing, processing and transmitting data and informations and can help solving the manifold problems presented by great urban areas tumultuous growth and creating what can be defined as a true *smart city*.

In the first chapter the theme of Smart City will be dealt with, giving the most complete definition of it, showing its origins and presenting the necessary features a city must have in order to be defined *Smart*.

In the second chapter the present situation in our country with all its local differences will be analized. The ICityRate 2018 has been analized in all its sections and with reference to both Sectors and Indicators. With respect to other countries Italy is still behind because of the economical, social and cultural gap existing between its North and South. In this chapter the proposals and changes our country should follow to reach the optimum level of general smartness will be listed and analized.

A focus on the case of Cagliari and the Pula District is made at the end of the analysis of the Italian present situation since it well shows how the role of ICT is fundamental to trasform traditional cities into *smart* ones. Located in a region with very few natural and economic resources, Cagliari, thanks to the innovating vision of its political management, is now becoming an example for the other Italian and European cities and is attracting international funds – mostly Chinese - for the projects it is developing in its Technologic Park.

The role of AgID and its organization and function is analized too, since it is the instument Italian governments find ready to use in managing all the different issues the innovating process involves on a national scale. A reference to the international frames Italy governments have to work is made too, with special regard to the UN Agenda 2030 and EU 2020 that give the goals to be reached by all nations on an global scale.

In the third chapter a focus on the *miracle* of Medellin is exploited to stress the relevance an innovating transformation of a city can prduce not only with regard to its infrastructures, but to the new attitude and feeling of pride its citizens have acquired thanks to a political *vision* that has put the individuals at the centre of its action. The city in Colombia once so famous for narcotrafficking and for being one of the most violent in the globe is becoming now an example of how a change is possible.

In the forth chapter the theme of Green Economy is introduced, since it is at the basis of the very idea of *Smart City*. Its origin and definition will be analized, considering also the

strategic sectors that are necessary to promote its development. The threatens climatic changes and biodiversity loss represent for humanity are also referred to, since a change towards Green Economy is the only means to overcome the present environmental and economical crisis. At the end of the chapter three study cases are presented to stress once again the fundamental role Technology possesses as to the solutions it can offer to overcome tremendous issues such as natural resources consumption, pollution, deforestation.

Sustainability therefore is more and more the keyword to interpret and act in a world that has really become *global* in its challenges but also in its solutions.

Chapter 1:

The Smart City Model

1.1 Definition and Concept

We should start by making the question “what is a Smart City?”. It is not simple to give a univocal answer and definition of *Smart City*, a term that is now going through an enormous success witnessed by a great deal of lectures, conferences, sensibilisation campaigns, information and training processes. Its success is mainly due to the decline of that model of growth started with the Industrial Revolution at the end of the eighteenth century and appearing now to be at the end of its development potential, foreshadowing for the future negative perspectives that threaten to overcome the benefits reached in the past. The alarming provisions of a systemic crisis urge communities towards new objectives and economical ways, new technological and scientific models, new forms of job organization, of technological competence and of social participation. We are actually in front of a ‘crisis’ that is not simply financial, but rather a civilisation ‘crisis’, involving and troubling the whole planet.

Planning a possible way to social, economical and ecological sustainability is becoming more and more urgent and the transformation of the old-style cities into smart ones is one of the central issues in that process. The task is not a simple one since it is not possible to refer just to one standard model of *smart city*: each city has in fact its own features, possibilities and needs and one model may be applied with success in some urban contests, while it wouldn’t be possible to apply it to others. The first preliminary problem to face is to identify and define the degree of a city *smartness*, understanding if and to what extent it is possible to quantify a city *smartness*, recognizing the weak or strong features of the urban area in exam and only then, on their basis, planning the radical future change.

But coming back to the definition of *Smart City*, it is thanks to the studies and researches led at the Polytechnic in Wien in collaboration with the Universities in Ljubljana and Delft that we can today give a more precise and acceptable definition of it: a city is *smart* when it is intelligent, and it is intelligent when the investments made in the human and social capital, those related to technological innovation, communication and transport innovation are all applied to the benefit of sustainable development, its inhabitants quality of life, a

careful management of the natural resources and the active participation of the whole community.

It is possible therefore to say that the *smartness* of a city is a sharing, active, distributive, democratic, society-oriented smartness, such as facilitating the participation and integration both of the citizens and the community with the perspective of sustainability in the management of the resources – the resources being not only the natural and environmental ones, but also the social and economical ones.

The role of ICT (Information and Communication Technologies) is essential to a city in order to define it as a *smart city* since the massive use of it is necessary in monitoring and controlling everyday citizens' life, in recording results, in sharing informations and data, in enhancing community interplay. ICT is therefore the fundamental element when a *smart city* is to be planned since those technologies affect net connections, advanced transport systems, infrastructures and renewable energies.

A *smart city* therefore, even when it is not a completely sustainable city, is at least a social community in evolution, planned to grow and last in time, to compete as to its economy, welfare and social inclusion.

“A *smart city* is a continuous thought of innovation and not a final goal”: this is a definition in perspective given by Aniello and Tessitore, two of the most important experts at present studying on the matter.

As a conclusion to this first part, we must refer to those authors that, since 2000, have tried to give a definition of *smart city* (Table 1).

Table 1: Main definitions of *smart city*

2000	Hall.R. E.	“A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens”.
2007	Giffinger R. <i>et all</i>	“A city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of activities of self-decisive, independent and aware citizens”.

2009	UE Strategic Energy Technology Plan	“... a city that makes a conscious effort to innovatively employ information and communication technologies (ICT) to support a more inclusive diverse and sustainable urban environment”.
	Lombardi <i>et al</i>	“A smart city therefore has smart inhabitants. In addition the term is related to the relation between the city government administration and its citizens. Good governance or smart governance is often referred to as the use of new channels of communication for the citizens, e.g. ‘e.governance’ or ‘e.democracy’”.
2010	Harrison C. <i>et al</i>	“A city connecting the physical infrastructure, the IT infrastructure, the social infrastructure and the business infrastructure to leverage the collective intelligence of the city”
	Toppeta D.	“A city combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and liveability”.
	Washburn D. <i>et al</i>	“The use of Smart Computing Technologies to make the critical infrastructure components and services of a city which include city administration, education, healthcare, public safety, real estate, transportation and utilities more intelligent, interconnected and efficient”.
2011	Nijikamp P. <i>et al</i>	“...the city is called <i>smart</i> when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance. Furthermore, cities can become ‘smart’ if universities and industry support government’s investments in the development of such infrastructures”
2013	Giovannella C.	“A smart city should be a city well performing in a forward-looking way in six smart characteristics (also called soft

		factors: smart economy, smart mobility, smart environment, smart people, smart living, smart governance) built on the smart combination of endowments and activities of self-decisive, independent and aware citizens”.
--	--	---

Source : De Santis, Fasano, Mignolli, Villa,2014

1.2 Features and requirements

After a great deal of debating on a theoretical definition of *smart city* and on its hypothetical reference model, the ITRE Commission for industry, research and energy at the European Parliament has stated in its paper “*Mapping Smart cities in EU*” that in any attempt of defining a *City as Smart* at least one of the six features listed in the project “*European Smart City Project*” must be present. Even though any city is different to the others as to demographical, economical, cultural, political and social terms, in each it is possible to trace back those common features that have made it possible to draw an outline vision of *Smart City*. According to it the smart cities can be identified or classified into six different dimensions:

I. SMART ECONOMY

The new idea of *smart economy* radically changes the global scenery, since it proposes a set of activities aimed at enhancing the entrepreneurial spirit and contributes through new technologies to direct the producing system towards better behaviours with the aim of satisfying companies, citizens and environment needs. In a world that is becoming economically and financially more and more complex, the smart economy interacts with innovating elements such as enterprise incubators, research centres or the so-called *Living Labs*. The *Living Labs* are a new approach to research activities since they are based on a co-projecting and co-creating vision, that is they invite citizens to co-operate with the reserchers, thus becoming “inventors” or creators of new products or services destined to themselves. Moreover, the *Living Labs* promote the creation of innovative start-ups and assist them in their growth giving them the useful tools and places to develop a true efficient business. The *smart economy* provides with interesting ideas as to the production of a synergic system where private owned companies, public authorities and research institutions work together with the aim of raising the general technological level and of creating a stimulating environment not only for high technology companies but also for

the common citizen. To help internalisation processes, knowledge sharing and creative talent promotion is the final goal of *smart economy*.

II. SMART MOBILITY

The problem of mobility is one of the sectors producing the greatest number of negative externalities, especially in great metropolitan areas where a high level of atmospheric and acoustic pollution - produced both by private-owned cars and by local public transport means - together with traffic congestion is present. The innovative system of smart mobility is a central theme when the idea of *smart city* is involved and, in order to reach the objective of *smart mobility*, both ITS (Intelligent Transport Systems) and ICT (Information and Communication Technology) as well as the development of alternative energy sources are to be taken into consideration. *Smart Mobility* becomes thus the new goal to reduce not only waste and pollution, but also to create a scale economy as to people and goods movements, to improve logistics and transport infrastructures and finally to reduce costs. Mobility and movements of people and goods are now to be planned through ICT and made easier and cheaper so that the standards and everyday quality of life can be environmentally sustainable and responsive. *Smart mobility* offers to citizens more comfortable and sustainable solutions through continuous updating:

- a. *Local public transport* – Well projected transport means allow the reduction in the use of private-owned cars and as a consequence of acoustic and atmospheric pollution.
- b. *Fast lanes* – Fast flowing lanes - one for private-owned cars and one to be always kept practicable and flowing for public transport or for emergency assistance - reduce traffic congestion.
- c. *Cycle paths* – Predominant in Northern European cities, as for instance in Amsterdam, they do really represent an alternative to cars.
- d. *Urban toll* – A system of payment with access ticket that allows non-resident citizens to use the city road net.
- e. *Pay parking* – It increases the costs of private-owned cars while facilitating the access to parking areas for a short period. It is a form of facility suitable to central city areas. In this field the American company ‘Streetline’ is leader in offering services based on technological infrastructures that make the search for a free parking easy and grants a better balance between demand and supply.

- f. *Car sharing and Car pooling* - Their common principle is the possibility of the collective usage of a private-owned car, with a range of different possibilities. Car Sharing is a system of “pay-per-usage” that is a car is rented and paid only on the basis of the time requested according to the kilometers to be made thus eliminating all the expenses and inconveniences of owning a car. For instance, “Enjoy” is a company in Milan that makes it possible to rent a car through smartphone. In *Car Pooling* instead the car is owned by someone who places his car at disposal of other people going to the same place and paying a small sum of money, in order to reduce the costs of owning a car. “Blablacar” is the biggest community of car pooling in the world.
- g. *Bikesharing* – An alternative and environmental-friendly system now present all over the world. A net of cycle-stations allows all its subscribers to take and leave back their bicycles, reaching their destinations and place them back at the end of their journey. It offers great advantages not only to the citizens of a city but also to its tourists.
- h. *Traffic Blockage* - Temporary urban traffic blockage is an emergency disposition to reduce pollution, but of course it can only be temporary and doesn't solve the problem. It is a measure aimed at stopping car usage and at inviting citizens to use more sustainable transportation means.
- i. *The Mobility Management* – The new professional position can be either the company or the area manager. His task is to promote the use of alternative means of transport to employees thus collaborating with local transport and improving mobility in the areas they work in.
- j. *Infomobility* – Using the informations received through mobile terminals, as for instance mobile phones, GPS, they permit the optimization of traffic flows, reducing both travelling time and gas emissions.

III. SMART ENVIRONMENT

Protection of the environment is a central issue in a *Smart City* and is one of the features listed in the project “*European Smart City Project*”: ‘Green’ themes like sustainability and energetic efficiency are involved in it. In the creation of a *smart environment* the separate collection of household waste, the recycling cycles and the renewable energy sources get a primary role together with the adoption of sustainable buildings and the consequent reduction of pollution due to heating.

The citizens are not only involved in the creation of a *smart cit* but they also become protagonists with their everyday environmentally friendly actions. Each single inhabitant can participate in the process of making his environment cleaner improving his everyday habits from evoding waste to the adoption of alternative transport means. A relevant role too is that of the City Management that has the function of stimulating and sustaining the community with sensibilation campaigns and incentives.

IV. SMART PEOPLE

The *smart city* originates from the participation, the involvement, the dialogue, the interaction, the engagement of each single inhabitant of it. One of the features of the *smart city* is the promotion of its human capital (smart people): there couldn't be any smart initiatives without 'smart' people. The city Mamagement's objective is therefore to develop computer skills in its citizens so that they can have access to the services based on ICT, but their objective is also to stimulate their creativity so that they can take an active part in innovation. The citizens can become the inventors of new services - as in the *Living Labs* - or can either produce electric power to feed into the *smart grids*. An interesting case is that of one of the projects realized in Barcellona: the transformation of a two hundred hectare industrial area at Poblenou into the district called "22@Barcellona", a knowledge and innovation centre surrounded by green areas and sustainable structures for people to realize in them their economical, cultural and educational activities.

A *smart city* is a city projected together, created through a partecipating process where people can find a new awareness and partecipation into the public life and common issues, where communal life between bringers of different interests is made possible, where a political and social growth is made real.

V. SMART LIVING

Smart Living is the way the people in a *smart city* behave: it refers to their life style, to their lives quality and to their consumption habits. It is the field where the most important public actions are taken as to health care, security, tourism and culture.

Smart health is a new model of digital health that can gather all the informations and clinical documents relative to a patient and monitor his health at distance, thus reducing time and costs. The new health tecnologies can solve the problems of those people not in

the conditions to be moved and involve the management of all the phases a patient has to undergo, from diagnosis to recovery.

Quite similar technologies are involved in the security field. A very interesting case is that of the city of Bolzano and its innovative project “Abitare Sicuri” through which old people houses are monitored by temperature, gas and water distant control.

Urban safety too is becoming more and more central in smart cities as a consequence of the new challenges the contemporary world is facing. The main themes involved are:

- Urban criminality
- Natural disasters and emergencies
- Infrastructural terrorism
- Informatic terrorism
- Transport security

VI. SMART GOVERNANCE

The aim of smart governance is to link and integrate all the public, private, civil and European bodies in order to let the *smart city* work efficiently as a complex organism. The instruments used to create the connection, to grant transparency, to remove obstacles to the innovative development are the ICT that can both grant *e-Government* (the management of services to the citizen) and *e-democracy* (the citizen participation to the management of the town).

The first step is creating a digital identity letting the citizens have direct access to the different areas such as mobility, justice and health care. The second is the digital management with the publishing of data, the development of net applications to stimulate the active citizens participation and the use of *tele presence*, a device limiting the presence of staff at meetings.

1.3 Measuring “smartness” levels

The features listed in the previous chapter are the first real attempt to give a definition of the concept of smart city and to provide a frame of a smartness city assessment. They are the result of the work carried out between 2013 and 2014 by the Politechnics in Wien and Delft and the University in Ljubljana. Those features have been applied to identify and classify seventy European medium size cities. Led by Professor Rudolf Giffinger, the researchers in those Universities have defined the six features a smart city has to possess

–in part or totally – and then have divided them into thirty-one factors with a result of seventy four indicators

Table 2: Smart Cities and Sustainability

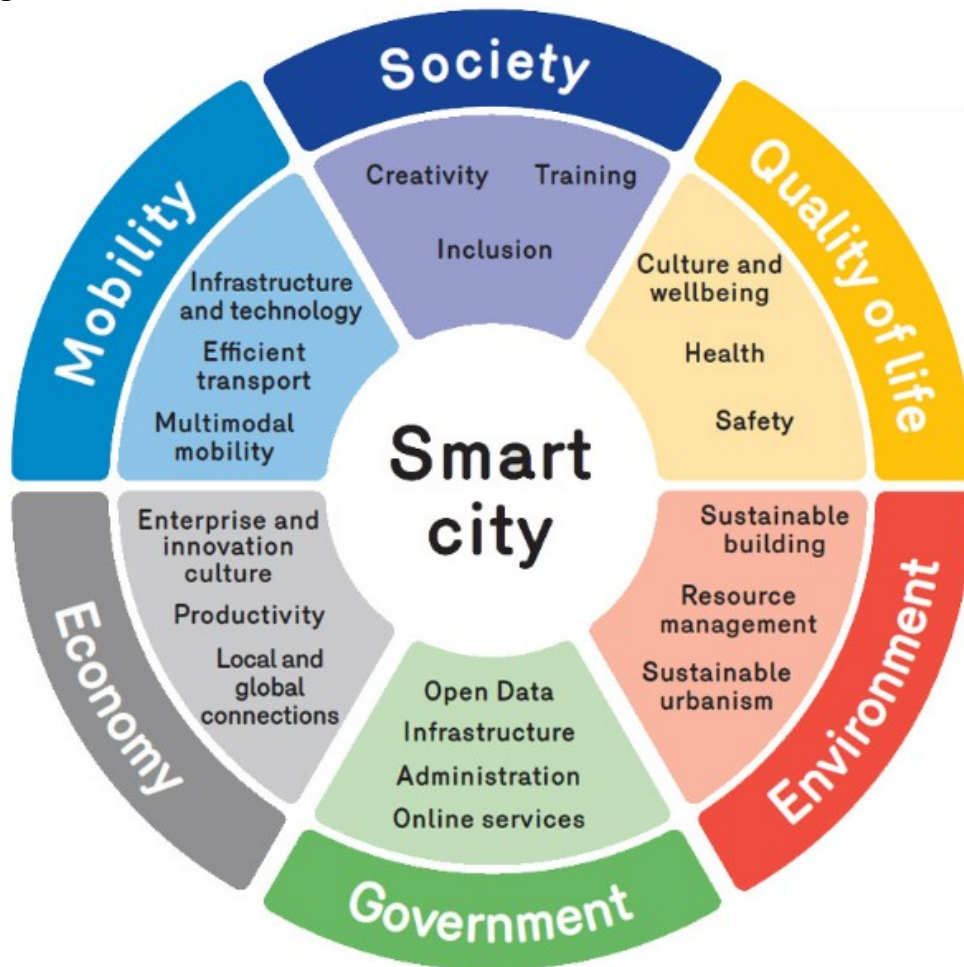
SMART ECONOMY (competitiveness)	SMART PEOPLE (social and human capital)
<ul style="list-style-type: none"> • Innovative spirit • Entrepreneurship • Economic image & trademarks • Productivity • Flexibility of labour market • International embeddedness • Ability to transform 	<ul style="list-style-type: none"> • Level of qualification • Affinity to long-life learning • Social and ethnic plurality • Flexibility • Recreativity • Cosmopolitanism/Open-mindedness • Participation to public life
SMART GOVERNANCE (participation)	SMART MOBILITY (transport and ICT)
<ul style="list-style-type: none"> • Participation in decision-making • Public and social services • Transparent governance • Political strategies & perspectives 	<ul style="list-style-type: none"> • Local accessibility • (Inter)-national accessibility • Availability of ICT- infrastructure • Sustainable, innovative, safe transport systems
SMART ENVIRONMENT (Natural resources)	SMART LIVING (quality of life)
<ul style="list-style-type: none"> • Attractivity of natural conditions • Pollution • Environmental protection • Sustainable resource management 	<ul style="list-style-type: none"> • Cultural facilities • Health conditions • Individual safety • Housing quality • Educational facilities • Touristic attractiveness • Social cohesion

Source: Giffinger *et al.* (2007)

The value of the above mentioned research lies in its positioning the cities inside the six reference features, but it is also reinforced by the fact that, on the basis of the cities strength and weakness points, it helps them find and plan the politics best suited to solve the problems and turn the city into a smart one.

A similar project has been elaborated by Boyd Cohen, an internationally known expert in urban sustainability and climatic changes. In 2012 on the American review Fast Company his ranking of the ten European and North American cities that present the highest degree of smartness was published. He elaborated an indicator instrument, called “The Smart Cities Wheel”, that presents the same features as Rudolf Giffinger adding to them three key factors for each of the features examined.

Figure 1: Cohen’s Wheel



According to Cohen the *smartiest* cities in Europe are in order: Copenhagen, Amsterdam, Wien, Stockholm, London, Hamburg, Berlin an Helsinki.

An analogous project with the aim of measuring the level of a city *smartness* has been elaborated by Between. His project, called “*Smart City Index*,” presents a ranking different to the two preceeding ones and is the result of a ten year work of annually monitoring 116 regional capitals based on three elements:

- Smart services to the inhabitants already enacted.

- Exploitation of official data from public institutions - such as ISTAT, MIUR in Italy and so on – for charts directly made by Between.
- Detailed analyses of the devices present on the area as broadband infrastructures and digital services.

The results obtained in 2014 give to Bologna the first place as the smartest city in Italy. In 2016 two more indicators were added: smart services effects on the citizens lives and strategic plans and institutional politics drawing up. According to that edition the general lagging of Italian cities with respect to the results obtained by the European ones is confirmed. Bologna, Milan and Turin are at the top positions, while Rome loses five positions dropping to the ninth place. Parma, Trento, Brescia and Reggio Emilia follow Turin. In Southern Italy the first city found is Lecce at the 52th position. In general, the small Italian cities lose positions with respect to the previous years and only 7 get the first ranking segment, with 5 of them in Northern Italy.

In Italy FORUMPA S.r.l. FPA - since 2015 –has followed for years the political changes, the processes and projects related to *smart cities*, promoting collaboration between civil service, companies and citizens. It has strengthened its actions aimed at promoting the development of Italian *Smart Cities* through the creation of a highly innovating initiative the “City Lab”, a new research and in-depth analysis place - on line since 2012 at the address www.iciyilab.it – that is not simply a web-site of information, but an instrument letting – thanks to the introduction of the platform ASSET – create analyses and visualizations from the data gathered in “I City Rate 2012” from that year to our days. It creates an annual report and a list place of the smartest Italian cities among regional capitals based on 105 indicators and the six thematic areas already seen plus one: Smart Economy, Smart Living, Smart Environment, Smart People, Smart Mobility, Smart Governance and Smart Legality. From their synergy a synthesis value is obtained: the ICity Index. The platform carries out basic functions, analyses and planning among which the most important are:

- Making maps, graphics and charts
- Measuring the health state of the city
- Finding the strength and weakness points in a city
- Letting its users select and cross different parameters
- Developing strategies in a faster, cheaper and easier way.

1.4 Planning 2013

In 2013 the “*Vademecum for the smart city*” was published in Italy by the Smart City National Observatory and ANCI, together to the above mentioned FORUMPA. Its aim was to provide with researches, analyses and plan models those Italian administrations wishing to start a change into smartness.

The *Vademecum* contains all the necessary informations to best manage the process of planning a *smart city*, presenting examples both from Italian and European cities. Four pre-requisites are listed for the administrators that feel the need to change their city into a smart one:

- To have an idea of city
- To have a plan
- To have the resources
- To have the needed organization

The *Vademecum* presents the different steps a successful programming has to go through, all originating from the city specific features and the potentialities it presents toward changing.

Seven are the steps dealt with in the *Vademecum*:

I. ANALYZING THE TERRITORY, KNOWING ITS NEEDS AND ITS RESOURCES

The observatory offers six different moments in the necessary analysis; they are:

- *Defining the right perspective to shape the city future*: before starting the planning process, it is necessary to identify clearly the perspective from which to look at the future city. This represents the basic datum in planning and it must be gathered from the citizens themselves since in any *smart city* the citizen does not only have the ‘right to knowledge’, but the ‘right to participation’ too. The citizen represents the first information element as the source to elaborate a program of city development. In order to be *smart*, a city must have smart citizens, and they must be put in the condition of taking part in the decisions regarding their future. The citizens must become co-inventors, co-developers, co-investors in the transformation projects thus creating one body with the city management.
- *Defining the analysis scopes*: this is the starting operation consisting in the selection of the scopes it will be necessary to concentrate on and to act, addressing the due

attention to the the resources at hand, the actions already made, the economical interests related, the consent and conflict levels. These can actually represent the first obstacles a city might face when starting a changing project.

- *Working in the management: from vertical knowlwdge to horizontal integration:* the first challenge a city has to face when starting its process of change is the overthrowing of the vertical structures inside the city management through three actions: a re-thinking of the internal organization, the definition of the problem analysis frame, the resources analysis.

Identifying indicators and rating codes: identyfing the indicators shared by the different cities that have already started the transformation process is an efficient tool in planning a *smart city*.

- *Gathering data, informations, opinions and suggestions through social network:* Facebook, Twitter and all the other socials are becoming more and more useful because of the saving in time and money they can grant.
- *Croudsourcing: the citizen creates the datum for the common welfare:* urban croudsourcing works for the solution of poblems and for the development of the ideas proposed through the collection of opinions, requests, advices and notices from companies, public bodies and citizens.

As to the Data gathered, it is possible to define different outlines:

-*Data in common:* a net of all the data coming from agencies, companies and citizens on emergencies connected to traffic and infrastructure services. In Italy an attempt is that of “IlCruscotto Urbano” in Turin.

-*Data fo the common welfare:* a platform offering data from different public administrations to the citizens. They favour direct dialogue with the citizens.

-*Big Data, Data visualization, Open Data Management, g-cloud:* shared information and knowledge, and the consequent data and their interpretation are becoming more and more a central issue in urban centres. The challenge will be what city will qualify as the best information storer to produce original innovations.

II. STAKEHOLDERS MAPPING

Stakholders mapping is the basic operation to identify all the interested agencies that it twill necessary to involve in a later moment in the initiative. Its result lays the necessary ground to start the definition of a form of *governance* and to begin the process of planning

the *smart city*. The *Vademecum* outlines distinctive traits to the identification of the Stakeholders:

- *Mapping through identifying and integrating data*: this method is suggested by the Agency for Digital Italy in its document “Architettura per le comunità intelligenti” with the aim of creating accordance between horizontal and vertical dimensions, giving relevance to technological and standardizing processes. The model has the aim of identifying a series of interest bringers for each thematic sector taken into consideration, and of creating a *governance* apt to provide informations and data related to stakeholders and the different sectorial areas.
- *Mapping on the basis of the role and position related to the project end*: some of the experiences already studied orientate the identifying of the Stakeholders according to their same position with respect to the project, taking into consideration three factors: importance, impact power and influence power. Stakeholders can be divided into internal (project management team and sponsors) and external (suppliers, users, citizens and their associations) and they can further be divided into three categories: population (inhabitants and tourists), enterprises (banks, health institutions, financing societies) and Public Management. Finally, they can be mapped according to three variables: extent of effects on the community, extent of impact on the *smart city project*, relevance of the project on the city life. The mapping will therefore provide the degree and ways of their future interactions.

In his study Vivek N Mathur proposes a classification into 3 macro categories in order to identify the degree of citizens response to Stakeholders:

- Those influencing the project
- Those being influenced by it
- Those in the position of being influenced

As to the protagonists/actors in the *smart city* programming and taking into consideration the experiences already completed it is possible to define macro categories involved in the process:

- Communal Administration and its departments
- National government, regional government with their boards
- Universities and territorial research centres
- Banks and Credit Institutes
- Cultural associations

- International networks

III. STAKEHOLDERS AND CITIZENS INVOLVEMENT

There cannot be any *smart city* planning without the active citizens, enterprises and the stakeholders involvement. But what is it to be meant when talking of involvement? Who is to take part in the process? What the different phases? What the levels? What the goals? What the instruments and methods? What the costs and the resources? The *Vademecum* has tried to give complete and detailed answers to each question and, examining the promoting cities experiences, has published a dossier entirely dedicated to the different methods of participation, engagement, and abilities related to the different local actors:

- *Listening methods*: in this first method the problem identification techniques are included, together to the different ways they are understood by the local administrations and the stakeholders. The adopted techniques include citizens sampling – in digital version too – web, video cabine and blog questionnaires. To them social networks are to be added.
- *Communication methods*: in some planning moments it is necessary to communicate to a wider public, since the processes enacted and the solutions proposed need a wider level of participation. The most recent typologies are included, as for instance the Bar-camp, the Fail camp, Technology festivals, Town meetings, Urban Centee together to you-tube and direct streaming to publicize results and events.
- *Vision definition methods*: the future city well-defined vision sharing is part of the very project of it. In order to share that vision, the cities have a series of techniques and experiences related to the common aim of creating scenarios at disposal. They are methodologies including debates and reflections on the possible evolutions of sectors such as mobility, environment, energy and so on. They include Delphi, Expert Planet, EASW the Building Exercise Scenario and so on.
- *Ideas production methods*: they are related to finding the best solutions to a problem through researches and suggestions. The founding principle is the co-generation and collection of the citizens ideas through simple free, involving and creative ways. They include co-working places, ateliers, sketchmobs and e-challenges. The common ground in these experiences - according especially to Italian experiences –is their aiming at letting enterprises, citizens, Public managers, designers meet freely in a creative atmosphere.

- *Co-projecting and co-designing methods*: the methods and tools for the direct passage from imaginary to reality, from the idea to its realization are included. The users, the consumers, those who will benefit from a product, a place, a service or a project must be integrant part in its planning. Great relevance examples in *smart cities* are the LivingLabs and the LabLab.
- *Methods to take decision and deliberate them*: during the process of co-generating ideas and the co-projecting of them heated debates and discussions may rise leaving conflicts and attitudes that will be negative for the planning fluidity. Democratic forms of participation have to be enacted with the purpose of closing the conflicts and re-establishing harmony. They include Citizen juries, Deliberative polling, Consensus conferences, Conflict spectra.
- *Monitoring and assessing methods*: the methodologies in this category stress the importance of the fact that the final success or failure evaluation of a project is made directly by the community. It will be possible when the responsible for an initiative will be the same who gets an advantage from it. In such a case the monitoring and the valuating phases will be a moment of collective reflection. A recent example in Italy is the “The open and public services and products testing”.

IV. ORGANIZATION AND COMPETENCES.

While going on with the process of planning it will be necessary that all the administrative structures hold the adequate competences, elasticity and adaptation spirits to the much faster times now in act if compared to the traditional ones, but above all a shared vision of what the future city is going to be will be necessary. The city must be ready to manage the change, making all the involved protagonists smart, starting from the local management – the driving force of the evolution – up to the citizens that will be the first to take advantage from the change. The main actions needed will be: the educational training strengthening in the administrative field and the computer literacy of the whole population, thus reducing difficulties of communication and times of operations. One of the first cities in Italy to start in this direction has been Florence that has also won a project financed by the European Community.

V. THE CHANGE GOVERNANCE.

The *governance* represents an important field where to concentrate and act to transform a city into smart. It has different features and functions, the most relevant among them

being that of the citizens inclusion and participation in the decision-making process, resulting in the more transparent administration functioning.

The relationship between the citizen and his local administration is a really qualifying issue in the *city* envisioning and planning. With the data availability increase and the local processes transparency, the response on the citizens part will be their greater involvement and participation, together with other public or private agencies - financial, research and so on – in a collective search for a shared solution. According to the governance experiences already done, the *governance* models appear to be strongly linked to the business model, that is they are planned to involve the actors financing the projects. As to its operativeness, the *smart city governance* is a machinery oriented to 3 main sectors integration:

- Infrastructures and projects sector
- Financing sector
- Citizens and stakeholders interaction.

From the legal point of view we can distinguish three different forms of *governance*: association, foundation and administration internal structure. The choice among them depends on the different ways the interest bringers are involved and the projects financing and implementation are conducted.

VI. SMART CITY FINANCING

The project *smart city* can receive different kinds of funds and financing for its realization. The funds can be used as a financial lever without being able to cover the entire project cost and they can be classified according to different levels and typologies: regional, national or European level.

- European Funds: in 2012 the European Commission described the objectives on European partnership for innovation dedicated to “Smart Cities and Communities”, having at disposal the necessary resources to sustain the diffusion of innovative technologies as to energy, transport and ICT in urban areas.

In 2013 the initiative had about 363 million euros, against the 81 billion gathered in 2012. In the new programming the project “Horizon 2020” is included as the new financial instrument for research and innovation having 81 billion euros at disposal. In the Structural Funds rules a high quote is destined to interventions for the reduction of Co2 emissions and of the energetic consumption.

Ten are the thematic objectives planned between 2012 and 2020:

- 1) Small and medium-sized enterprises competitiveness
- 2) Environment protection and resources management
- 3) Progress towards a low carbon emission economy
- 4) Workers smart mobility support
- 5) Climatic changes control and risks prevention and management
- 6) Permanent education, learning and competences
- 7) Social integration and contrast to poverty
- 8) Institutions management improvements and local administrations efficiency
- 9) Eco-sustainability of transportations and net-infrastructures
- 10) Information and Communication Technologies

In order to complete the structural funds programming, *ad hoc funds* have been created inside the European Community: the EEEF (Energetic Efficiency European Fund), the ELENA (European Local Energy Assistance) Programme and JESSICA (Joint European Support for Sustainable Investments in City Areas).

VII. RESULTS MEASURING AND MONITORING

Monitoring in planning is central and functional to the efficiency of the *smart* actions and of their control. The whole interventions and projects results measurement puts cities in the condition of telling the measures (indicators and descriptors) of their development and therefore of drawing the precise objectives and clear results since their very first projecting.

A shared method for the monitoring and assesment of results in order to help cities has been adopted. It

- Monitors impact, output and efficiency
- Confronts the results obtained by the different experiences in a bankmarking vision
- Uses the data obtained to program new cctions

1.5 Worldwide smart cities experiences

There are a great number of smart urban solutions all over the world, even though a fully *smart* city doesn't appear to exist. Just to make an example, Amsterdam has focused on mobility and energetic efficiency, but not on all the other aspects characterizing the *smart*

city. Moreover it is possible to use different approaches of different typologies when organizing a *smart* project, depending on the different actors leading the process (private companies, public institutions, international financing banks and so on) and on the different models of development.

The *smart cities* can in fact develop according to two different models: *greenfield* – cities created *ex novo* –or *brownfield* – actions made on cities already existing -.

The first *smart city* to be created *ex novo* will be Masdar City in Abu Dhabi, on a project by the company bearing the same name started in 2008 and to be completed by 2020. The strategy connected to it will design zero emissions, zero waste and 80% of recycled water. Once completed, the city will cover 640 hectares and will consume 75% energy less than a traditional city having the same dimensions. The most striking features it will present are:

- Energy will be solar by 80%
- Rain collectors, desalinization plants and irrigation systems through grey waters will be present
- 99% of waste will be recycled or used in composting plants
- Individual energy consumption will be fixed to 30kw of electricity and 80 litres of water per day
- Ecological print limit for each citizen has been fixed
- Transportation will be completely green on electrical taxis moving on magnetic paths.

Usually instead *smart* projects and actions are made on already existing urban areas, therefore focusing on specific aspects and that is what has happened with all the existing *smart cities*.

Hong Kong has focused on mobility and has introduced the “*Mobility Card Octopus*” that can be used on the local transportation means, but is also usable for other kinds of public services and can even be used as credit card.

Singapore has concentrated on the Health System, and in 2009 has started the project “*National Electronic Health Records*” involving all the health public structures. Thanks to it is possible to access to any information in every citizen’s medical record in real time, thus greatly reducing costs.

London has instead reached great results investing on digital technologies. It is in fact the seat of a research centre for *smart cities*, with the aim of creating sustainable solutions in different sectors. It has also tested the *PlanIT Urban Operating System (UOS)*, an

operating system projected by Living PlanIT SA with the purpose to connect all the services related to transportation, energy and water.

Amsterdam is one of the very few cities that have invested in manifold sectors, such as sustainable mobility, energetic efficiency and urban re-planning. The plan was started in 2009 by the collaboration between Liander, Amsterdam Innovation Motor and Amsterdam municipality. *Smart* rubbish containers compacting waste and using solar energy have been placed, smart meters to optimize consumptions have been installed, bike sharing and bike rentals, street and bus-stop energy saving lighting systems have been introduced. The active citizens participation has been decisive for the realization and success of the plan.

Other important European cities are on the way to success in trying to change into *smart cities*. Good examples are Barcelona, Helsinki, Manchester, Wien and Barcelona. In all of them the factors leading to the successful realization of the different projects can be resumed in the following three ones: a clear vision; citizens and local enterprises involvement; the processes efficiency. Of course the wish for a better quality of life must be well spread over the population, the bringers of interests' involvement is essential to reach the objectives and the processes management must be supported by both *project management* and *knowledge* in order to reach the expected results.

As to the geographical distribution of *smart cities* in EU Eastern Europe seems to be characterized by a minor presence of them with respect to the rest of Europe while the countries showing the highest number are Italy, Austria and Holland, followed by UK, Portugal, Spain and Belgium.

A correlation exists too between the urban area dimension and the level of smartness a European city has: in fact *smart cities* are usually the smaller ones, with a number of inhabitants between 100,000 and 199,999. The most widespread feature in European cities is that of the environment (*Smart Environment*) on which a particular focus is that of northern countries, the second feature is *Smart Mobility*, followed by *Smart Governance*.

Chaper 2:

Italy and Smart Cities

2.1 Italian Smart Cities

2.1.1 Analisis of the Italian situation with respect to the *Smart City* project

The National Observatory for Smart City by ANCI/ForumPA Report published in September 2018 shows a picture of the present situation in Italy in great movement with respect to the goal of Italian cities change into *smart* ones. A great part of them, i.e. 79%, has already started a path leading to the planning of trasformation into a *smart city*, while 21% is still far behind since no project in that direction has even been started.

The first step made by Italian public managers, even before the analysis of the territory, is the search for the financing sources: 3 out of 4 cities declare they have already started: the irregularity of the Italian planning, with respect to what seen in the previous chapter, shows the Italian Administrations need to search and monitor the financing possibilities not only to better support the projects already made, but also to stimulate the development of new and useful creations and innovations.

The second important step made by a considerable number of Italian cities is that of the stakeholders mapping in the territory: more than half of them has proceded in that direction. This aproach shows the municipality administrations will to act in a sinergic way with their cities, with special care for the interest holders involvement.

The other phases such as the governance, the monitoring and assesment system, the analysis of the territory and the competences organization are all phases still to be started, because probably of the programming dawning.

Coming back to the financing frame, it can be noticed that 82% of the Italian cities has already presented project proposals for national or community financing. Since 2011 the most important financing opportunities exploited by Italian cities have been the European Commission Bans, the Ministero dell'Istruzione, dell'Università e della Ricerc (MIUR) bans for Smart Cities, financing lines from the European Fund for Regional Development (EFRD) and other national programming agencies as POR (Programmi Operativi Regionali) and PON (Programmi Operativi Nazionali). The cities that haven't so far been able to present proposals for projects financing show either lack in the administration competences or the absence of the due features in the project as stated in the ban. The

initiatives up to now proposed by the Italian administrations are mainly related to digitalization, energetic saving and environmentally sustainable transportation means. As to the private forms of financing, more than half the cities have shown adherence to that model. As referring model the local administrations have taken that of the 'project financing' quite often used for initiatives directed to the production of renewable energetic sources or for energetic efficiency improvement.

Among the different experiences made by the Italian cities, examples of conventions with relevant players on the territory can be included, while innovative financing projects like Esco (Energy Service Company) or other kinds especially present in Anglo-Saxon countries of diffused shareholders companies are scarcely present. A different problem is that of the little sensibility and information attitude on the part of Italian Credit Agencies and foundations.

Quite an enormous difficulty to overcome is the fact that important phases in the *smart city* planning have been neglected and one of them is certainly the choice of the governance. From the experiences of the cities studied by the National Observatory only one third has successfully defined the perimeter and composition of the governance in charge of directing the process of the *smart city* planning. The rest hasn't up to now been able to state the political and the organizing direction. This result shows how the Italian cities find difficulties in tracing the institutional and the operative frame of a planning process that includes actors from different decisional areas and levels. A critic point seems to be that of the involvement of private actors, due certainly to the abnormal normative frame uncertainty. The data on the definition of the shape of governance show that 44% of the cities are oriented in favour of a department inside the municipality, 28% of an association, 11% of a foundation. Particularly interesting is the case of Turin that, since 2011, thanks to its foundation, has projected and presented smart initiatives succeeding in involving more than 100 subjects - both public and private ones - and medium and big companies. Quite a frequent governance declination on two levels comes out from the analysis made on Italian cities projects: the first level is related to the political direction taken by the municipality administration keeping the control both on the decisions to be taken and on the solutions to be adopted, the other level is that of the operative management in which different actors in different forms are involved. As we have already seen in the previous chapter, while planning the new *smart city* it is necessary to draw the seven different areas involved in the projecting, thus proceeding

from the accurate study of the territory and then the monitoring of the results obtained in the different phases of the project realization.

2.1.2 The ICRate 2018

The main source providing a detailed picture of the present situation in Italy as to *smart city* planning is the “ICityRate”, the innovative platform created by ICity Lab, one of FORUMPA initiatives, whose objective is that of rendering a detailed picture of the Italian cities in their process towards a change into smarter, inclusive and liveable places. A novelty with respect to the preceding editions is that in its seventh edition of 2018 ICityRate has addressed its attention to measuring through a series of enriched indicators—107 detailed ones related to the 15 area indexes, the seven thematic areas already seen in the previous editions and to the eight new ones as defined by the ONU Program 2030 - not only the urban life quality but the city ability to act as a working platform and to foreshadow long distance goals while choosing those financing agents addressed to new development drivers. The *smart city* planning has therefore focused its attention from the technological innovation to the common welfare management and to the co-designing of the future city. This evolution of the idea of *smart city* and its reflexion on the political choices to be made has led to the need of including new variables in the ICityRate indicators in order to measure the city ability to:

- Create innovative utilities
- Make public data available to everybody
- Contain and manage migratory movements
- Attract European funds for innovation and research
- Create places for co-working and co-sharing of tools and knowledge
- Attract talents and brains
- Activate relation nets for the management and sustainability of the *smart* policies

The indicators measuring the aspects related both to safety and legality have been made more effective too. As a conclusion it is possible to state that in this last edition the level of the objectives a city has to face has been improved. ICRate 2018 presents therefore a new classification of the Italian *smart cities* into five analysis macro dimensions each containing three indexes: Economy (Economic Solidity, Job Opportunities, Innovation and Research), Society (Education, Social Inclusiveness, Touristic Attractiveness), Environment (Air and Water Quality, Urban Green Areas,

Territory and Soil), Governance (Citizens Participation, Legality and Security, Digital Transformation), and Functional Services (Energy, Urban Waste Treatment, Sustainable Mobility).

General ICity Rate Chart

Table 3: General ICity Rate Chart 2018

1	Milano	640,2	28	Biella	492,7	55	Terni	434,9	82	Sassari	334,7
2	Firenze	621,6	29	Siena	492,6	56	Cuneo	434,5	83	Isernia	331,7
3	Bologna	620,0	30	Rimini	491,9	57	Verbania	427,7	84	Nuoro	328,9
4	Trento	583,6	31	Brescia	489,5	58	Lucca	426,5	85	Campobasso	324,9
5	Bergamo	567,1	32	Lodi	488,0	59	Ascoli Piceno	425,2	86	Siracusa	323,2
6	Torino	547,7	33	Ferrara	485,2	60	L'Aquila	423,9	87	Latina	322,9
7	Venezia	544,1	34	Lecco	482,8	61	Asti	417,4	88	Palermo	322,1
8	Parma	539,1	35	Pavia	480,2	62	Lecce	408,9	89	Catania	312,9
9	Pisa	538,6	36	Belluno	476,8	63	Pescara	407,9	90	Cosenza	307,0
10	Reggio nell'Emilia	532,8	37	Novara	476,3	64	Fermo	405,7	91	Andria	302,7
11	Padova	532,5	38	Perugia	470,8	65	Massa	402,7	92	Messina	302,5
12	Ravenna	531,7	39	Como	469,6	66	Alessandria	402,1	93	Foggia	298,2
13	Pordenone	529,9	40	Aosta	468,3	67	Bari	391,6	94	Catanzaro	296,9
14	Trieste	523,2	41	Piacenza	467,9	68	Pistoia	390,3	95	Avellino	296,7
15	Roma	522,7	42	Arezzo	465,2	69	Grosseto	385,1	96	Ragusa	296,2
16	Cremona	522,6	43	Cagliari	459,1	70	Matera	384,9	97	Reggio di Calabria	292,5
17	Modena	521,0	44	Macerata	458,1	71	Frosinone	381,0	98	Benevento	287,6
18	Udine	520,6	45	Ancona	457,0	72	Rieti	369,5	99	Caserta	283,0
19	Mantova	516,0	46	Varese	455,1	73	Potenza	362,9	100	Brindisi	278,3
20	Bolzano - Bozen	512,9	47	Sondrio	455,1	74	Viterbo	360,8	101	Enna	275,1
21	Treviso	512,1	48	Prato	454,7	75	Imperia	357,6	102	Taranto	268,9
22	Verona	506,7	49	Vercelli	449,6	76	Teramo	354,8	103	Crotone	248,8
23	Genova	503,5	50	Gorizia	446,8	77	Rovigo	351,0	104	Trapani	237,4
24	Forlì	500,6	51	Pesaro	439,8	78	Oristano	350,2	105	Caltanissetta	235,9
25	Monza	496,6	52	Livorno	438,5	79	Napoli	345,3	106	Vibo Valentia	227,6
26	Vicenza	494,5	53	La Spezia	435,7	80	Salerno	342,9	107	Agrigento	225,2
27	Cesena	493,7	54	Savona	435,6	81	Chieti	336,6			

2.1.3 The five ICity Rate 2018 Dimensions and the related indicators

a. Economy

Economic Solidity: The index is built on the basis of 6 indicators (4 provincial and 2 municipal) measuring the ability, present and future, to create wealth. In total among the first ten cities we find four in Lombardy, two in Veneto, two in Emilia, one in Tuscany and one in Trentino Alto Adige. Among the last ten cities we find five in Sicily, three in Calabria and three in Puglia. Milan prevails thanks to a Pro-capite Added Value (more than 47,300 euros) that is more than the double of the average among the other provincial capitals. The second is Bolzano with 38,700 euros. Florence is the first (before Bergamo) as to Credit Availability, while Vicenza is first for Productive Internationalization followed by Reggio Emilia. Soon after Milan in the general chart Bergamo is second thanks to its

b. Entrepreneurship

Job Opportunities: The index exploits 8 indicators 3 of which for the first time calculated on the local job systems, 4 provincial and 1 regional referring to the different job features. Bologna is first thanks to the extremely positive data as to Activity Rates (56%), Employment (52,6%) and Unemployment (6%) in its urban area, to the high levels

of Job Qualification (30% employed with high school diploma) and to low Irregular Job rate (10%). Milan is second thanks to high values in all the indicators; Bolzano has the best indicators for the Employment and Unemployment rates, but resents of the low value in Job Qualification. Among the first ten cities four are in Lombardy, two in Emilia, two in Trentino Alto Adige, one in Tuscany and one in Friuli Venezia Giulia. Among the last ten five are in Sicily, three in Calabria and two in Puglia.

Innovation and Research: This index includes seven indicators, of which two municipal, three provincial and two regional. Milan confirms its leadership thanks to the presence of High Knowledge Enterprises (22%), high number of Coworking Density (25 on 10,000) and to the high value in the indicator of Productive Innovation Diffusion. Trento gets the second position thanks to the high values in almost all the indicators but Fablab Density. Bologna is third in the area, but first in Coworking Density. Pordenone and Belluno are the emerging cities as to the greatest improvements with respect to the previous year. Rome is seventh in the area but first in Productive Innovation Diffusion and Innovative Services Presence. Among the last ten cities we find five in Sicily, two in Puglia, one in Sardinia and one in Campania.

As a whole we can say that the improving of the economic indicators measuring the cities ability to attract European funds for innovation and research, to involve high knowledge agencies and to create start-ups leads to a variation in the rating with respect to the previous editions that in turn leads to the accentuation of the distance already existing among the cities and the regional systems. This edition too classifies Southern Italy below the national average, while the cities in the center of Italy are closer to the national average. The cities in the North-East and the North West compete in the maximum index values.

In the North Milan is first in the national classification, its economical dimension surpassing all the other cities doubling in all the indicators the national average. Its municipal district is the city where the added value is the highest in the whole country, it is the first seat for big dimension companies and is too a city characterized by high “patent intensity”. It has witnessed the birth of the highest number of Fablab and Makerspaces in comparison to other cities in Italy and is the place chosen by digital experts to work in, because it has decided to invest on a new model of urban innovation directed to new forms of collaborative economy and social innovation, because it grants places and economical help to projects and enterprises, innovators nets and new urban politics.

Moving from the North to the central regions it is not possible to compare Rome to Milan. Rome in fact, though it is the capital city attracting important European funds, high knowledge companies and graduated experts, unfortunately in the economical dimension as a whole is only after the first ten cities rising from the previous edition by one step. The elements favouring the progress in this dimension are two: the reaching of a high position in the standard variables as the indicator for credit availability and the high number of graduated among the employed; the economical strengthening thanks to the presence of two new indicators measuring the ability of attracting European funds linked to innovation and research and to generate high knowledge enterprises.

Bologna owes its third position to its featuring a system of research creating new enterprises and start-ups. Its urban and regional areas have been rewarded, as to the economical development, for their ability in acting in favour of innovation and creation of a net of scientific parks that have had a fundamental role in the production of new assets, new patents and new technological collaborations.

Tuscany as a whole has the merit rating for research and entrepreneurship: Tuscan cities register in fact a good overall positioning in the Italian economic rating. Florence is third, but others are the significant Tuscan records: Pisa is the first Italian city for its concentration of “**R&S**”, that is for the presence of subjects engaged in development and research inside public institutions, enterprises and ‘no-profit’ agencies. Prato and Grosseto too reach very important positions overcoming other Italian municipalities for their number of active enterprises in relation to the inhabitants number. Grosseto in particular is shooting to the top in the chart as one of the cities with the highest growing rate.

c. Society

Education: with respect to the 2017 edition the indicators have risen from three to six (five provincial and one municipal). Pisa wins the first position in the area index and in the specific indicator related to Public Education, having too a very high value in School Accessibility and a very low value for NEET (non-working and non-studying young people). The three leader cities are soon after Pisa (Bologna with 37,5% of the 25-39aged population with high Education Diploma, then Florence and Milan). Padua with its University campus is fourth, preceeding Siena and Trieste (first in Continuous Training). Rome has the widest range of University Offer with 835 of the typologies for Degree

Courses, Parma and Perugia complete the top ten. In the last ten positions there are four cities in Sicily, two in Puglia two in Calabria and one in Liguria.

Social Inclusion: This index includes 10 indicators, 4 of them are municipal, 5 provincial and one regional. Parma confirms its first position in this area getting very positive values in the indicators related to Economic Poverty, Housing Poverty and Eviction Rate (328 cases every 100,000 families) but Inclusiveness. In the top position we find four cities in Emilia Romagna, three in Friuli Venezia Giulia and Bolzano. Udine gets the second position thanks to the high values related to Health Care (very low levels in Hospital Migration and high density of National Health Care Employees). Bologna in the third position shows low values in Eviction Rate and Hospital Migration. Five among the “Small Capitals” (Parma, Bolzano, Modena, Trieste and Reggio Emilia) are among the first ten while the remaining six appear among the first twenty. Bolzano presents the best values for Poverty Risk and Old People Care.

Touristic and Cultural Attractiveness: This index is based on 10 indicators (six municipal and four provincial) related to its various aspects not only in terms of tourists presences, but also of productiveness in the economical sectors involved. Florence confirms its first position both in the indicators related to Attractiveness and Cultural Heritage. Another leader city, Milan, is in the second position reaching the maximum values for the indicators Cultural Employment and Cultural Entrepreneurship. Siena is third – it is third for Cultural Internationalization - thus preceding Venice, Turin and Rome. Bologna and three cities in the North East follow (Verona, Trento and Padua) and are among the first twenty one. Among the last ten we find three Sicilian Cities, three in Calabria, two in Puglia, one in Sardinia and one in Latium.

The indicators in this dimension are related to the living standards in a city, with regard to the cultural offer, basic services, personal security, social cohesion and working opportunities. A novelty presented in this edition is that the old traditional gap between North and South, and between medium sized cities and metropolitan ones, at least in this macrodimension is reducing. As to the rest there are no noteworthy differences with respect to the previous editions: in this macrodimension too Milan goes farther than the other Italian cities, distancing even Bologna by more than 100 points. The main reason for this city enormous performance lies in the sectors taken into consideration and in which Milan is so strong: Co-working, Cultural Internalization, Connection Services. The only negative indicator for this city is that of the ability of Care for Old People. Bologna is second thanks especially to the Working Opportunities provided in the provincial areas

and the Services of Care for Children. Quite high have resulted the results obtained in two of the new indicators: the one measuring the economical problems related to the Impact of Low Income Families on the rest of the inhabitants and the one of the Urban Attractiveness; it has been verified how people born in or moved to Bologna very seldom leave the city. The third position is occupied by Parma for the good results reached as to those aspects of liveability like Personal Security, Social Cohesion and the excellent Touristic Attractiveness. Following in the fourth and fifth position are Florence and Bolzano both in quick growth. Bolzano owes its position for the variables regarding Old People Care, Infrastructure Connection Services and Working Opportunities. Florence owes its position to a well balanced growth in a good number of the variables in the dimension. Good results have been obtained by a few cities in Southern Italy reaching high positions in the list thanks to some indicators like: Connecting Infrastructures for Pescara and Palermo; Co-working for Naples; Low School Dispersion for Benevento; Urban Attractiveness for Ragusa; Connecting Services for Pescara and Crotone

d. Environment

Water and Air Quality: the indicators used are the same as in the following edition with the replacing of water treatment with Hydric Service Coverage. All the six indicators are municipal. It is the area where the smaller difference between cities in the South and cities in the North has been recorded. Ascoli Piceno gets the first position both in the dimension and in the indicators for Hydric Service Coverage and PM10. Among the first ten cities are two more advancing ones: Macerata and Ancona. Vibo Valentia and Brindisi in the South confirm their good values in almost all the indicators. The last ten cities in this area are equally distributed among Southern and Northern-Central Italy.

Territory and Soil: For this index area the new Data Bank provided by Ispra has been used and it has permitted the updating of the indicators Soil Consumption and Soil Consumption Dynamic. In this area the disadvantage for Southern Italy is registered too, even if with a lesser distance to the Northern cities. Parma is the first in this area and has the highest values in Soil Consumption Dynamic that since 2012 has lessened by 1.9%. Among the other ten top cities we find L'Aquila, Ragusa, Lecce, Ravenna and Reggio Emilia. They are all municipalities that have adopted an Emergency Plan and therefore reach the highest value in Risk Mitigation. The city presenting the lowest value for Soil Consumption is Enna that unfortunately presents problems in the other indicators too.

Among the last ten cities there are five in Campania, three in Sicily, one in Lombardy and one in Piedmont.

Urban Green: The three indicators in this area have been updated with the data published by Istat for Capital Municipalities in 2016. Venice keeps its first position and other six metropolitan cities are among the first 21 in this area. They are Cagliari, Bologna, Milan, Palermo, Naples and Florence. Venice owes the first position thanks to the high values obtained in the indicators Public Green (the amount of protected or public destined areas reaches 65%) and Green Planning.

In this macro-dimension cities environmental sustainability is taken into consideration. The indicators have been chosen according to their adherence to a precise measurement of environmental protection and quality of the local administration policies. The list, both recent and past, presents in the first ten positions only small and medium size cities. It is possible to make a further distinction inside the peninsula between the Adriatic regions that get a better assessment if compared to positions gained by the Tyrrhenian ones. As to this macro-dimension the first position is kept by Sondrio thanks to its extremely efficient system of Air Quality Monitoring and to its Air Quality too; highly efficient too is the waters management system provided with excellent abduction nets and purification plants; high too is the presence of green companies in its territory.

Trento, first in the list up to 2015, owes its second position to the quality of the air in its Urban Green Areas and to its extremely efficient Urban Waste Collection and Transformation. The third position is held by Matera thanks to its wide urban green patrimony and to its photovoltaic production placed on the public buildings.

e. Functional Services

Sustainable Mobility: This area index is the most complex since it is made by 14 different indicators all in the municipal dimension. 11 have been updated with respect to the previous edition, 1 reproduced and 2 replaced by the new indicators TPL Velocity and IT Mobility. This is a particularly relevant area for metropolitan cities as it is shown by the presence of four of them (Milan, Florence, Venice and Turin) at the top of a list considering with special attention the efforts made and the innovations introduced to reduce the physiologic dynamics of congestion characterizing the greater dimension and attractiveness of the urban realities. Milan confirms as the first in the list thanks to the specific indicators related to Electric Mobility, Bike Sharing and TPL Offer. Florence is

second thanks to its high intensity in Carsharing, Venice is third thanks to Collective Mobility Propension and Pedestrian Precints Extnsion. Among the last ten cities there are four in Sicily, two in Calabria and one each in Tuscany, Liguria, Campania and Sardinia.

Energy: All the four indicators in this area (three in the municipal dimension) have been updated with respect to ICR2017 introducing methodological changes in the values assessment. In this area too quality medium size cities “the small capitals” get very good results, placing between the fifth –Padua- and the twentyfifth –Pisa- position. Bologna keeps its first position thanks to the excellent results in all the four indicators. Udine reaches the second position while Vicenza confirms its third position getting the best result in Municipal Patrimony Adequacy Actions. Among the first ten Florence (first as to the Implementation of the ‘Patto tra i Sindaci’ for Energy) and Trieste as capital of the province for the Electric Service Quality. Among the last ten cities three are four in Calabria, three in Campania and two each for Puglia and Sicily.

Urban Waste Treatment: The three municipal indicators have been updated through the data provided by Istat and Ispra for 2016. Among the first ten cities we find three of the “small capitals” (Treviso, Belluno and Pordenone) and two more of them appear among the first 25. Trento confirms its first position thanks to the high values in all the three indicators. Treviso is second and is the city reaching the first position as to the Separate Collection of Household Waste (87.1%) where also Belluno and Pordenone obtain extremely good results. The city with the absolute best results for the Least Waste Production is Nuoro that is out of the first ten because of very low results in the other indicators. Oristano, Asti and Parma get very high results for Municipal Adopted Initiatives. Among the last ten cities there are four in Sicily, two in Tuscany and one each four Calabria, Molise, Latium and Sardinia.

Inside this macro-dimension we find mobility that measures the cities ability in *smart* and sustainable mobility models application. The variables taken into consideration refer to external accessibility and internal fluidity as well as the efforts in improving them. In this dimension too in the present edition the difference between North and South lessens but still sees Milan in the first place in the list. The indicators letting Milan getting to the first place are: a great Bikesharing Availability and the best Offer in Local Public Transportation Means in the Italian cities. Its strenght point is linked to its offer mix and to the fact that in all the indicators it presents values above the average. Venice reaches the second position for its intrinsic feature of having applied a model of collective transportation system where the city shows excellence. Venice governance as to the

mobility dimension plays an important role since it is based on a wide supply of planning instruments that actually represent its strenght point. Florence in the third position boasts a wide Limited Traffic Area and a wide Bike Sharing Availability net together to a high number of Cycle Paths.

Italy is not split in two – North and South – as to the theme of mobility: very good exemples are present everywhere but a reference geographic model can be seen in the Emilian cities: Parma, Piacenza, Reggio Emilia, Bologna and Modena present high positions in different indicators such as the Territorial Fruition, the Ecologic Adjustment of the Circulating Vehicles and the diffusion of Cycle Paths.

f. Governance:

Partecipation: This area uses 10 indicators measuring both the behaviour intensity as to Electoral Partecipation, Social Partecipation, Trust in the Institutions, Cooperation Diffusion, Social Innovations Experiences, and the local administrations actions and features as to Gender Balance in the Representation Ogans, Shared Idministration Instruments Utilization, Innovative Projecting, Green Acquisitions, Seb sitesTransparency. Bologna is first in this area, while Florence is fifth and Milan is seventh, Among the first seven we find Turin and six medium size cities in the Central-Northen regions. All the last ten cities are in the Southern regions, among them four in Calabria and four in Puglia.

Legality and Security: this area presents 10 indicators and among them the new Territory Protection (Urban Policy Density) that has been calculated on the municipal scale. Three of the small innovating cities are present among the first ten cities (Biella, Pordenone and Udine). Aosta keeps its first position reached in 2017, being first in Courts Efficiency and Social Re-usage of Seized Goods. Biella, Cuneo and Asti in Piedmont keep their positioning among the first ten. Among the last ten cities three are in Sicily, two each for Calabria, Puglia and Campania, one for Tuscany.

Digital Transformation: This area includes 8 indicators: Broadband Access (the number of municipal families having potential access to comunication through 30Mbps or more according to the last AGCOM survey) and Homebanking Diffusion (provincial rate between home banking users and families) are the new ones. The other six indicators are related to the actions made by municipal adminiistrations for a widespread digital transformation. Florence gets the first position thanks to the first placement in the indicators related to the Open Data and Public WiFi. Other four metropolitan cities

are included among the first ten: Bologna first in the Open Data, Milan first in Home Banking, Rome first in Municipal Apps. Bergamo, Modena and Cesena are in the top positions for Digital Adaptation. Among the last ten three are in Sicily, two in Puglia, two in Molise, two in Latium and one in Abruzzo.

This macro dimension measures the new communication means usage among the citizens. In the high *smartness* level cities the best human capital exists, showing participation and civic, politic and cultural involvement as a proof of the high educational level of the population. The features listed picture a multicultural, connected, dynamic, strong in attracting brains and in including migrants city, where the job market is wide, differentiated and non-discriminating. Florence is in the first position followed by Milan, Trieste, Rome and Siena. Only 22% of the cities reaches the high positioning in the classification with 25% of the cities not reaching 300 rating points. The bottom positions are held by Benevento, Caserta, Catanzaro, Vibo Valentia and Reggio Calabria. Among Southern cities Matera and Potenza show dynamism in the classification thanks to the very good levels in 'Intellectual Migration'. Lecce, Taranto and Andria too are moving towards higher positions in the chart.

This macro-dimension is related to Legality, Participation and Digital Transformation. It describes the administration efficiency and the city social security. The indicators measure not only the public management performances, but also their ability in using the new citizens participation and involvement tools. The relationship between citizens and public administration is analyzed as for instance the Participation to Elections, the Confidence Level in the Political and Institutional System, the Gender Balance in the Administrative Representation. Other indicators, more related to *smartness*, provide a series of informations in the administration usage of the new technologies and in the new systems of recording, communicating and sharing public utility data. The resulting picture defines the different approach to smart governance between the metropolitan cities and the small ones: the former work through governance strategies quite similar to the *smart* approach, even if with different acceleration, the latter use governance schemes more related to higher territorial institutions and new alliances for the common wealth usage. In the top positions are Bologna, Turin and Venice.

As to legality the indicators newly included are related to three different levels of analysis: presence of criminal organizations with reference to relationships to Public Administrations (public managers, journalists, rating agencies), Justice activities (Tribunals efficiency), Environmental crimes (eco crimes); they are Money Laundering,

Commercial Illegality, Presence of Criminal Organizations. They have therefore caused changing positions toward the bottom in the chart, as for instance is the case of Parma from the top position to about half the chart due to Commercial Illegality for the presence of brand and product counterfeiting in the agricultural and food industry. The same indicator assesses low values and positions to Brindisi, Isernia, Foggia, Naples and Rome. Parma is the city in Northern Italy showing the greatest presence of organized and mafia criminality. In Money Laundering Genoa is in the top position, followed by Gorizia, Prato and Trieste. Nuoro shows the highest rate for Wilful Murders followed by Crotone, Sassari, Ragusa, Reggio Calabria and Foggia. The top positions for Microcriminality are Milan, Rome and Turin, while for Crimes Against the Environment the worst cities are those in Campania: Naples, Avellino and Caserta. As to crimes relate to the waste cycle the worst cities are Naples again, with Rome Reggio Calabria and Venice to follow. The highest positive assessment in this dimension is for Aosta in the first position, followed by Ferrara, Mantua, Cuneo, Lecco and other medium sized cities in the North, while the first positive position in the South is kept by Aquila.

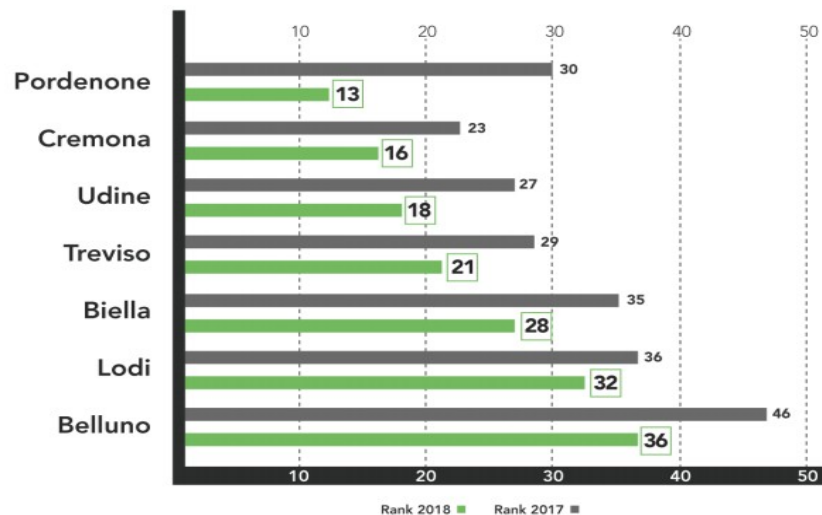
2.1.4 The three leader metropolitan cities

From a closer analysis of the five dimensions and their indicators as we have already seen Milan confirms as the most advanced Italian city trying to make the widest use of the urban *smartness* instruments to promote and manage development in sustainable ways. It is followed by Florence and Bologna that more and more get a role of reference models for the other urban realities. It is not by chance that the three cities are in the first positions as to the indicators Digital Transformation and Job Opportunities, strategic sectors that both determine and reflect a more general transformation dynamism. They are too cities at the top in the indicators of Education and Citizens Participation, confirming the crucial role of the “human capital” in determining the cities positioning in the list. Starting from the strenght point characterizing them the three leader cities have succeeded in building a multisectorial excellence. As to Milan it is its Economic Solidity, as to Florence it is its Touristic and Cultural Attractiveness, as to Bologna its Citizens Participation. The critical points they share are in a way generated by those features and are Security, Urban Waste Collection, Territory and Soil Management.

2.1.5 The Seven Small Innovating Cities

From a close analysis of the five dimensions and their indicators a novelty is the dynamism presented by seven urban realities all in Northern Italy – Pordenone, Cremona, Udine, Treviso, Biella, Lodi and Belluno – that gain the most significant improvements in the general chart thanks to the combination of innovating areas, good Functional Services management and Legality and Security.

Figure 2: *the seven small innovating cities rank*



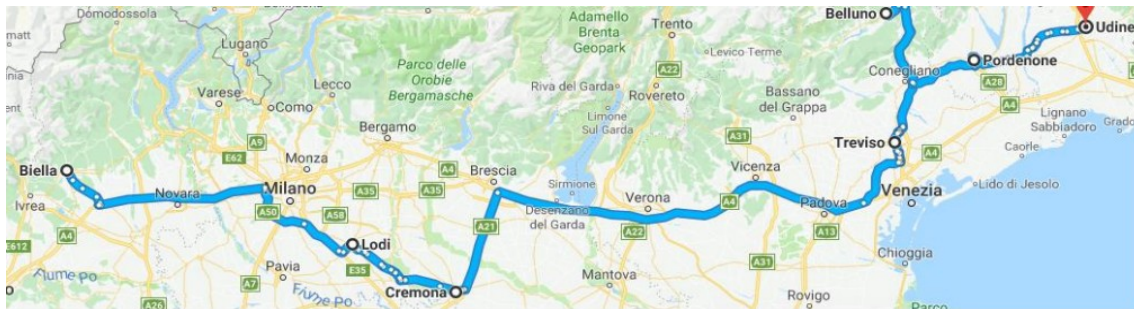
It is interesting to note that, inside the high chart segment the most imponent progresses have been made by small or medium size cities (all below 100,000 inhabitants). A few of these cities (Belluno and Pordenone, but also Treviso, Lodi and the others) are characterized by their excellent performance in Innovation and Research thanks also to the presence both in the urban area and in their territory of the concentration and promotion of productive innovation. A good example is the Polo Tecnologico Galvani in Pordenone, the first to receive the Award for “Centro di Trasferimento Tecnologico Industria 4.0” from MISE. In Cremona the seat of Polo Digitale/CRIT is being doubled, In Treviso the second Society for Innovation and Technological Change t2i is active, in the area surrounding Belluno is the Digital Innovation Lab, in Biella the Po.in.Tex (Textile Innovation Pole), in Lodi the project “Officine del Talento Tecnologico” is opening.

To the relevance in Innovation quite often is related that of high levels in Security (Pordenone, Biella Udine are among the first ten in the sectorial indicators), good levels in Social Inclusion (Pordenone and Udine), and a good management of a functional service quite often problematic as the Urban Waste Treatment. Cremona finds its place

inside the group thanks to the good results in Digital Transformation and Sustainable Mobility and Lodi gets a good position for Urban Green Areas.

The picture presents a combination of factors linked to the specific territory factors (Productive Innovation, Human Capital, Security and Social Inclusion, Efficient Service Management) that is the result of the entrepreneurial productivity and the administrative efficiency.

Figure 3: *The 7 innovating cities axis*



From the geographical point of view the seven cities draw a transversal line – decidedly in the Northern regions – crossing the new productive triangle going from Biella in Piedmont, Pordenone and Udine in Friuli to Lombardy (Lodi and Cremona) and Veneto (Treviso and Belluno). Slightly South to this line is Cesena for the first time in the ICR and reaching a striking 27th position.

2.1.6 The Small Capitals

The Medium Quality City net (starting from Trento, Bergamo and Parma) confirms its good positioning in the highest places in the chart thanks to its excellent sectorial realities, but also to a general good balance between the different dimensions.

11 out of 21 cities in the first positions belong to the group of the “**Small Capitals**”. Among them we find Bergamo, Parma, Pisa and Reggio Emilia but also Padua, Ravenna Modena Mantua and Bolzano. All of them, but Pisa, located in the area made up by the Northern-Eastern regions and by Lombardy. Even if they present differences, the model applied seems to be founded on an approach tending to a well balanced search for the objectives of intelligent and sustainable growth in all the different dimensions.

In the general index the 11 cities obtain an average 12th position, and in 14 indicators out of 15 their average position is within the 42th on the 107 cities taken into consideration, never going below the 60th even in the most critical of the indicators, that is in Water and

Air Quality. Excellences and criticalities are both present, of course. Among the first, above those already mentioned, the extremely high position of Trento for Research and Innovation, Bergamo for Economic Solidity and Urban Green Areas, Reggio Emilia and Ravenna for Citizens Participation and Bolzano for Job Opportunities.

The dimensions where the Small Capitals are not as a whole brilliant in the same way are those of the Urban Green Areas, Territory and Soil, Security and Legality and Water and Air Quality.

2.1.7 The South: The Need for New Developing Strategies

The traditional distance between North and South is confirmed in the urban conditions not only in the traditional disadvantaged areas as Job Opportunities and Economic Solidity but unfortunately also in the more innovating sectors Innovation and Research, Digital Transformation and Energy.

It will be necessary to get to the 43rd position in the general list – between the intermedium and the medium-high - to find Cagliari, the first in the South and in the Isles, and then to go down to find L'Aquila, Lecce, Pescara and Bari at the 67th position. All the last twenty positions are held by Southern cities. The comparison between the medium values calculated in the Northern and in the Southern regions not only does confirm the historical distance in the traditional sectors, Job Opportunities, Economic Solidity, Research and Innovation, but great distances too are present in those sectors where more room for a more balanced development could be expected: Energy and Digital Transformation.

The only sectors where the Southern cities succeed in containing the distance and in a few cases in getting to the top positions in the national lists are the environmental ones: Urban Green Areas, Territory and Soil Management, Water and Air Quality. Obviously above Cagliari there are other cities that show dynamism such as Lecce, getting 9 positions with respect to 2017, Nuoro, Cosenza, and Catanzaro whose indicators, at least in a few sectors, show significant progresses thus bettering their general positioning

2.2 A Study Case: Cagliari

2.2.1: Cagliari and the Pula district. The IOC. A focus on TDM

Among the positions reached by Southern Cities, that as we have already seen present heavy criticalities, Cagliari stands out for its very good placement, from the 47th in 2017

to the 43rd, very similar to the Central regions results and by little not getting into the area of the medium-high cities, thanks to its very high values in Urban Green Areas, Education, Security and Legality. But it is thanks to the Administration interest toward Innovation that Cagliari is going to be one of the smartest cities in Europe.

The Sardinian capital for some time has been at the centre of researches as to *smart development of the cities in the new millenium*, at the CRS4 (Centro di Ricerca, Sviluppo e Studi Superiori in Sardegna) at Pula - 15 kilometres from Cagliari - inside the Regional Scientific and Technologic Park, a system of more then 50 companies working in the sectors of Ict, biotechnologies and energy. The Park has its locations at Pula, 15 km from Cagliari, inside a natural park, at Alghero in a high environmental value area in front of the sea and at Torregrande – Oristano- where the International Sea Reserches Centre is located and where scientific researces applied to sea, coast and lake ecosystems are made. The CRS4 Was funded by the Nobel Prize Carlo Rubbia in 1990 and its mission has always been the development of strategic research programs in the sectors of biomedicine and biotechnology, of the information, energy and environment society. Today 150 people having advanced computational resources (more then 280 TeraFlop power on more then 400 compute node, 2,5 storage petabyte, 1,5 backup online petabyte) work there and represent a reference partner for Huawei since it well knows the territory and its features, being also a knot both with the Institutions and the local enterprises.

The participation with Huawei, started with the Sardinia Region in 2015, has seen the creation of a highly specialized pole with the objective of creating new technologies linked to the *smart and safe city* development. In compliance with the objectives fixed by Horizon 20, by the UE Framework Programme for Research and Innovation, the result of the collaboration between the Cinese Company and the CRS4 is the JOC (Joint Innovation Centre) of Pula -operative since Dicember 2016 - and made possible thanks to an investment of 20 million Dollars by the Cinese Company and 3 by the Regione Sarda. The JOC employs about twenty resercers from CRS4 together to 20 Huawei researchers that in turn fly to Sardinia to take part in the researches.

Among its technical features the laboratory boasts a high performance computing cluster, 576 core big data cluster, Huawei OceanStor storage system 6800v3 and a big data storage system Huawei OceanStor 5300 v3, above firewall equipment to protect and isolate the infrastructure. The first Project realized at the Centre is the IOC (Intelligent Operation Centre) an electronic supercomputer already operating in Cagliari thanks to its applications passing through 25 telecameras, 95 traffic stations, 23 parking sensors.

Started at the end of 2018 the IOC is an operative centre that exploiting both the technological JIC infrastructure and a big data analytics platform processes data related to the municipality of Cagliari.

The only of its kind in Europe, IOC is already being used in Cagliari as the prototype on a regional scale to let Sardinia become the first *smart* region in Italy. In Cagliari the IOC is collecting the data for its working in order to make the city become a laboratory for the development of the *smart city* of the future. According to the Region's projects new job opportunities will be created and new technological instruments to improve the traditional economic sectors like agriculture and breeding will be made.

The IOC is applied to traffic management, transportation optimization, security in crowded areas, waste collection, but also climate monitoring and energetic saving. The objective is that of avoiding terroristic attacks, natural disasters, disastrous accidents. Cagliari as a smart city will first of all improve the quality of life inside the city and grant it will satisfy the inhabitants needs.

Some applications have already been started in their experimental phase in the metropolitan system of Cagliari and they are on traffic and overcrowding. The main objective is anyway that of granting the citizens' security. In the control station a series of operators from different departments as firemen, civil protection officials, traffic policemen and so on are present to be ready to act with all the information needed in case of emergency.

Since its inauguration in September 2016 the centre has already developed solutions that have proved to the benefit not only of Sardinia but also of the whole country. An important occasion was that of the Rigopiano tragedy when the centre put at the disposal of the national firemen its portable system e-Lte emergency solution to facilitate the entrapped people rescue after the hotel had been swept away and destroyed by an avalanche.

Another solution already produced by the centre is the *croud detecting* for the security management of crowds in the city open spaces, based on the anonymous and dynamic control and monitoring of the people present in a given place. This project has a parallel in the lte net for the facial and behaviour identification and control at distance of potentially harmful people, signalled through photographs loaded on a database.

A very important project that has been started at the CRS4 is that of the "Tessuto Digitale Metropolitano TDM" started in collaboration with the University of Cagliari. The project (2017-2021) aims at offering innovative and smart solutions to increase city

attractiveness, resource management efficiency and the safety and quality of life of citizens, through the study and development of enabling technologies and innovative vertical solutions for the protection from environmental risks, energy efficiency awareness and cultural heritage management. Methods and applications are being tested and validated in the city of Cagliari, using advanced communication infrastructure and widespread distributed sensor network. TDM research activities are complemented by a dissemination and training plan that will include the organisation of three Summer School on Urban Informatics (2019, 2020, 2021).

The research program, led by Professor Enrico Gobetti, focuses on visualization and virtual reality spanning many areas of visual computing. The primary aim is the development of technology for acquisition, storage, processing, distribution, and interactive exploration of complex objects. Many of the technologies developed by his group have already been used in as diverse real-world applications as internet geoviewing, scientific data analysis, surgical training, and cultural heritage study and valorization.

The project is part of a broader framework that aims to make Sardinia one of the most important regions in the development and application of innovative technologies for *smart cities*. In particular, project experiments are being carried out at a metropolitan scale by means of a framework agreement with the city of Cagliari and are making use of the computing and networks infrastructures of the Joint Innovation Center.

Two years after its inauguration, the Joint Innovation Center (JIC) of the Pula Technology Park, the joint innovation laboratory of Huawei and the CRS4 dedicated to research projects on Smart & Safe City has entered a new planning phase. The new agreement, signed in November 2018 in Rome by the President of the Regione Sarda and Huawei, provides a specific action plan to develop ICT solutions and services in the areas of health, transport, waste management, logistics, security and Industry 4.0 with the involvement of the Municipality of Cagliari, local institutions, universities and local SMEs. The first services will be provided to the Municipality of Cagliari - Metropolitan City. In this way Sardinia becomes a real laboratory where human capital and technology collaborate on Smart & Safe City research projects.

2.2.2. The role of Huawei in Italy

The Role of **Huawei** in Italy is getting more and more strategic as to *Smart Cities* planning, as we have seen in the case of Cagliari, but not only as to it since Huawei declared purpose is that of “Building a Better Connected World”. Huge investments are being made by Chinese Companies because in Italy they can find:

- An Open Market
- Fair Competition
- No Prejudices on foreign Companies
- New fiscal approach and tools for foreign investors and large taxpayers
- Human capital and highly skilled ITC workforces
- Healthy enterprises ecosystem and availability of valuable partners
- Good trade relationships between Italy and China

Huawei has therefore made both Direct and Indirect investments in Italy related to R&D, Innovation Centres, Labs.

As to Direct Investments, above the already treated Joint Innovation Centre of Pula, we find the:

- Milan Research Center. Established in 2008 in Segrate, became Global R&D in 2011, it serves the Company all over the world. The investment has been made thanks to the unique highly skilled workforce on high frequencies and microwave technology in Milan area. It employs 100 researchers and is partners with Lombardy highly specialized electronics SMBs. Up to now it has filed 30 patents and since 2016 has increased its research scope including 5G. It has invested 1 mln EUR in 2016 on Joint Projects with Politecnico of Milan, University of Pavia, University of Trento, University of Padua.

In Italy Indirect Investments are related to Universities' collaborations. Huawei in fact participates in local innovations planned at Italian Universities such as:

- Polytechnic of Milan: Optical technologies and algorithms to be used for fixed access (FBB)
- University of Trento: Optical filter assembly feasibility study activities
- University of Perugia: MEMs device technologies and design. Involved in the design of RF E band switch. MEMs device and Reflector Antenna Array Design
- University of Bologna: Ray-Tracing Core Algorithms Collaboration Project
- University of Pavia: BiCMOS components for 5G access millimeter-wave

- University of Cagliari: Reliability and Spectroscopy analysis.

All the above mentioned activities show not only a strategic attitude on Huawei's part, but the necessity of a new perspective and internalization of research and collaboration when planning such a huge and challenging transformation as that into *Smart City*.

2.3 An international frame to Italian smart cities

2.3.1 Italian Smart Cities and the Objectives for the Future: The UN Agenda 2030

As we have seen, some of the indicators used in the 2018 edition of the ICityRate have been changed to suit better the new needs originated by a transforming reality – others have been deleted since old and obsolete – but above all to fit with the goals listed in the UN Agenda 2030 for sustainable development. The goals are 17 with 169 associated targets which are “integrated and “indivisible”.

UN Agenda 2030

The Agenda was issued in New York at the Nations Headquarters on 25-27 September 2015 on the occasion of the celebrations for the UN seventieth anniversary. Its declared aim is to stimulate action over the next 30 years in areas of critical importance for humanity and planet:

People: “We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential dignity and equality and in a healthy environment”.

Planet:” We are determined to protect the planet from destruction through sustainable urgent action on climate change, so that it can sustainably support the production and consumption, managing its natural resources and taking care of it for the present and future generations.

Prosperity: “We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occur in harmony with nature”.

Peace: “We are determined to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development”.

Partnership: “We are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on spirit of strengthened global solidarity, focused in particular on the needs of the

poorest and most vulnerable and with the participation of all countries, all stakeholders and all people”.

The Agenda states therefore the 17 goals that would come into effect on 1 January 2016 and would guide the decisions to be taken over the next fifteen years. The Agenda would be implemented within the different countries and at the regional and local levels taking into account different national realities capacities and levels of development. National policies space for sustained, inclusive and environmentally friendly economy would be respected.

Figure 4: *The 17 sustainable development goals*



- 1) End poverty in all its forms everywhere
- 2) End hunger, achieve food security and improved nutrition and promote sustainable agriculture everywhere
- 3) Ensure healthy lives and promote well-being for all at any age
- 4) Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- 5) Achieve gender equality and empower all women and girls
- 6) Ensure available and sustainable management of water and sanitation for all
- 7) Ensure access to affordable, reliable, sustainable and modern energy for all
- 8) Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all

- 9) Build resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation
- 10) Reduce inequality within and among countries
- 11) Make cities and human settlements inclusive, safe, resilient and sustainable
- 12) Ensure sustainable consumption and production patterns
- 13) Take urgent action to combat climatic change and its impacts
- 14) Conserve and sustainably use oceans, seas and marine resources for sustainable development
- 15) Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- 16) Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
- 17) Strengthen the means of implementation and revitalize the global partnership for sustainable development

2.3.2 Europe 2020

Europe 2020 is a 10-year strategy proposed by the European Commission on 3 March 2010 for advancement of the economy of the European Union. It aims at "smart, sustainable, inclusive growth" with greater coordination of national and European policy. It follows the Lisbon Strategy for the period 2000–2010.

The strategy identifies five headline targets the European Union should take to boost growth and employment. Originated from the Germany Digital Agenda in 2009 led by Henrik von Scheel for the Federal Minister of Economy & Technology and evolved in 2013 into Industry 4.0.

They are:

- To raise the employment rate of the population aged 20–64 from the current 69% to at least 75%.
- To achieve the target of investing 3% of GDP in R&D in particular by improving the conditions for R&D investment by the private sector, and develop a new indicator to track innovation.

- To reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if the conditions are right, increase the share of renewable energy in final energy consumption to 20%, and achieve a 20% increase in energy efficiency - 20-20-20 target.
- To reduce the share of early school leavers to 10% from the current 15% and increase the share of the population aged 30–34 having completed tertiary education from 31% to at least 40%.
- To reduce the number of Europeans living below national poverty lines by 25%, lifting 20 million people out of poverty.

Those headline targets are broken down into seven flagship initiatives:

1. Innovation Union: to improve framework conditions and access to finance for research and innovation so as to strengthen the innovation chain and boost levels of investment throughout the Union.
2. Youth on the move: to enhance the performance of education systems and to reinforce the international attractiveness of Europe's higher education.
3. A digital agenda for Europe: to speed up the roll-out of high-speed internet and reap the benefits of a Digital Single Market for households and firms. The Digital Agenda for Europe originated from the Germany Digital Agenda-led Federal Minister of Economy & Technology.
4. Resource efficient Europe: to help decouple economic growth from the use of resources, by decarbonising the economy, increasing the use of renewable sources, modernising the transport sector and promoting efficient energy use.
5. An industrial policy for the globalisation era: to improve the business environment, especially for SMEs, and to support the development of a strong and sustainable industrial base able to compete globally.
6. An agenda for new skills and jobs: to modernise labour markets by facilitating labour mobility and the development of skills throughout the lifecycle with a view to increasing labour participation and better matching labour supply and demand.
7. European platform against poverty: to ensure social and territorial cohesion such that the benefits of growth and jobs are widely shared and people experiencing poverty and social exclusion are enabled to live in dignity and take an active part in society.

The Horizon 2020 framework programme, with its 80 billion euro budget for the years 2014–2020, is one of the implementing tools of the Europe 2020 strategy.

Reactions to the initiative were mostly positive, but there was some skepticism about the Commission's ability to convince the 28 EU member states that these were the right priorities. Some members of the business community did not seem to find any strong incentives for change and Germany did not welcome further proposals on EU governance.

On 26 March 2010, the European Council agreed on key elements of the new strategy. President Herman Van Rompuy, who chaired the meeting, pointed out that the strategy sums up the European model of social market economy with a strong environmental dimension.

The strategy elements were formally adopted on 17 June 2010. Monitoring progress and ensuring the active involvement of EU countries are key elements of the strategy. This is done through the European Semester, an annual cycle of macro-economic, budgetary and structural policy coordination. The key stages in the European semester are as follows:

- In January, the Commission issues its Annual Growth Survey, which sets out EU priorities for the coming year to boost growth and job creation.
- In February, the Council of the European Union and the European Parliament discuss the Annual Growth Survey.
- In March, EU Heads of State and Government (i.e. the European Council) issue EU guidance for national policies on the basis of the Annual Growth Survey.
- In April, Member States submit their plans for sound public finances (Stability or Convergence Programmes) and reforms and measures to make progress towards smart, sustainable and inclusive growth (National Reform Programmes).
- In May, the Commission assesses these Programmes.
- In June, the Commission provides country-specific recommendations as appropriate. The European Council discusses and endorses the recommendations.
- In July, the Council of the European Union formally adopts the country-specific recommendations.

In Autumn, the Governments present the budget draft to their Parliaments.

2.3.3 Seven proposals to help Italy become smarter

Within the above presented international frame and the agreements subscribed, a great number of experts, national agencies and institutional bodies are working in Italy on different political levels in order to produce proposals to help Italy change into a smarter country and confronting their efforts in a lot of different meeting opportunities, the most important of them being surely the annual House-Ambrosetti Meeting. The different proposals up to now elaborated and confronted can be unified into seven large common areas:

Proposal 1: *A general strategy for Italy.*

The objective of this first proposal is that of drawing a vision of the country in a shared way, as an operation aiming at ensuring the action continuity. In order to make it effective it is necessary to reinforce the Government role as a general addressing system and to urge and mobilize the country with the purpose of providing citizens, institutions and enterprises with a high value objective where to address the possible future efforts. It is therefore essential a communication plan to awaken, involve and urge the citizens in being an active part in it. The proposal is shaped as a condition that it is not possible to bypass, since the tactic country managing is a basic condition for decisions related to the urban policy. Without a shared, well-designed, forceful vision it will infact be difficult to optimize the resources and the strategies on the field that would otherwise result as totally lacking their goal.

Moreover it is not possible to forget that Italy is living one of the most serious crises in its history and it is of fundamental importance for it to appear a trustworthy country to European institutions and financial markets. Defining the objectives is the first step to recover a shaken credibility, give credibility back to its policy, re-stating the central system addressing function, grant the country the national agencies support to the reaching of the general goals.

The proposal contents are related to the elaboration of a political, social, economical project able to define a future shared situation to be the gude of the final common goal. This means a decision as to the social and economical model to promote the values to safeguard, the sectors to develop and the tactic competences to adopt. Such decisions will then have to be placed inside a process with obliged time schedules and objectives that will have to appear as clear, selected, well linked to the new strategic needs.

It is therefore to be wished the institution of a Commission advocating the experts presenting the highest degree of competence as to the fundamental issues linked to the future development, and responding for the elaboration of a participating process that might see the contribution and the agreement by all the actors in the territory, thus reaffirming the central Government role as the institution by right designed as a guide for all the promoting actions on its territory.

Proposal 2. *Smartness governance.*

This proposal focuses on the making of a national governance as to *smartness* themes so that it might uniform the transversal interests while directing its action, with the aim of harmoniously interacting with the subjects working on the smartness issues and well stating for each of them the functions and the tasks in a clear and recognizable pattern. A common level playing field will thus be created where all the *smartness* issues will be linked without resenting from the Government changes and in a well defined frame where all the interest bringers may move in all certainty.

Another attempt made possible by this proposal is that of exploiting in full all the competences and interests of the different central and local institution actors, guiding them in the cooperation with the entrepreneurship and profiting of the immense opportunities offered by them all.

When a clear definition of the *smartness* concept isn't given, any actor will put forward its own initiatives, interpretations and tools, thus creating confusion and a limit risking to weaken the initiative force and to give rise to incoherence among their different actions with serious reflections on the general results. It is actually of the primary importance that any process will have to be managed not by different actors but instead by one direction having one idea of what *smartness* will have to be.

The proposal contents well define what the governance tasks will be:

- To express in one way the country's needs
- To satisfy them with the suitable actions and in defined times
- To use at best the resources at disposal
- To take the system responsibility checking its adequacy to the targets
- To create the conditions for the operative sussidiarity efficient action as to the local realities

The Italian Digital Agency - that will be presented in full at the end of the proposal - created in 2012 through a Development Decree appears to be the best-suited candidate for such a role.

Proposal 3: *Italian Smart City Innovation Partnership*

The proposal originates with the aim of creating an Italian version of the European Partnership model for innovation related and directed to the *Smart City*, a very important chance to develop a set of urban management methods. Its objectives are:

- To urge the development of tactic Partnership in a win-win relationship between enterprises, financial institutions and local administrations, in order to promote both innovation and ‘team playing’ between enterprises, territories and financing agencies for a wider objective.
- To locate the resources at disposal on a limited number of initiatives having a high potential of effects on the territory.

In the proposal the Partnership featuring aspects and the roles related to it are well defined. They are:

- The Advisory Board, a board meeting twice a year to the Partnership enhancement and to trace the guiding line as to the future steps, envisaging Italy’s future in a global perspective and selecting the related projects.
- The Country’s territories that will have to be involved, in the number of at least two, to ensure the solutions diffusion and the different enterprises, in the number of at least three, to favour the insectorial cooperation and the industrial interests convergence.
- The adoption of open standards, essential to the technologies functioning and to the smart cities development all over the country, but necessary to avoid the dipendence from one supplier by the local institutions.

Private and public financing schemes too are needed to grant a long term companies engagement, an active budget balance of the local companies both to create investment opportunities and to provide a monitoring system letting the step by step assessment of the adopted measures efficiency.

Proposal 4: “*Smart City*” Prize based on a shared model

The fourth proposal is about the Italian cities involvement through a stimulous in reaching the maximum *smartness* level. In order to get the aim a Prize has been created for the first five cities classifying with the best score given in compliance to the real benefits for the

citizens. The Prize is about the realization of a *case study* aiming at the national and international experience exaltation on the winning cities to be made by a well-known film director.

The aim of this proposal is to put the cities in competition axalting the Country's excellencies so as to enhance emulating processes and at the same time to raise the national sensibility toward the *smart city* theme.

Proposal 5: *Perfectioning the initiatives already started*

The focal point of this proposal is the engagement in bringing the projects related to the city *smartness* to their end and to close those initiatives already started in the years and never brought to conclusion. To make the proposal effective it will be necessary to check the projects already started controlling the real need of the financial resources provided and re-establishing trust in the public opinion. It is also necessary to establish one direction to the projects already started and at a standstill because of the absence of both co-ordination and communication between the institutional actors.

The proposal can be compared to a 'cleaning' operation with the aim of optimizing the system with a proper responsibility action towards the citizens and the Country. Italy has got all the resources, possibilities and abilities to close this operation successfully but it is of course necessary a stronger determination in the ruling class and an adequate guiding and controlling body. The perfect candidate is once more the Agenzia Digitale Italiana, designed to projecting and directing the initiatives presenting the highest national interest, together to the best availability of the Public Administration services to citizens and enterprises.

Proposal 6: *Short distance quick-win*

The objectives to be aimed at are the winning *smart* solutions promotion, those of course having the lowest costs and the quickest real results and being ready to use. The proposal has the goal of making immediate effective investments – not only the long term ones – so as to urge short term results towards solutions to be:

- Real and immediately available with re-shaped investments
- Bringer of results easily controllable
- Possible to be applied again in different situations
- Capable of immediately solving problems presented by the citizens
- Capable of a learning process

This proposal therefore means to provide a signal to the citizens as to the objective that it is possible to reach through real demonstrations of what it is possible to do in the sense that ‘ facts count more than words’.

Proposal 7: *10% increase in ‘truly free’ time for citizens in 5 year time*

The proposal wants to make the citizens aware of the fact that it is possible for them to receive real benefits for their lives when they get closer to *smart* solutions and to show them the institutional and political engagement by putting the citizens at the centre of the operative choices.

In the transforming process into *smartness* it is important that the life quality and the free time become the drivers for its becoming true. Half the Italians in fact would do anything in order to have more free time at disposal considering it the most valuable among the present benefits. According to the data provided by ISTAT in the last 20 years the time for physiologic functions, as for instance sleeping and eating, and for sport has considerably diminished while the time needed for commuting and working has increased. As to this dimension Italy is by far the worse country with respect to other European countries.

To sum up the seven proposal above presented, their objective is a sort of Europe 2020, that is the stress is on the performance result more then on specific actions to be made within a well defined and obliged time. The result will be the product of actions and initiatives involving manifold dimensions aiming at a Country change

- Commuting times
- Working times
- Teleworking and telepresence
- Simplified and digitalized relationships with the bureaucratic machinery
- Education at distance with innovating training processes
- Telemedicine
- -Urban re-organization involving residential areas and service areas

2.3.4 The Italian Digital Agency

We have already addressed to the Italian Digital Agency (AgID) as to the Agency better suited to accompany the Italian public administrations in their transforming process into *smart cities*. AgID is an Italian public Agency started in 2012 under the Government of President Monti. It works under the controlling and addressing power of the Cabinet and acts in conformity to the functions and tasks given to it by law.

Its mission is to manage the implementation of the Italian Digital Agenda's objectives, in coherence with the EU Digital Agenda and to contribute to the diffusion of new information and communication technologies, with the aim of fostering innovation and economic growth. It coordinates the activities of the State, the regional and local administrations, designing and monitoring the evolution of the IT system of the Public Administration. It defines guidelines, regulations and standards, and designs and coordinates strategic initiatives for effective provision of online services to citizens and businesses by P.A in order to:

- Ensure the informatic coordination of the P.A. with the aim of projecting and monitoring the strategic evolution of the informative system favouring the adoption of standards to reduce costs and improve services
- Credit the certifying subjects in the digital system
- Optimize the costs held by the public administrations
- Perform all the necessary actions to comply with the international obligations taken by the State in the issues of competence
- Promote the digital innovation in the country and contribute in creating and spreading new opportunities of economic, cultural and social development.
- Collaborate with European, national and local institutions and agencies having the same goals also through strategic agreements.
- Publish guidelines, rules and standard form
- Promote citizens' digital literacy.

Chapter 3

The Miracle of Medellin

3.1 A study case: The miracle of Medellin

3.1.1 The vision of Medellin. Its beginning: The SIMM

Medellin is a city that went from being known for its security problems to being and international reference for technological and social innovation, urban transformation, equity, and citizen participation. A city where the homicide rate was up to 20 years ago of 381 for 100,000 residents, it has now reduced it by 80% through a transformation that has seen the citizen and his trust in Institutions at the center of a policy that has given back dignity the citizenship because centered around the transformation into a *smart city* where every citizen is proud of his new innovative city. Medellin has implemented a series of strategies that have made it a *smart city*: that is developing the capacity and organic structure of all the agencies that control mobility, the environment, and security. In subsequent phases, Medellin expects to integrate services under a single control center, which will enable it to centralize the monitoring of all the city operations.

Although there is no single methodological framework for implementation, all the initiatives share one characteristic: they are aimed at serving citizens, and they have created mechanisms to communicate and interact with them to promote the continuous improvement of smart services. Through the Program “MDE: Medellin Smart City,” Medellin is implementing projects to create free Internet access zones, community centers where ICT can be accessed, a Mi-Medellin co-creation portal, open data, online transactions, and other services that aim to achieve citizen participation, open government, social innovation in problem solving, and project sustainability.

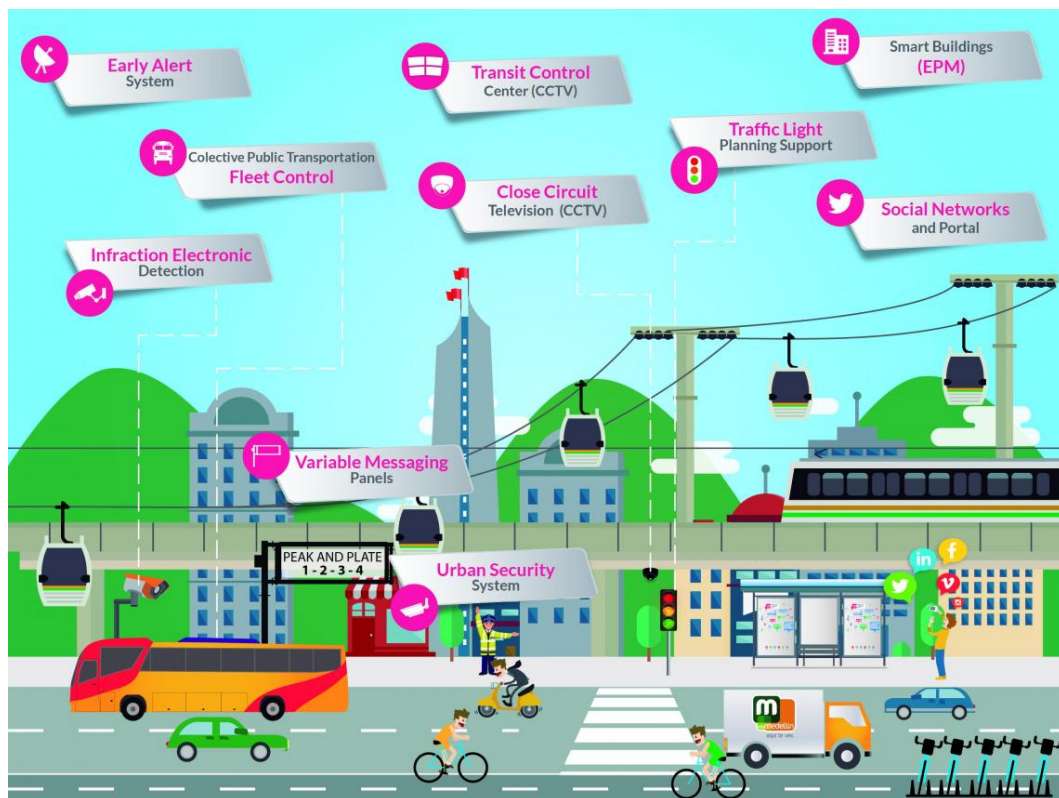
Another strategy is the creation of the Smart Mobility System (Sistema Integrado de Movilidad de Medellin, or SIMM) which, through the use of technology, of an operations center, and of a series of monitoring and control services, has achieved a reduced number of accidents and has improved mobility and a reduced accident response time.

In the environmental strategy, the Early Warning System (Sistema de Alertas Tempranas, or SIATA), the Noise Monitoring Network, and the Air Quality Network combine with the emergency care network to integrate services that are all linked. Added to this are the Integrated Metropolitan Emergency and Safety System (Sistema Integrado de

Emergencia y Seguridad Metropolitana, or SIES-M), a systemic strategy of interinstitutional convergence between the safety and emergency agencies of the State that integrates more than 10 local and national government agencies.

These initiatives have been continuous since their beginning, using operational models that bring together public and private associations and agreements between government entities in different sectors, with the participation of academic institutions and innovation, science, and technological centres. Medellin authorities well know that *Smart city* innovation is not only technological, it must also be social. It must seek sustainability in each project or service by ensuring income sources and/or adjudication to operators that outlast changes in government. It should also encompass technological renovation and maintenance to guarantee continuity of ongoing projects. In Medellin, a series of citizen-centered services are improving the residents' quality of life. Although they still must evolve substantially to achieve integration and predictability, they are already showing results in capacities developed for the future management of a consolidated *smart city*.

Figure 5: Medellin Smart City Vision



The Medellin Smart City Program consolidates ICT adoption processes, content generation, design of services, and support for public connectivity strategies with the aim

of improving the relationship between citizens, their environment, and the municipal administration.

It is expected that by 2020 this strategy will improve the quality of life of the citizens, providing continuity and extending existing actions, and developing new strategies using ICTs as a way of contributing to solving problems and creating opportunities in education, safety, mobility, the environment, economic development, housing, citizen participation, and equity. The strategic lines of the Medellín Smart City program are the following:

- Citizen participation: Create a culture of participation through adequate spaces that reflect residents' proposals for the city's public policies.
- Open government: Generate, promote, and position open data. The information developed by the municipal administration, public bodies, businesses, and academic institutions must be made available for the citizens' use and benefit, through ICTs as social networks, webpages, and applications.
- Social innovation: Promote processes that allow citizens to modify their environment, transform their reality, and find solutions to their problems.
- Sustainability: Develop projects to promote sustainability and ensure economic, environmental, political, and social conditions for current and future generations.

In this evolution, Medellín has been implementing a series of initiatives with a high degree of technical and social innovation content, integrating services, systems, and technology from each of the departments of the Municipal Administration.

One of the departments with the most initiative in the area of innovation and technology is Medellín's Mobility Department, which has modernized its services and created the Medellín Smart Mobility System (Sistema Integrado de Movilidad de Medellín, or SIMM). This system has consolidated the creation of the Mobility Control Center, the transit records services, the electronic detection of traffic infractions, cameras for traffic monitoring, variable messaging panels, support systems for the traffic light network, and a system for public transportation control, among others, that have made the city a world reference in the area of integration to improve mobility and reduce accidents.

The increase in the number of vehicles, population growth, urbanization, industrialization, and population densification have a considerable impact on the city's mobility. They reduce the efficiency of the transportation infrastructure and increase commuting time, air pollution, and fuel consumption.

For all of these reasons, in 2010, the municipality of Medellin began studying the need to implement a mobility system (SIMM) that integrates information technologies, communication, transportation infrastructure, and the different types of vehicles. This system seeks to manage all these components efficiently to improve mobility in the city by optimizing the use of the roads, improving safety, reducing commuting times, pollution, and fuel consumption, and disseminating information to users so that they can make better decisions related to their travel. SIMM seeks to employ technological solutions to lessen mobility constraints. SIMM is a successful case of public-private partnership. It has seven technological components integrated into a transit control center for surveillance and mobility management within the city.

Since the implementation of the Smart Mobility System in 2010, a series of results have been recorded, which are presented below. They can still be improved upon, and should be integrated with policies designed to reduce the use of private cars and significantly improve the use of public services under optimal conditions for all. The current experience has brought the following results:

- A 24% reduction in the rate of traffic accidents per 10,000 vehicles in the areas covered by variable messaging panels.
- A 35% reduction in the traffic accident rate for every 10,000 vehicles in the areas covered by the photo-detection cameras
- An 18% reduction in the percentage of negative incidents (responses to false alarms)
- 74% fewer drivers fined for exceeding the speed limit
- 193,840 hours of congestion saved in 2014 as a result of the reduction in response times since 2010
- 27% fewer photo-detections were made for speeding
- 24 out of every 1000 vehicles were subject to photo-detection; now only 4 out of every 1000
- An 8% increase in response times of under 15 minutes to accidents
- 69% fewer drivers were fined for running red lights

In addition to implementing services, technology, and control centers that centralize the city's operations, Medellin supports social innovation. Through open government strategies, citizen participation, social innovation, and sustainability, with MDE - Medellin Smart City - it hopes to put forth a program that is both technological and social.

Through strategies such as free hotspots, the co-creation MIMedellin, and content creation, among others, the idea is to view technology as a tool that people should know how to use and enable residents to live better in their surroundings. Cooperation policies between entities of different governmental fields are necessary for the integration of the services in shared territories.

One of the fundamental factors in creating synergies and providing integrated services is collaboration among municipal, departmental, metropolitan, and national administrative entities. Thus, the Medellin Municipal Partnership with the Aburra Valley Metropolitan Area enables them to monitor the environment in Medellin and surrounding municipalities, integrating SIMM into emergency response. This partnership has boosted efficiency in the management of field devices maintained by the Mobility Control Center that require constant support to comply with environmental regulations. Likewise, the collaboration between the National Police, the emergency network and decentralized entities has been successful thanks to the will and joint participation of the different entities, even though they fall under different government jurisdictions. This implies that the level of trust in the government is affected by people's impression of the service they receive when using it.

Medellin made important advances in modernizing transactions with the State, such as the public-private partnership within the Mobility Department, decentralization of technical services, innovation in the USC, and implementation of a one-stop shop for handling transactions in the decentralized branches of the municipality and through the webpage, among others. All of this makes the municipality's processes and databases more organized, which enhances its capacity to manage and integrate smart city services with reliable information for its correct functioning.

Before implementing any services that involve interaction with citizens, it is indispensable to identify the social objectives of the project and the benefits that will occur for citizens, and determine the possibility of quantifying them. In implementing the SIMM, for example, an awareness campaign was needed to educate citizens on the importance of electronic detection cameras. Thus, despite the fact that they were pioneering technologies in the country and they encountered resistance, citizens have identified benefits in terms of protection and culture.

Figure 6: *Medellin Smart transportation system*



When it comes to moving citizens from home to work to play, mobility is where Medellín shines. Colombia's only municipal rail network has won a bevy of global awards since it opened over 20 years ago. Modern, efficient, clean and cost-effective (base fare is 2,125 pesos, or 70 cents), the Metro is integrated with Metrocable, a gondola system that carries commuters from the mountains above the city down to the valley and city center.

Dedicated bus lines also crisscross the city, while ample bicycle lanes and a citywide bike sharing system help locals move around Medellín. For countless residents, motorbikes are the preferred mode of transport, as they make it easy to zigzag in and out of traffic. Many public places such as the city's shopping malls, in fact, have dedicated parking areas for motorbikes.

But not only for its transportation system does Medellín today shine, others too are the dimensions where it has made an enormous change thus becoming an all dimensions *smart city*.

3.3.2 Medellin: an all dimensions smart city

Education:

Home to over 30 universities and leading technology centers, Medellín has been on a public education growth this century. The expansion of the city's schools is especially noteworthy for where many of the newer ones are located: in the poorer neighborhoods of Medellín. The same can be said for many of the city's "library parks," which are exactly that: a library building surrounded by plenty of green space for public use.

The civic leader responsible for this emphasis on education has been Sergio Fajardo, a University Professor in Mathematics, mayor of Medellín from 2004-2007 and then Governor of Antioquia from 2012 to 2016. In an interview during the early days of his governorship, Fajardo explained his administration's approach was to build "the most beautiful for the most needy" and that the emphasis on building top level facilities was "because the first step in education is having a dignified space in which to learn." Fajardo introduced a positive state presence in the poorest and most violent areas of the city, through social, cultural and integrated urban projects accompanied by good architecture, which was by public competition and therefore opened space for the youngest Architects of Colombia. For the first time, the City of Medellín considered the "Social Urbanism" as an instrument of inclusion and as a tool to sew, connect, integrate and articulate the city so that it is for everyone and for all.

Based on the slogan: "Medellin: From Fear to Hope", Fajardo's Government worked on reducing poverty and violence by simultaneously attacking both problems. The idea was to increase opportunities for both employment and business generation and reduce social inequality through educational policies and specific architectural projects. By means of integrating architectural projects such as parks and libraries in marginalized sectors, and modernization of schools within the framework of "Medellín, the most educated" policy, the indexes of violence and insecurity were reduced, as well as the social exclusion, within very few years.

The Library Parks

The *Library Parks* in The City of Medellín were born as a strategic city project that seeks to make public libraries the centre of cultural and social development. These libraries are presented as a commitment to the integration, participation, and empowerment of communities by the public space, as well as the meeting points and socialisation for communities that are considered the most vulnerable. Likewise, these projects were

oriented towards the urban and architectural transformation of the city, with innovative designs that attract the attention of the citizens. A good example of these buildings is the Spain Library Park by Giancarlo Mazzanti.

The Library Parks were located strategically in vulnerable areas of Medellin, taking into account demographic, urban, social and cultural aspects, in which it was necessary to raise the quality of life of the citizens and rebuild the social fabric for governance.

Figure 7: Spain Library park, by Giancarlo Mazzanti



The environment: Medellin The Greenbelt

One project that is simultaneously taking on challenges including suburban sprawl, erosion and even food insecurity is Medellín's *El Cinturon Verde Metropolitano*, or metropolitan greenbelt. A work in progress, this greenbelt will be almost 50 miles long (75 kilometers), with plans including community gardens, recreational spaces, hiking trails and improved housing for some of the city's poorest residents. The project is being built in four phases and seeks a completion date in 2030.

The Greenbelt will bring socioeconomic benefits by better connecting existing residents to the city – particularly those in Medellín's remote settlements – and by upgrading homes and introducing public services and transit options in those settlements. The project has already engaged more than 64,000 community members, with its agro-ecological gardens benefitting more than 300 families. Another benefit of the Greenbelt is its boost to food

security. So far, the city has planted more than 120,000 native plants and trees on 85 hectares of land won a bid to help restore the ecosystem on the sloping outskirts of the city. Of this rehabilitated land, almost 2,500 m² has been transformed into terraced gardens – mitigating the risks of climate change by better protecting the land and its residents from landslides while providing residents with spaces to grow food.

Public Health

Home to several of South America's top-ranked hospitals, Medellín has long enjoyed a reputation as a leader in medical tourism. But this important city's investment in public health is not only benefitting rich Colombians or Americans seeking for high quality medical care - it is also having a role in improving the lives of low-income residents.

The *Buen Comienzo* ("Good Start") program, for example, offers expectant mothers medical information online at the dozens of public areas that offer free Wi-Fi and computer access. Communicating online does not necessarily replace a live doctor's visit, but for citizens for whom the cost of transportation from a remote neighbourhood can exceed a day's wages, *Buen Comienzo* reduces the need for trips to a clinic and provides information about prenatal care available at one's fingertips. The program also offers various health and education lines to support families during their children's first five years of life.

Transparency

"We don't have to worry about violence anymore. Now we just worry about poverty and corruption" public managers in Medellín today affirm.

Medellín still has its problems with crime and corruption, but investments in infrastructure, health and education offer proof that the city's government works more effectively when compared to other cities across the region. Critics may doubt the effectiveness of the city's governance code, but online platforms such as MiMedellin.org help to encourage civic participation. For well over a decade, the city has also been a global model of participatory budgeting – five percent of the city's budget is distributed across the city's neighborhoods, allowing locals to make their own decisions on how to spend the money - whether it is allocated for education, infrastructure or cultural events.

Colombia's City of Eternal Spring is On the Move

The city's innovations in infrastructure and social impact are just part of why Medellín is a place to which other cities look for ideas on how to improve the quality of life for all citizens. Of course not everything in Medellín is perfect: traffic is snarled during rush hour, and Medellín's international airport, about an hour ride from the city centre, is hardly in the most convenient location. The city's economy, largely dependent on sectors susceptible to economic volatility, such as coffee, flowers and textiles, could benefit from more diversification. But when compared to South America at large, Medellín is doing many things right. After all, income rate in Medellín is higher when compared to the entire nation of Colombia. The city's poverty rate is also lower than the nation as a whole. What up to twentyfive years ago was a place of poverty, corruption and fear thanks to the brave choices made by its political leaders and to their capacity of vision has now become one of the smartest cities not only in South America but in the world.

Chapter 4

Green Economy and Sustainability

4.1 Green Economy for a global change

4.1.1 Definition of Green Economy

The protection of the environment, the waste reduction and more in general sustainability are themes that in the last decades have witnessed a growing interest by both common citizens and policy makers on every level - international, national, local - with a special eye towards the opportunities provided by the new socio-economic productive models linked to the principles of *green economy*.

The origin of the above presented process is to be connected to the attention that two issues are more and more requiring: the natural resources scarcity and the demographic increase. The product of such reflection is the generating of a theory on a new economic model called *green economy*, whose objective is keeping together both the scarcity of the existing resources and the sustainable development.

The demographic growth in particular, accompanied by the increasing urbanization of the world's population, is an issue that is menacing the management and liveability inside urban areas and is causing a new awareness as to the inefficiency of the existing models and the need for completely different actions by the politic authorities. The innovating model of projecting, managing and organizing cities - as it has emerged in the latest years and has spread on national and international levels – is that of the *smart city*.

The new attention to environmental issues has produced a change as to the approach in the normative production and in the definition of the world politics. The turning point is represented by year 1972 when 113 nations took part in the United States Conference on Human Environment in Stockholm inside which a new conception of the natural environment originated and was expressed in the 26 principles stated in the “United States Declaration on Human Environment”. According to them the defense and improvement of the environment have become ‘an imperative goal for all humanity’. That document is a milestone and the reference point for all national policies up to the “Rio de Janeiro Declaration” of 1992 and the “Kioto Protocol” of 1997.

The concept of *green economy* is in progress and therefore it is difficult to find a definition both univocal and exhaustive, but we can refer to the UNEP (United Nations Environment

Programme) according to which it is to be meant as “a kind of economy whose goal is human wellness and social equity, significantly reducing environmental risks and ecological scarcity”.

The Italian Fondazione Impresa, whose task is research on enterprises, green economy and new professions, defines *green economy* as a theoretical model of economic development considering, beside the benefits resulting in a given productive contest, also the environmental damages caused by the whole transforming process, with the aim of optimizing the economic circuit.

It is not possible to consider *green economy* a sort of ‘fourth sector’ since it transversally cuts a series of existing important sectors, but in general we can refer to it as to a new economic model that presents at its basis the equation “resources scarcity-sustainable development”, and is made up by a complex system of variables, measurings, instruments and policies apt to act with all the productive existing activities.

A lot of economists agree on the fact that *green economy* is an instrument apt to speed economic growth. A confirmation to this acceptance is given by the European Commission, according to which, in order to solve the problems linked both to life conditions and the protection of the environment, it is not necessary to slow down growth, but instead it is necessary to promote “the right kind of growth”, that is a *green economy*. But there are still some of them that underline the fact that the adesion to this kind of economy is particularly onerous especially for enterprises and that it negatively affects their competitive force. The theories are manifold and sometimes contrasting, but the *trait d’union* lies in the fact that all of them have the same awareness as to the global, national and local relevance of the issue.

4.1.2 Green Economy Sectors

The “Report on Green Economy” by the Foundation for Sustainable Development in collaboration with Enea in Italy has identified six strategic sectors through which it is possible to develop *green economy*: energy efficiency and conservation; renewable sources development; resources efficient usage, waste prevention and recycle; sustainable mobility; eco-innovation; ecologically quality agricultural production.

As it is possible to see, all of them are related to the idea of *smart city* and once again we can state that the two issues – that of *smart city* and that of *green economy* – are tightly related one to the other.

Energy efficiency and conservation: *the smart grids*

The energetic efficiency and the energy rational use are the two pillars of energy conservation. Through the first one we mean the reduction – keeping the same objective to reach and by the use of the right processes and technologies – of the primary energy consumption. Through the expression ‘rational use’ instead the optimization of energy use - with respect to the needs thus reducing both consumption and costs - is meant.

The measures of energetic efficiency are applied in a great number of sectors and the most important of them are to be found in the urban settlements: construction, lighting, heating and electric appliances.

In the wide field of the above-mentioned measures *smart grids* are an innovative instrument to obtain positive results as to the environmental impact too, since they permit the reduction of primary energy usage. *Smart grids* are bi-directional electric nets that smartly link all the performances by all the actors involved - both producers and consumers - thus distributing energy in an efficient, sustainable, safe and economically advantageous way. They put together innovative services and products to monitoring, controlling, and self-healing smart technologies in order to grant heterogeneous electric generators connection and efficiency and to provide consumers with the instruments and the choice capacity to make the global system efficiently functioning. Moreover, they are a good way to reduce the electric system environmental impact, at the same time increasing its safety and reliability since they reduce congestions through the supply of informations to all the customers in real time.

The *smart grids* thus represent a strong change with respect to the traditional electric nets operating in one-direction way, transporting energy from the big producing power plants to a high number of consumers and operating through a centralized controlling station. The *smart grids* instead, thanks to their bi-directional nets, give the consumers the possibility of becoming producers too, since they can pour into the net the energy produced in their houses. They can actually integrate the centralized electric production in the net, granting the connection with the other service nets and power fluxes.

It is therefore self-evident how these technologies are a fundamental pillar for the *green economy* development and an innovative and sustainable solution for cities.

Renewable sources energy production

A further solution helping not to cause permanent environmental damages to a manifold number of *habitat* and to protect the life of future generations is the use of renewable energy sources.

The natural resources – the goods and services provided by the environment to human activity and generating social or economical benefit – are divided into renewable and non-renewable. The former have the power to regenerate in time, the latter only exist in quantities that are limited and reduced any time it is made use of them. The fact that some resources can be defined as renewable does not mean that they are illimited or that they cannot exhaust. Once a maximum treshhold is being reached, they actually keep a sort of static balance, while below a minimum critical dimension they tend to extinguish.

In the same way as the non-renewable ones, some renewable resources (the solar irradiaton, the wind, the tides and the marine streams) can be used to produce energy (chiminal, mechanical, thermical or electrical) and are called renewable energetic sources (RES). In Italy too the RES have acquired a great importance and in 1018 they have supplied 32,4% of the total both for industrial and for domestic use.

If on the one side they offer advantages as to the environmental impact reduction and the dependence from foreign countries, on the other side they present problems related to the power production continuity. Since it is not possible to know in advance the energetic source availability trend, it is necessary to orgaize a *backup* system, quite often through a conventional plant fed by non-renewable resources, so that it might supply in case of need.

RES are considered energetic flux sources, in opposition to stock energetic sources and their present use doesn't affect the future use of them. Those usually exploited in electric power generation are: the hydraulic source, the geothermic source, the aeolian source, the solar source and the biomasses. Studies and researches are at present being made to get to the power production through the wave motion and the tidemoving force too.

Hydraulic source: the water energy derives from the water motion flowing from top mountains to the bottom. The hydroelectric plants exploit the geodetic fall between two water sections in a water stream, or between two water reservoirs, taking water upstream, sending it trough a hydraulic turbine and giving it back downstream. Three kinds of plants are known: 'water streaming' built along a river course, 'reservoir' built through weir and letting great water volumes deposits and collection in time, and 'pumping stations' made by two reservoirs, one upstream and one downstream, that exploit the level differences.

Geothermic source: the geothermic energy is generated by the heat in the earth crust layers where steam is produced by the water underground springs and cought by special turbines. The Earth's geothermal resources are theoretically more than adequate to supply

humanity's energy needs, but only a very small fraction may be profitably exploited. Drilling and exploration for deep resources is very expensive. Forecasts for the future of geothermal power depend on a great number of factors related to technology, energy prices, subsidies, plate boundary movement and interest rates.

Biomasses: the biomass too is a source of renewable energy. Biomass is organic material that comes from plants and animals. It contains stored energy from the sun. Plants absorb the sun's energy in the photosynthesis process and when biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels. Examples of biomass and their uses for energy are:

- Wood and wood processing wastes: burned to heat buildings, to produce process heat in industry, and to generate electricity
- Agricultural crops and waste materials: burned as a fuel or converted to liquid biofuels
- Food, yard and wood waste in garbage: burned to generate electricity in power plants or converted to biogas in landfills
- Animal manure and human sewage: converted to biogas, which can be burned as a fuel

Aeolian source: another resource that can be exploited to produce energy is the wind. The wind energy is the most mature and developed renewable energy. It generates electricity through wind, by using the kinetic energy produced by the effect of air currents. It is a source of clean and renewable energy, which reduces the emission of greenhouse-effect gases and preserves the environment. Wind power has been used since antiquity to move boats powered by sails or to operate the machinery of mills to move their blades. Since the early twentieth century, it produces energy through wind turbines. The wind drives a propeller and, through a mechanical system, it rotates the rotor of a generator that produces electricity. Wind turbines are often grouped together in wind farms to make better use of energy, reducing environmental impact. The machines have a lifespan of twenty years.

Solar source: its origin is the radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, molten salt

power plants and artificial photosynthesis. Its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar techniques include the use of photovoltaic, concentrated solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate the air.

The large magnitude of solar energy available makes it a highly appealing source of electricity. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total of world energy consumption, which was 559.8 EJ in 2017.

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge long-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global.

Wave energy: it is a renewable energy whereby we capture the energy that is being generated naturally by waves. Waves get their energy from the wind passing over the surface of the sea and can transmit their energy over long distances with little degradation; wave energy is considered a significant renewable energy resource. The irregular and oscillating flow of wave energy in oceans - kinetic energy - has tremendous energy potential and if harnessed could provide a tremendous addition to a clean energy system. The energy in a wave is determined and calculated by wave height, speed, length, and the density of the water. Though most wave technologies are intended to be installed near the ocean surface, they can be used in nearshore, offshore, and far offshore locations depending on where the resources lie. Wave power systems are not practical everywhere due to the variation in wave energy. Ideal locations for wave energy farms exist on the western coasts of Scotland, Northern Canada, Northwest America, Southern Africa, and Australia. Large commercial wave farms have only begun to be tested, with several challenges arising through the trials:

- Wave energy is irregular, which can create problems with absorption rates
- Wave energy devices need to withstand major oceanic assaults such as storms and saltwater corrosion
- Currently wave power is very expensive to the point where it is not yet competitive with fossil fuel energies
- There are some concerns about the environmental impact of wave energy for marine populations
- Wave energy farms can result in the displacement of fishing grounds, which can have a negative impact on local economies.

Lastly the ***Moon motion*** can be mentioned as a source of energy since the gravitational attraction force causes the upheaval of the water masses up to 20 meters of highness. Studies and researches are being made in order to see how it can successfully be exploited.

Resources efficient usage, waste prevention and recycle

At the basis of *green economy* the precept of the rational usage of resources, both as related to energetic consumption but also to material consumption, is to be found. The theme of the waste management is tightly related to that precept since a greater waste production is the result of the greater use of the resources. The objective is now the conceiving of waste as an economical resource that only as a last step is to be destined to a dumping ground.

The EU General Policy Directions in 2008 stated the hierarchy of actions to be fulfilled in the waste management: reduction, re-use, re-cycle, re-generation. Campaigns of sensibilisation among citizens are to be carried too since the theme is particularly important and good results can be reached through the adoption of qualitative and quantitative prevention measures that can be either economical or technological. The stress must be on the benefits that the correct management of waste will produce. It:

- Prevents pollution caused by reducing the need to harvest new raw materials
- Saves energy
- Reduces greenhouse gas emissions that contribute to global climate change
- Helps sustain the environment for future generations
- Saves money

- Reduces the amount of waste that will need to be recycled or sent to landfills and incinerators
- This is a central issue in cities because there the waste production is greater then elsewhere.

Sustainable mobility

The fourth sector of *green economy* is sustainable mobility meant as the ability of meeting the desires and needs of the citizens to move freely, to communicate, to exchange and establish relationships without putting at risk other human and ecological essential values both for today and the future.

At present the transportation sector is one of the most responsible for gas emission with greenhouse effect and in general for the global pollution levels. It is therefore necessary to meet the challenges this sector presents and to proceed more and more in a *green* direction. The demand for transportation is increasing with great rapidity and it will double by 2050: the number of vehicles is as well increasing and new technologies making them more efficient and with low environmental impact are needed to balance the effect of the increase. The policies related to *green mobility* are:

- Improving vehicles technologies with more efficient mechanics and fuel mix
- New urban transport planning
- Sensibilization campaigns addressed to the citizens
- Encouraging shared transport systems
- Promoting *teleworking* and *car-pooling*

In Italy a Fund for Sustainable Mobility has been created with the aim of financing the local administrations projects planned for the air quality bettering and the local public transport improvement.

In Europe Guidelines have been published to enhance Sustainable Urban Mobility, providing the objectives, the examples already enacted and the challenges to face.

Eco-Innovation

Eco-innovation is defined any innovation that brings with it environmental advantages such as the reduction of the natural resources use, of pollution, of energy consumption or of the quantity of waste produced.

Eco-Innovations can be ‘process’ eco-innovations when they are related to the technologies, the machineries and the plants involved in the production; ‘product’ and ‘system’ eco-innovations are instead those related to the organizing level, to the innovative components and to the dematerialization that is to the reduction of materials and energy in the industrial production thanks to the informatic innovation.

The ‘process’ eco-innovations are: *end of pipe*, *lean technologies* and *clean technologies*: the first and the second types contribute in reducing the environmental impact, the resources consumption, the waste production and the high costs. Quite often law dispositions impose the first kind of eco-innovations, while as to the second and the third kinds they are often left to the decision freely taken by enterprises in order to increase efficiency or competitive advantages. Moreover *clean technologies*, if compared to the first two, need more radical production features changes, and therefore higher costs, even though the advantages are granted for a much longer time span.

As to the ‘product’ eco-innovations, of course no product exists that doesn’t cause environmental impact, therefore they are defined as ecological only if compared to the traditionally produced goods. In order to improve the product or service ecological efficiency while keeping its performance unchanged - above taking into consideration all the related life cycle phases following the rule of the *Life Cycle Assessment* - it is necessary to introduce the eco-innovations since the very first steps of production.

Environmentally quality agriculture production

Conventional agricultural systems today have the task not only to produce much greater amounts of food, feed, fibre and energy to meet the global needs, but also challenge problems to improve health and social well-being of man, reduce dependence on fossil fuels, adapt to climate change and extreme weather, reduce environmental degradation and decline in the quality of soil, water, air and land resources throughout the world as well. The present one-dimensional physical and chemical production systems should be

therefore replaced by an agricultural paradigm that rely more on biology and ecology and meet global food needs based on the soil, water, land and fertility resources without compromising the capacity of future generations in meeting their environmental, food and resource needs.

A new kind of agriculture as an alternative to conventional systems of food production should contain features of agricultural systems that promote the environmentally, socially and economically sound production of food and fibre, and aim to optimize quality at all levels.

The underlying principles are to minimize the use of external inputs as far as possible and to make use of resources and practices that enhance the balance of ecosystems and integrate components of farming systems into an ecological system. Recognizing the ecological principles, self-regulating ability and system stability, agro-biodiversity, climate change and global warming, soil nutrients and soil biology, erosion, nonchemical crop protection and generally agroecosystem health are the most significant ecological and environmental issues regarding production systems. An eco-oriented agriculture in farming, processing, distribution or consumption will therefore sustain and enhance the process of food safety and health at all stages and levels of the agroecosystem in order to prevent serious food safety hazards such as pathogens like prions (BSE), allergens, mycotoxins, dioxins, GMOs, pesticide residues, growth hormones, food additives like colorants, preservatives, flavours, process aids, nitrite added to processed meat, salt, added sugar and saturated fat. There are growing evidences suggesting that ecologically oriented agricultural systems produce enough quantity and quality foods and have a number of ecological, and health advantages for consumers over food from conventional systems

Agricultural policies are being dealt with at any level and always improving since new challenges are presenting every day. The EU commision too has felt the urgency to improve its policy and on 1 June 2018 it presented legislative proposals on the common agricultural policy (CAP) beyond 2020. These proposals aim to make the CAP more responsive to current and future challenges such as climate change or generational renewal, while continuing to support European farmers for a sustainable and competitive agricultural sector.

Based on 9 objectives, the future CAP will continue to ensure access to high-quality food and strong support for the unique European farming model.

Figure 8: the 9 CAP objectives



The 9 objectives of the future CAP are:

- To ensure a fair income to farmers
- To increase competitiveness
- To rebalance the power in the food chain
- To respect climate change action
- To promote environmental care
- To preserve landscapes and biodiversity
- To support generational renewal
- To protect vibrant rural areas
- To protect food and health quality

4.1.3 Climatic Changes

When dealing with *green economy* it doesn't seem possible not to make mention of a phenomenon that in the last years is having enormous effects on the world environment, on man's life conditions and health. The climatic change is a change in the long run of the atmospheric phenomena due to the increase of the Earth's temperature caused by the exceeding amplification of what is a natural phenomenon: the Glasshouse Effect.

When the glasshouse effect gases concentration increases in the atmosphere, the quantity of the entrapped heat increases too, starting an increase of the Earth's temperature and as a consequence a chain process. The above-mentioned concentration can vary according either to natural events (animal and plants breathing) or to anthropic activities. Since the natural emission are balanced by the natural absorption, the increase in the concentration of CO₂ is totally due to anthropic activities, whose emissions are only partly balanced by natural systems. It is important to note that cities contribute for the most part to the emissions since in urban environments the cemented and asphalted surfaces tend to absorb more solar energy and higher temperatures - if compared to rural areas - are registered. This phenomenon is called '*Heat Isle*'.

The consequences are already visible in all continents, the global climate is changing and it is going to have more and more devastating consequences everywhere. At all levels the problem is being faced, from world organizations to local ones.

In order to reduce the anthropic emissions, the Kioto Protocol was signed in 1992 by more than 180 countries that were followed by other 12 up to now. Another important international agreement was reached inside the UN Climate Change Conference held at Doha in 2012 that extended the Kioto Protokol up to 2020. UE has promoted the "Climate Action 20-20-20" fixing three objectives to be reached by 2020: 20% reduction of CO₂ emissions, 20% coverage of energetic consumptions through renewable sources, 20% reduction of total energetic consumptions. The UN intergovernmental Panel on Climate Change (IPCC) issued in October 2018 is clear on the matter. The world's leading climate scientists have warned there is only a dozen years for global warming to be kept to a maximum of 1.5C, beyond which even half a degree will significantly worsen the risks of drought, floods, extreme heat and poverty for hundreds of millions of people.

The authors of the landmark report say urgent and unprecedented changes are needed to reach the target, which they say is affordable and feasible although it lies at the most ambitious end of the Paris agreement to keep temperatures between 1.5C and 2C. Policymakers commissioned the report at the Paris climate talks in 2016, but since then the gap between science and politics has widened. Donald Trump has promised to withdraw the US – the world's biggest source of historical emissions – from the accord.

The world is currently 1C warmer than preindustrial levels. Following devastating hurricanes in the US, record droughts in Cape Town and forest fires in the Arctic, the IPCC makes clear that climate change is already happening, upgrades its risk warning from previous reports, and warns that every fraction of additional warming would worsen the impact.

Scientists who reviewed the 6,000 works referenced in the report, said the change caused by just half a degree came as a revelation: at 1.5C the proportion of the global population exposed to water stress could be 50% lower than at 2C. Food scarcity would be less of a problem and hundreds of millions fewer people, particularly in poor countries, would be at risk of climate-related poverty.

At 2C extremely hot days, such as those experienced in the northern hemisphere in summer 2018, would become more severe and common, increasing heat-related deaths and causing more forest fires.

But the greatest difference would be to nature:

- Insects, which are vital for pollination of crops, and plants are almost twice as likely to lose half their habitat at 2C compared with 1.5C. Corals would be 99% lost at the higher of the two temperatures, but more than 10% have a chance of surviving if the lower target is reached.
- Sea-level rise would affect 10 million more people by 2100 if the half-degree extra warming brought a forecast 10cm additional pressure on coastlines. The number affected would increase substantially in the following centuries due to locked-in ice melt.

- Oceans are already suffering from elevated acidity and lower levels of oxygen as a result of climate change. One model shows marine fisheries would lose 3m tonnes at 2C, twice the decline at 1.5C.
- Sea ice-free summers in the Arctic, which is warming two to three times faster than the world average, would come once every 100 years at 1.5C, but every 10 years with half a degree more of global warming.

Time and carbon budgets are running out. By mid-century, a shift to the lower goal would require a supercharged roll-back of emissions sources that have built up over the past 250 years.

The IPCC maps out four pathways to achieve 1.5C, with different combinations of land use and technological change. Reforestation is essential to all of them as are shifts to electric transport systems and greater adoption of carbon capture technology.

Carbon pollution would have to be cut by 45% by 2030 – compared with a 20% cut under the 2C pathway – and come down to zero by 2050, compared with 2075 for 2C. This would require carbon prices that are three to four times higher than for a 2C target. But the costs of doing nothing would be far higher.

“We have presented governments with pretty hard choices. We have pointed out the enormous benefits of keeping to 1.5C, and also the unprecedented shift in energy systems and transport that would be needed to achieve that,” said Jim Skea, a co-chair of the working group on mitigation. “We show it can be done within laws of physics and chemistry. Then the final tick box is political will. We cannot answer that. Only our audience can – and that is the governments that receive it.”

He said the main finding of his group was the need for urgency. Although unexpectedly good progress has been made in the adoption of renewable energy, deforestation for agriculture was turning a natural carbon sink into a source of emissions. Carbon capture and storage projects, which are essential for reducing emissions in the concrete and waste disposal industries, have also ground to a halt.

Reversing these trends is essential if the world has any chance of reaching 1.5C without relying on the untried technology of solar radiation modification and other forms of geo-engineering, which could have negative consequences.

In the run-up to the final week of negotiations, there were fears the text of the report would be watered down by the US, Saudi Arabia and other oil-rich countries that are reluctant to consider more ambitious cuts. The authors said nothing of substance was cut from a text.

UN Environment's sixth Global Environment Outlook (2019) calls on decision makers to take immediate action to address pressing environmental issues to achieve the Sustainable Development Goals as well as other Internationally Agreed Environment Goals, such as the Paris Agreement. By bringing together a community of hundreds of scientists, peer reviewers and collaborating institutions and partners, the GEO reports have built on sound scientific knowledge to provide governments, local authorities, businesses and individual citizens with a report on the state of the Global Climate in 2018. In its 25th anniversary edition, it highlights record sea level rise, as well as exceptionally high land and ocean temperatures over the past four years. This warming trend has lasted since the start of this century and is expected to continue.

To take action is imperative and scientists believe that limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society. With clear benefits to people and natural ecosystems, limiting global warming to 1.5°C compared to 2°C could go hand in hand with ensuring a more sustainable and equitable society.

The WMO (World Meteorological Organization) Greenhouse Gas Bulletin reports on atmospheric concentrations of greenhouse gases in the earth's atmosphere. The report says that levels of heat-trapping greenhouse gases in the atmosphere have reached another new record high, according to the World Meteorological Organization. There is no sign of a reversal in this trend, which is driving long-term climate change, sea level rise, ocean acidification and more extreme weather.

The next 2-3 years will be a critical moment when many of the policy and investment decisions that shape the next 10-15 years will be taken. The New Climate Economy report has found that leaders are already seizing the exciting economic and market opportunities of the new growth approach, while the laggards are not only missing out on these opportunities but are also putting all the rest at greater risk.

4.1.4 The biodiversity crisis

In May 2019 the UN's Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services will release a summary of an upcoming 1,500-page report on the state of biodiversity on Earth. The report has 145 authors from 50 countries, and it sums up about 15,000 scientific papers on the threats against life in the age of humans but the UN has already released a 40-page summary of its findings for policymakers and the media.

The report's findings are impressive: it finds that species of all kinds — mammals, birds, amphibians, insects, plants, marine life, terrestrial life — are disappearing at a rate “tens to hundreds of times higher than the average over the last 10 million years” due to human activity.

The average abundance of native species in most major land-based habitats has fallen by at least 20%, mostly since 1900. More than 40% of amphibian species, almost 33% of reef-forming corals and more than a third of all marine mammals are threatened. The picture is less clear for insect species, but available evidence supports a tentative estimate of 10% being threatened. At least 680 vertebrate species had been driven to extinction since the 16th century and more than 9% of all domesticated breeds of mammals used for food and agriculture had become extinct by 2016, with at least 1,000 more breeds still threatened. In all the report warns as many as 1 million species are now at risk of extinction if we don't act to save them. It amounts to a biodiversity crisis that spans the globe and threatens every ecosystem. The results echo much of what we already know. Earlier this year, the World Wide Fund for Nature (WWF) published its Annual Report on Living life, a global assessment of the health of animal populations all over the world. They found that the average vertebrate population — that is, the average size of any given species population in the organization's database, whether it has 10,000 individuals or 10 million — has declined 60 percent since 1970.

The reasons for this biodiversity crisis can be found in five main factors, but the presence of humanity affects them all. It is also important to stress that, while the biodiversity crisis is related to, and fueled by, the climate crisis, it's also distinct from it. The five factors are:

1. Changes in land and sea use. The area of the world that has been unaltered and untouched by humans is shrinking all the time. And when it shrinks, so does room

for nature. A third of the world's land, the report finds, is currently reserved for agriculture or livestock. Around 100 million hectares of tropical forest disappeared between 1980 and 2000.

2. Direct exploitation of organisms. As for instance hunting and poaching.
3. Climate change, which increases hardships for species in so many ways, from the polar bears in the Arctic losing ice to hunt upon to the fact that when ocean waters warm, they cannot hold as much oxygen or sustain as much life.
4. Pollution. One example for all is the huge amount of plastic that enters the ocean every year.
5. Invasive alien species. Due to a globalized world, species from one continent can move to another, where they don't have natural predators, and dominate the environment.

Other notable findings of the Report include:

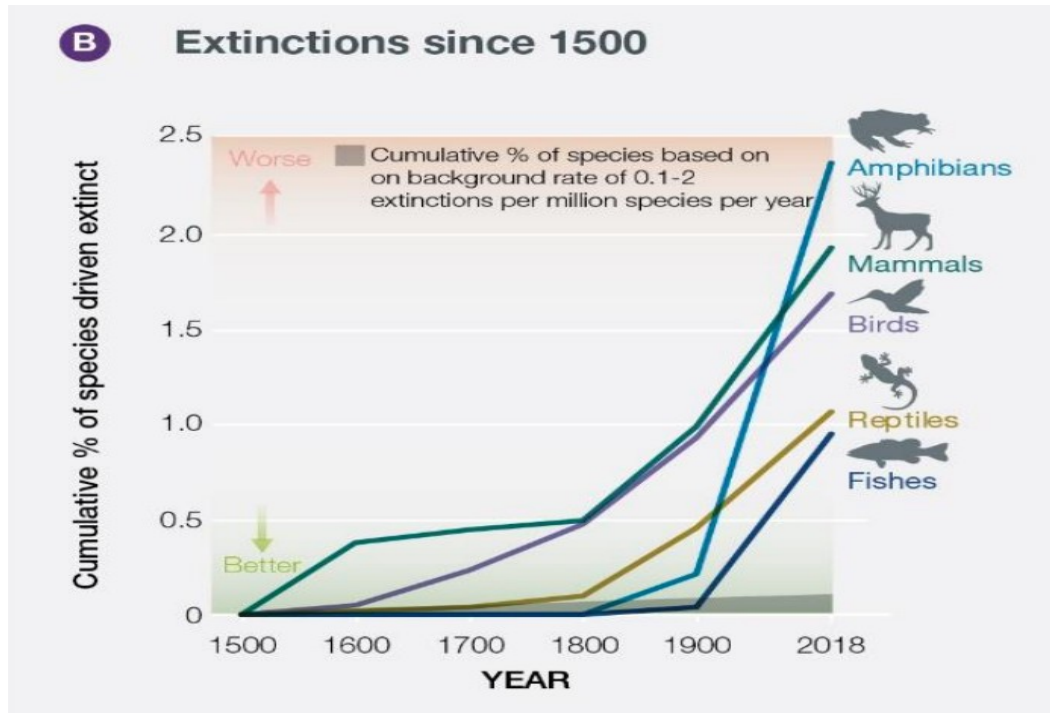
- Three-quarters of the land-based environment and about 66% of the marine environment have been significantly altered by human actions. On average these trends have been less severe or avoided in areas held or managed by Indigenous Peoples and Local Communities.
- More than a third of the world's land surface and nearly 75% of freshwater resources are now devoted to crop or livestock production.
- The value of agricultural crop production has increased by about 300% since 1970, raw timber harvest has risen by 45% and approximately 60 billion tons of renewable and nonrenewable resources are now extracted globally every year – having nearly doubled since 1980.
- Land degradation has reduced the productivity of 23% of the global land surface, up to US\$577 billion in annual global crops are at risk from pollinator loss and 100-300 million people are at increased risk of floods and hurricanes because of loss of coastal habitats and protection.
- In 2015, 33% of marine fish stocks were being harvested at unsustainable levels; 60% were maximally sustainably fished, with just 7% harvested at levels lower than what can be sustainably fished.
- Urban areas have more than doubled since 1992.

- Plastic pollution has increased tenfold since 1980, 300-400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are dumped annually into the world's waters, and fertilizers entering coastal ecosystems have produced more than 400 ocean 'dead zones', totalling more than 245,000 km² (591-595) – a combined area greater than that of the United Kingdom.
- Negative trends in nature will continue to 2050 and beyond in all of the policy scenarios explored in the Report, except those that include transformative change – due to the projected impacts of increasing land-use change, exploitation of organisms and climate change, although with significant differences between regions.

To solve the biodiversity crisis, it will be necessary to take more than the actions of individuals, it will be necessary to take countries deciding to set aside more room for nature, in the form of protected areas by lessening the load of plastic pollution on our seas or addressing climate change and its various inputs. It will be necessary to take policies that more strongly control the import of invasive species. It also means protecting indigenous communities, who use their land in a more sustainable way. It means above all to take innovation: to feed the increasing number of humans in the world it will be necessary to rely on the role of innovation.

The report states “goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories.” But the problems are dramatically accelerating and in 2020 the UN is convening a global conference in China to set new decade-long goals to preserve biodiversity.

Figure 9: *Percentage of species extinction since 1500*



When we lose species, we lose access to learning about their biology. Last year, scientists discovered that a rare species of corn essentially makes its own fertilizer. It's possible that biologists will figure out how to add this trait to other plants, boosting their productivity while lessening the need for chemical fertilizer, which is hugely polluting. If that species had gone extinct, we wouldn't have access to this potential biological tool. When we lose species, we lose out in finding potential drugs made by nature that could help cure human diseases. And we lose out on the rich ecosystems those species help sustain: just to make an example, when pollinators like bees die off it means flowering plants don't produce new seeds.

The biodiversity crisis also means that men are potentially setting themselves up for a food crisis. Increasingly, the world's diet is homogeneous. "Fewer and fewer varieties and breeds of plants and animals are being cultivated, raised, traded and maintained around the world," the report says. If a disease were to wipe them out, we couldn't necessarily turn to nature to find new sources of food.

For all we know, Earth is the only place in the universe with life. If life exists in the solar system it's probably very primitive, singled-celled at most. The Earth has the greatest diversity of life in our solar system, perhaps in the galaxy, perhaps in the universe. And we're eroding it.

4.1.5 The role of technology: focus on three innovation cases around the world

The Isle of Tilos in Greece

As we have remembered above, by 2020 the EU member states will have to meet their energy needs achieving the 20% target of energy coming from renewable sources: some places have already reached this goal. In particular, there is a little island in the Mediterranean Sea, which as early as this summer could entirely rely on wind and solar energy. Its name is Tilos, a small island in the Dodecanesos with about 500 inhabitants and attracting a good number of visitors: up to 3000 in high season, for a total of 13.000 annual tourists. It is precisely this peak of numbers during the hot season that has often led to serious problems in the island. Electrical energy used to come entirely from a submarine pipeline which tied Tilos with the close Kos and, due to the high demand of energy which often exceeded the supply, prolonged blackouts were frequent. The damage for locals and tourists - forced to remain without light and air conditioning - or, even worse, for the restaurants which repeatedly had to throw their food supplies, because of the lack of cold storage, used to be great. It is therefore not a coincidence if Tilos has been selected by the European Commission as the winner of a financed project for the spread of sustainable energy that will make the island a full-fledged green reality. The pilot project, worth 13.7 million of euros (80% of which is borne by the EU), is part of the Horizon 2020 Project, involving 13 enterprises and institutes from seven EU countries.

Figure 10: *Tilos windmills*



It must be said that Tilos is not the only existing representative of this new trend of clean energy. Another example, still in the European area, is the Danish isle of Samsø that has become the protagonist of a gradual but continuous shift and it represents an ecological model: it has been a decade since electricity needed by over 4000 citizens is produced by renewable sources. The last challenge to be faced is the complete elimination of fossil fuel, replacing all the vehicles, including all the privately owned ones.

The great innovation about the project on Tilos, however, is not the realization of wind and solar installations, but the introduction of two accumulators equipped with special sodium-nickel batteries, produced by the Italian company Fiamm. The main characteristic of these batteries is their insensitivity to outdoor temperatures, managing to store the energy produced in the most profitable days and use it when the demand increases. The test already completed gave positive results, but the real test will be only next summer, when the number of tourists is at his maximum. Tourism, in fact, is the first source of livelihood for the island, but a particular one has been encouraged: the slow one. “We are looking for the type of tourist who loves the environment and who is naturally inclined to safeguard it” says the mayor of the small island. Thus, who is keen on trekking and birdwatching will find in Tilos his perfect destination, since it is the habitat of 150 species of birds and 650 different plants and now even the first – and for the moment the only one – 100% clean island of the Mediterranean.

Copenhill: from waste to a touristic attraction

Copenhagen’s waste-to-energy plant sets new standards for environmental performance, energy production and waste treatment. Innovative technology and architecture integrate to form a future in which waste-to-energy plants are welcomed in any city.

Copenhageners and visitors are witnessing a waste-to-energy plant that is not only one of the best performing European plants in terms of energy efficiency, waste treatment capacity, and environmental consideration, but also in terms of visual attractiveness.

Figure 11: Copenhagen – Copenhill / Amager Bakke



Copenhill / Amager Bakke is equipped with two furnace lines and a joint turbine and generator system. The plant replaces a 45-year-old plant with four furnace lines. Amager Resource center is running a plant that burns 2 x 35 tonnes of waste per hour.

Altogether the energy plant is able to:

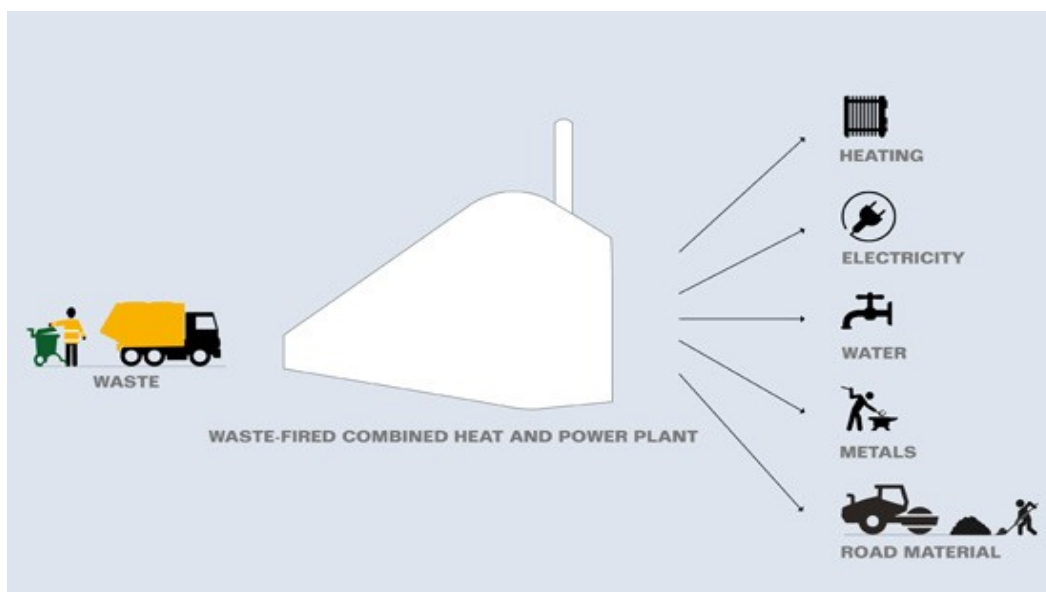
- Treat around 400,000 tonnes of waste annually produced by 500,000 – 700,000 inhabitants and at least 46,000 companies.
- Supply a minimum of 50,000 households with electricity and 120,000 households with district heating.
- Have steam data at 440 degrees and 70 bars, which doubles the electrical efficiency compared to the former plant. In addition to the technological merits, the plant's architecture includes a roof-wide artificial ski slope open to the public.

It is a multi-purpose plant that is already catching the eyes of the world because of its local appeal. The plant provides energy and waste treatment, and is an architectural landmark and a leisure facility too with its park and a ski slope on top of it. The novelty of the project is the combination of ingenious technology and innovative architecture in

a project dedicated to the local community: it stands out in terms of environmental considerations, energy production, and its working environment.

Copenhill plant utilizes more than 100% of the fuel's energy content, has a 28% electrical efficiency rate, reduces sulphur emissions by 99.5%, and minimizes NOx emissions to a tenth, compared to the former plant. The NOx-reduction is enabled due to a flue gas cleaning technology, Selective Catalytic Reduction (SCR) therefore ski enthusiasts need not to worry about the air quality at the slope on the operating plant. This is how efficient the technology of the Copenhill plant is:

Figure 12: Copenhill composition



400,000 tons of waste a year result in:

- 99% energy efficiency.
- District heating for 160,000 households.
- Electricity for 62,500 households.
- 100 million litres of spare water recovered through flue gas condensation.
- 90% reuse of metals from waste amounting to 10,000 tonnes of metal a year
- 100,000 tonnes of bottom ash reused as road material which saves large amounts of gravel

Fighting deforestation: Drones plant millions of trees. Seeds cocoons.

Every year, 15 billion trees are destroyed, and while there is a large global tree planting effort that already spends \$50Bn each year, there remains an annual net loss of 6Bn trees.

Governments have recognized this, and 120 national and domestic governments committed to restore 350m Ha of degraded land by 2030. Achieving these global restoration targets with slow and expensive traditional methods alone will be impossible. These will need to be supplemented with new technologies.

BioCarbon Engineering, a start up company in Oxford, has developed a system to plant trees with drones with the core objective to plant 500bn trees by 2060. Just 400 teams will plant 10B trees each year, with the capability to scale to 10's of billions of trees/year.

Figure 13: *planting drones*



The core objectives are ecosystem restoration, conservation, and sustainable land use. The system uses satellite and UAV collected data to determine the best location to plant each tree. The planting drones fire a biodegradable seedpod at each predetermined position at 120 per minute. Two operators equipped with 10 drones will plant 400,000 trees per day. Just 400 teams will plant 10B trees each year.

The new system uses satellites and drones to make detailed maps of the terrain, nutrients, and biodiversity. It combines these data with information from local ecologists who identify the correct mix of native local species appropriate to protect and expand local biodiversity. The data are then processed through a machine learning algorithm and generate a geo-referenced planting map. This allows local ecologists to match trees and other species with the correct soil conditions to ensure the highest yields and biodiversity.

The mapping provides data important for the planning of restoration, conservation, and certification of restored environments.

This planting map is uploaded into the firm's automated planting drones which fly at 3 meters above the ground and fire a biodegradable seed-pod with pressurized air at each of the pre-determined positions. The bio-degradable seed-pods are filled with a germinated seed, nutrients, and other vital components. These penetrate the earth, are activated by moisture, and allow the seed to grow into healthy trees.

Each drone plants seedpods at 120 pods per minute. A team of two operators with a swarm of 10 of these drones will be able to plant as many as 400,000 trees each day. Just 40 teams of two can plant 1bn trees/yr, with the potential to scale to tens of billions each year. The fully automated and highly scalable BCE solution plants 150 times faster and 4-10 times cheaper than the current gold standard – hand planting (>600x multiplier).

The main competitive traditional methods of planting.

- Direct seeding where seeds are broadcast over a parcel of land carried out with automated tractor or manned helicopter systems resulting in very low survival rates
- Hand planting is the most common method. It is slow, expensive, and labour intensive
- Managed restoration where forests restore themselves naturally with limited tree planting. It is slow and expensive and results in limited biodiversity
- Ground-based machinery planting of nursery grown seedlings by GPS-enabled tractors. This is only used in flat terrain

Advantages to these techniques:

- Low cost
- High mobility allowing access to challenging or inaccessible areas
- Automatic tree planting
- Integrating Biology, Engineering, and Data
- Barriers to entry include patents and significant internal IP on seed selection and survival

- Deep network of collaborations and supporters.

At present the start-up is planting 350,000 mangroves in Birmania where they were before felled to create aquacultures. However, their long subaquean roots can store much more carbon dioxide than plants on dryland and make profitable barriers against cyclones and tsunamis. Moreover, the habitat they create can be exploited to farm fish and shellfish.

Another start up, the Dutch one LandLife, has created an innovative system to fight deforestation: the 'cocoon'. The Cocoon is a biodegradable tree incubator, designed to provide seedlings with shelter and water and give them a higher chance of survival in degraded ecosystems during their first year of growth – the time when they are most vulnerable. The Cocoon is made from recycled paper pulp, and is completely biodegradable. The seedling sits in the centre of the pot in a protective shelter, making it less exposed to animals and harsh weather conditions. The pot around the seedling holds 20 litres of water and its technology slowly transports the water from the outer container into the protective shelter. This provides a stable source of water for the seedling during early growth when the seedling is establishing root structures to find groundwater. This is particularly critical in areas where there is little rainfall, as without secure water access plants often die before they are able to develop roots deep enough to discover water beneath the surface.

The start-up has already started projects in over 25 countries. For instance, in Australia it has partnered with the University of New South Wales to reforest a former mine site. Australia's gold rush, which took place during the 1850s, left an unfortunate legacy of over 50,000 unrestored mine sites. The two organisations planted two types of native Australian trees – eucalyptus and casuarina trees – in the former mine site using the Cocoon technology. Despite harsh weather conditions and dry soils, 90% of the seedlings have survived.

At present, there are over two billion hectares of land on earth that have suffered from degradation. Reforesting arid areas is challenging due to harsh conditions, dry soils and inconsistent rainfall. Conventional reforestation techniques in these areas may rely on irrigation, which can be expensive and water intensive. Reforestation can bring numerous benefits to the environment and to people. It can protect the watershed, prevent erosion and landslides, and act as a natural carbon sink. In addition, forests can provide livelihoods, shelter, food and medicine for rural communities. The world's forests are the second largest carbon sinks after the oceans. Increasing forest coverage is an effective

way to sequester carbon naturally. Forests are home to 80% of life on earth. New technologies to promote reforestation will combat desertification, restore degraded lands and soils, help to improve forest resource management.

Chapter 5

The role of ICT: London Datastore

5.1 London Datastore

5.1.1 A portal at the service of Londoners

As we have seen in the first chapter, in its transformation into a smart city London has focused on ICT and quite a striking example of it is provided by its portal London Datastore that has won the 2015 ODI Open Data Publisher Award.

The London Datastore is a free and open data-sharing portal where anyone can access data relating to the capital. To citizens, business owners, researchers or developers, the site provides over 700 datasets to help understand the city and develop solutions to London's problems. They are all invited to have a look around, and let the Municipality know what they think or suggest.

The Datastore has been created by the Greater London Authority (GLA) as a first step towards freeing London's data. Everyone can access the data that the GLA and other public sector organisations hold and use that data however they see fit – for free. The GLA is committed to using its connections and influence to request other public sector organisations into releasing their data here too. The London Datastore encourages users to take the raw data and transform it into websites or applications in order to make it more useful and easy to understand. Channel 4 is also encouraging such innovation by offering up to £200,000 from its 4ip fund to individuals or companies who can devise the best ways of harnessing the data.

Through the City Data Analytics Programme, a virtual hub co-ordinated by the Greater London Authority's (GLA) City Intelligence Team in City Hall, it develops and supports data collaborations across public services in London and forms part of the Smart London Together Work. Individual public organisations across London have infact been using data analytics for many years and some are increasingly developing their own data science capacity. Benefits provided by the City Data Analitics Programme include:

- The ability to progress beyond reporting and dashboards to provide forecasts of service demand

- Linking large, complex and regularly changing datasets together, giving a more holistic view
- Discovering patterns and trends that are not immediately obvious or widely known

The main interface on the London Datastore website is the London Dashboard, which is described as a window on London's public services. It displays data in the form of tiles which show selected statistics, with either an up or down arrow, coloured green or red to indicate if it is a positive statistic or a negative one. For example, the Transport tile displays 'Lost Customer Hours (Tube), down 25% on same quarter last year', displayed with a down arrow, coloured green to show a positive result, while the Jobs & Economy tile shows 'Total Workforce Jobs, down 5,000 since last quarter (-0.1%)', with a down arrow, this time coloured red to indicate a disappointing result.

The topics explored and made accessible are: Demographics, Transparency, Employment and Skills, Environment, Business and Economy, Housing, Health, Planning, Transport, Education, Community Safety and Crime, Young People, Art and Culture, Sport, Income, Poverty and Welfare. If a more detailed analysis is required, further information can be accessed by clicking on the tile. Clicking on the Jobs & Economy tile, for example, brings up a page with a variety of statistics and graphs, including Total Workforce Jobs, Unemployment, Apprenticeships, GLA Employment Projections, and NEETS. The page also includes links to relevant data on other sites, and internal Datastore links.

As to the Environment, for instance, it is possible to know the data showing roadside and background average readings for Nitric Oxide, Nitrogen Dioxide, Oxides of Nitrogen, Ozone, Particulate Matter (PM10 and PM2.5), and Sulphur Dioxide measured in Micrograms per Cubic Meter of Air (ug/m³). The spreadsheet shows which Index level each reading falls in, and contains charts showing pollutant levels by time of day per month. Trend graphs of Nitrogen Dioxide and Particulate Matter PM2.5 are on the London Dashboard and a link is provided to know more.

As to Young People, a dataset shows numbers and rates of Under 18 and under 16 conceptions, including proportion leading to abortion. Data is for London Boroughs. The Office of National Statistics (ONS) conception statistics are used to monitor progress towards the Teenage Pregnancy Strategy's target to halve England's under-18 conception

rate by 2010, from a 1998 baseline. These statistics are part of a well established series, which are compiled by combining information from birth registrations and abortion notifications.

Under 18 rates are per 1000 female population aged 15-17.
Under 16 rates are per 1000 female population aged 13-15.

Or as to Art and Entertainment, to make one last example, it is possible to know about the use of public libraries, visits to museums and galleries and engagement in the arts by Londoneers and tourists:

Libraries measures the percentage of adults who have used a public library service in the past 12 months. Use is for leisure purposes, including informal learning and studying or research for personal interests. *Museums and Galleries* measures the percentage of adults who have visited a museum or gallery in the past 12 months. Visits are for leisure purposes, including informal learning and studying or research for personal interests. Online access to collections and outreach services are not counted. *Arts* measures the percentage of adults who have either attended an arts event or participated in an arts activity at least three times in the past 12 months. Engagement must be for leisure purposes.

The data-sets on the website have been provided by the GLA and its four functional bodies: Transport for London, London Development Agency, London Fire and Emergency Planning Authority and the Metropolitan Police Service. Ten London boroughs have provided data, and many other relevant organisations have contributed, all of which are displayed on the site in a tag cloud. There is a catalogue which is available to download in CSV format, with an automated process, designed by the GLA Information Technology Unit, to export content from the MySQL database that powers the Datastore site. The catalogue file is updated daily.

Another part of the site is devoted to the 2011 Census. The Census Information Scheme, working within the GLA, gives a London-specific analysis of Census statistics from the GLA, its functional bodies and the 33 London Boroughs. The Census can be explored in various ways: by themes, tools, or data and there are links to news, historical tables and a summary. *Inspirational Uses* is a page that features applications and visualisations

which have been created from the data provided by the GLA and uploaded by users for others to share. These submissions are displayed in date order, with the option to vote or comment on them.

A very interesting and useful section in the portal is the London Area Profiles offering detailed data of each borough. It helps paint a general picture of an area allowing the user to explore a wealth of local data to better understand the profile of London's communities and the neighbourhoods they live in. The data is presented in two formats. Firstly, the dashboard view allows the interaction with the data via mapping, charts and data tables. It is also possible to switch between Borough and Ward data using the purple map icon. When a geographical area is selected, it is possible to click on the "View report" button to generate a custom-made report visualising a range of the latest demographic, economic, social and environmental information available for that area. The complete list of the London boroughs is given with the updated data as to the population, the main spoken languages, the educational and employment rates, the life expectancy just to give a few examples.

The blog too is important in the interaction between the city management and the citizens: 'We want this blog space to be filled with contributions from far and wide. If we are monopolising the conversation, then we are getting it wrong' the City DataTeam affirms. If someone has got something to say that deals with London data, Smart city issues, or an event involving London, the Datastore blog is a great place to get a message across. So if someone has a point to make about open city data or an idea around which he wants to start some creative thinking, he will simply have to get in touch.

Published primarily to improve transparency and accountability and launched in January 2010, it originally hosted some 200 datasets. Today it is considered—together with TfL's Unified API from 2014—one of the first city-platforms of its kind to make public data open and accessible, and a marker of London as a leading smart city globally. (That's all the more remarkable given that London's open data ecosystem in 2009 had barely formed with the Future Cities Catapult and Open Data Institute not yet in existence).

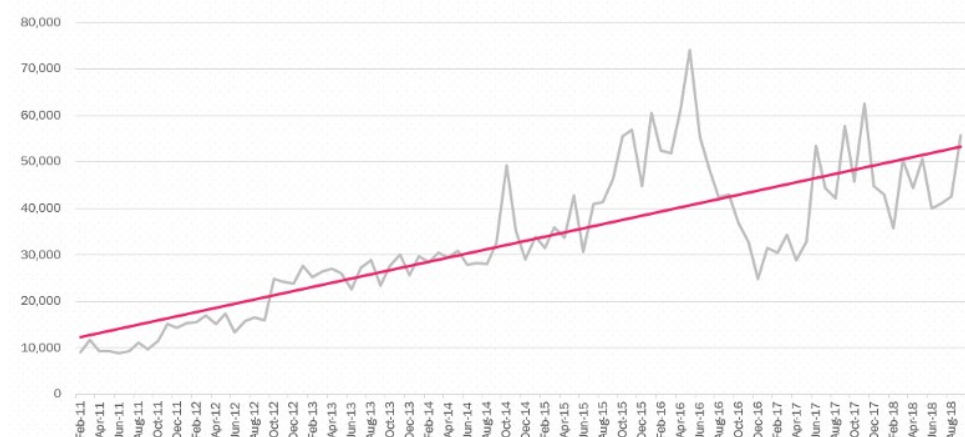
The Datastore has also been through several iterations, improving its design and functionality—most notably in 2015 with a complete revision. Today the Datastore is constituted of almost 800 datasets and 3,000 files (mostly excel or csv) available to

download on open licence. Examples include population estimates, cycle flows, house prices, ambulance incidents, crime rates or international visitor numbers, benefit claimants , obesity prevalence, school grades and number of fires.

Its mission now, as when established, is to make London’s data accessible for all and encourage its use to fully realise the potential social, economic and environmental value it can bring.

The London Datastore use has more than quadrupled since its launch in 2010, now with around 50k users each month (with a high spike of over 70k during the London elections of 2016).

Figure 14: *Growth in Datastore users by month*



Users vary from local government (for policy analysis & making), academic research and for commercial use.

Some of the most popular datasets this year have been:

- Number of International Visitors to London
- Rough sleeping in London (CHAIN reports)
- GLA Population and Household Projections

Moving beyond open data means sharing and using city data more effectively. This will deliver improved public services, more efficient infrastructure, and wider data-led innovation. City data is more than just open data, but also private data, commercial data, sensor data, and crowd-sourced data—such as:

Open data: non-privacy-restricted and non-confidential data.

Private data: restricted and/or licensed data including permission, privacy, publication and distribution; as well as data that is presently held privately merely because it has not yet been recognised to offer value.

Commercial data: licensed data including permission, charging for access, use and distribution.

Sensory data: open and/or restricted data collected by sensors, actuators and devices owned by public and private sector, and citizens.

Crowd-sourced data: data provided, collected and distributed by citizens using digital technologies and social media.

5.2 Data Analysis

The Data used to create the two graphs below were taken from the London Datastore, that is a free and open data-sharing portal, where anyone can access data relating to the capital. In particular, the analysis focused on the energy consumption from 2011 to 2014 and on the average temperature; to facilitate the understanding of the energy consumption, a comparison with the smart meter user count series has been presented.

First, the first step of the analysis consisted in the creation of a table named “all_year_month_eng_wth” which consolidates total energy consumption required per month and average temperature in that month. Those steps lead to the creation of the dataset for the two graphs presented below.

```
all_block.year_month_grp_eng <- all_block %>%
  group_by(year_month) %>%
  summarise(energy_sum_mean = mean(energy_sum),
            energy_sum_total = sum(energy_sum),
            LCLid_uniq_count = length(unique(LCLid)),
            n=n())

wth_daily.year_month_grp_wth <- wth_daily %>%
  group_by(year_month) %>%
  summarise(avg_temp_mean = mean(avg_temperature),
            n=n())

all_year_month_eng_wth <-
  inner_join(all_block.year_month_grp_eng,wth_daily.year_month_grp_wth,by
    ="year_month")
```

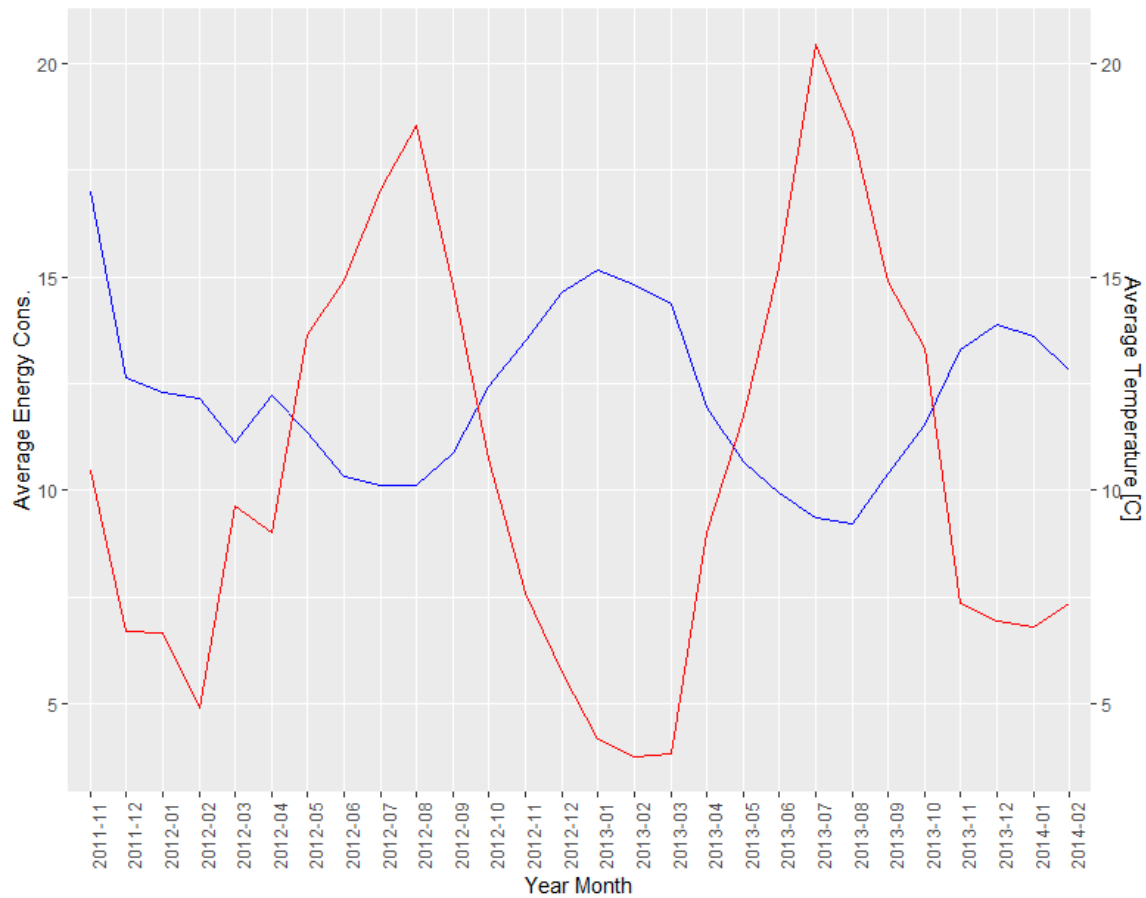
a. The trend of Average Energy Consumption and Average Temperature

To stress out the trend of energy consumption based on years and the weather situations, two separate tables have been created with the aim of showing the energy consumption through a selected sample from whole population from different acorn groups. Based on the first table, the below graph has been created to show how energy consumption changes based on the average temperatures of a specific month.

The dataset created previously has been used to as a basis for the first graph shown below. In particular, the function “ggplot” from the R package has been used to create the time series graph. The data used are Average Energy consumption and Average temperature.

```
ggplot(all_year_month_eng_wth,aes(x = year_month)) +
  geom_line(aes(y=energy_sum_mean,colour="Energy Cons."),group=1,colour="Blue") +
  geom_line(aes(y=avg_temp_mean, colour = "Avg. Temperature"),group=1,colour="Red")
+
  scale_y_continuous(sec.axis = sec_axis(~.,name = "Average Temperature [C]")) +
  labs(y = "Average Energy Cons.",
       x = "Year Month",
       colour = "Parameter") +
  theme(legend.position = c(0.8,0.9),axis.text.x = element_text(angle = 90,hjust =
1))
```

Figure 15: average energy consump vs average temp



The three-dimensional graph above presents a time series with monthly data: the X axis represents the time, starting from November 2011 to February 2014, the Y axis on the left represents the Average Energy consumption instead the Y axis on the right represents the Average Temperature [C]. The blue line represents the Average Energy Consumption and the red one the Average Temperature. As resulted, energy consumption decreases as the temperatures increase and energy consumptions increase as the temperatures decrease; this implies a negative correlation between the two variables. The negative correlations can be easily observed after February 2012.

However, there are some unusual results as well, such as the data on 2011-11 that seems uncommon due to the peculiar situation because although the average temperature on that month is quite average, energy consumption on 2011-11 represents the highest amount in the entire sample data.

Moreover, the lowest values of the Average Temperature were measured during the first month on 2013, while the highest values on July of the same year. For the Average Energy

Consumption, as outlined before, the highest value appeared on November of 2011, while the lowest on August of 2013.

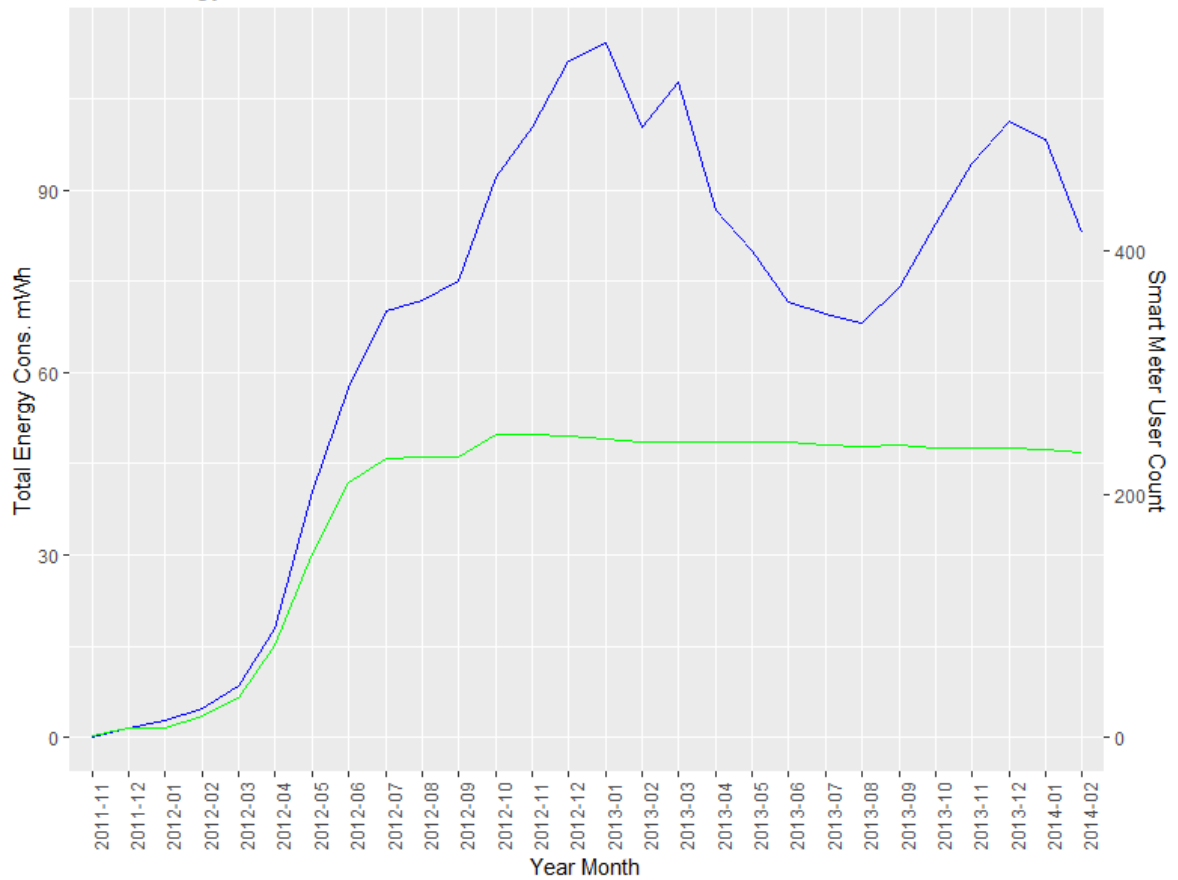
b. Total Energy Consumption and Smart Meter User Count

In the next graph, the smart meter ID count has been analysed by comparing the total energy consumption of that specific year_month. To better track the energy consumption, the government has expressed the willing to have energy suppliers to install smart meters in every home in England, Wales and Scotland. There are more than 26 million homes for the energy suppliers to reach out to, and the government's goal is install in every home a smart meter by 2020.

The second graph is based on a dataset, which has been previously created. In particular, the function "ggplot" from the R package has been used to create the time series graph. The data used are Total Energy consumption and Smart meter user count.

```
ggplot(all_year_month_eng_wth,aes(x = year_month)) +  
  geom_line(aes(y=energy_sum_total/1000,colour="Energy  
Cons."),group=1,colour="Blue") +  
  geom_line(aes(y=LCLid_uniq_count/5, colour = "User Count"),group=1,colour="Green")  
+  
  scale_y_continuous(sec.axis = sec_axis(~.*5,name = "Smart Meter User Count")) +  
  labs(y = "Total Energy Cons. mWh",  
       x = "Year Month",  
       colour = "Parameter",  
       title = "Total Energy Cons. vs Smart Meter User Count") +  
  theme(legend.position = c(0.8,0.9),axis.text.x = element_text(angle = 90,hjust =  
1))
```


Figure 16: total energy consump. Vs smart meter user count
Total Energy Cons. vs Smart Meter User Count



The graph above is a time series graph with monthly data: the X axis represents the time, starting from November 2011 to February 2014, the Y axis on the left represents the Total Energy Consumption in mWh while the Y axis on the right represents the Smart Meter User Count. The blue line represents the Total Energy Consumption and the green one the Smart Meter User Count.

Both series have a deep increase from November 2011 to June 2012; after this month the series that represents the Smart Meter User Count become stationary for the remaining observations, with a low-level increase between September and October 2012.

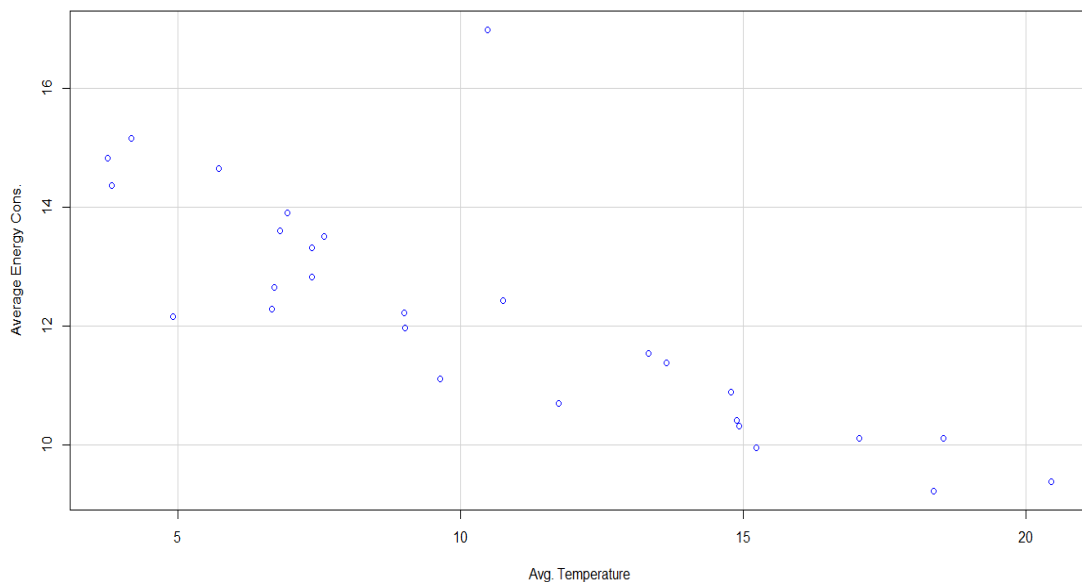
With respect to the Total Energy Consumption the series continues to grow until it reached the highest peak in January 2013. After that specific year, the series has experienced a decrease, which lasted until August of the same year when it started to grow.

5.2.1 Correlations

From the same dataset described previously, in this section I investigate the relationships between energy consumption, average temperatures and the use of Smart Meters. In particular, I used two scatterplots to evaluate correlations: in the first plot (a) we depict the average energy consumption and the average temperature. As we might expect, the consumption reduces as the temperatures raise, but we do not see a clear negative correlation that would have been the signature of highly optimized consumptions.

In the second plot (b) it is shown how the total consumption relates to the usage of smart meters; in this case there is no clear trend.

a. The trend of Average Energy Consumption and Average Temperature

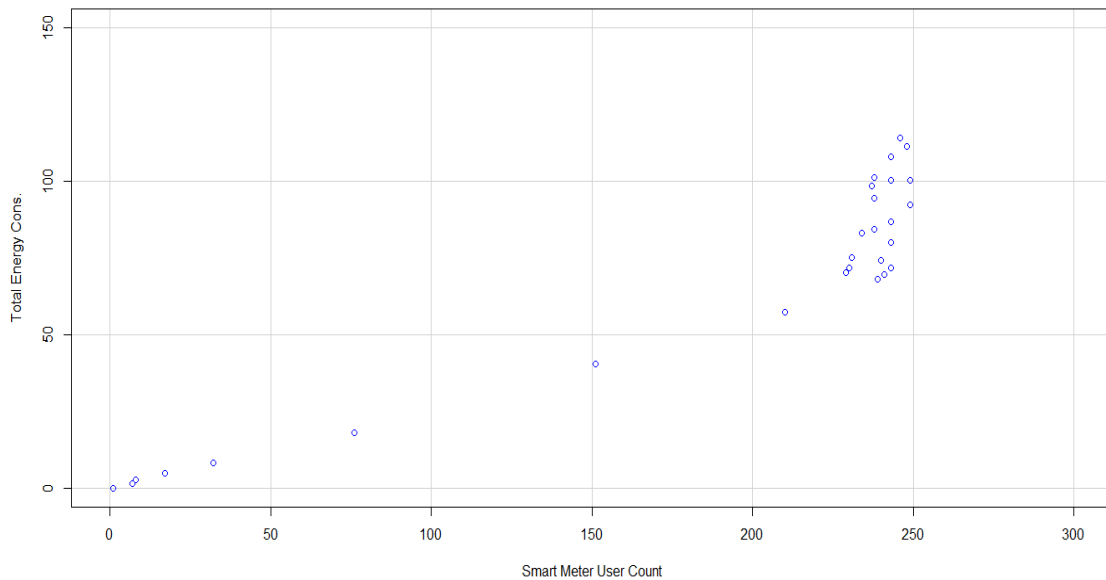


The graph above has the average temperature on the X axis and the average energy consumption on the Y axis. High average temperature values, high average temperature

values, minimum values of average energy consumption. Therefore, the presence of a negative correlation between the two variables is confirmed.

```
scatterplot(energymean ~ avgtempmean,  
            boxplots=F, regLine=F, smooth=F, ylab="Average Energy Cons.", xlab="Avg.  
            Temperature")
```

b. Total Energy Consumption and Smart Meter User Count



The graph above has the Smart Meter User Count variable on the X axis and the total energy consumption on the Y axis. For low values the two variables seem to grow together; however, the Smart Meter User Count variable takes on many values between 225 and 250 (stationarity of the previous graph), thus creating a point cloud.

```
scatterplot(energytotal ~ usercount,  
            boxplots=F, regLine=F, smooth=F, ylim=c(0,150), xlim=c(0,300),  
            ylab="Total Energy Cons.", xlab="Smart Meter User Count")
```

Conclusion

The aim of this dissertation is attempting to define the reference picture of a recently emerged phenomenon that finds its place in urban settlements and involves a great number of issues that are too emerging ones in the temporal span of years corresponding to the second half of the last century: the *smart city*.

With respect to the urban context new trends have been acquiring more and more relevance and requiring new political strategies, not only on a local level, but also on the national, international and global ones: uncontrolled urbanization, pollution, natural resources consumption and scarcity and climatic changes are few examples of the ones strictly related to scope of the work.

Only half a century ago, there were twice as many people in the world living in rural settings (2 billion) versus urban (1 billion). Over the second half of the 20th century this gap shrunk, not as a result of absolute declines in rural population, but due to a rapid growth in urban areas. In 2007, rural and urban populations were approximately equal in size — both at 3.33 billion people. Since 2007 urban population has continued to increase rapidly while rural population has grown only marginally. In 2016 it has been estimated that 4 billion people lived in urban areas, and 3.4 billion in rural areas.

By 2050, global population is projected to increase to around 9.8 billion. It is estimated that more than twice as many people in the world will be living in urban (6.7 billion) than in rural settings (3.1 billion).

The crisis of the traditional living urban model produced by such uncontrollable change requires therefore, a radical change in urban policies too, since until now in most parts of the world uncontrolled urbanization has produced extremely poor living environments (slums). All the international agencies are trying to solve the problem; indeed this topic has become a common one in the agendas and annual meetings of the UN or UE.

Another relevant process is though taking place and it offers one of the most efficient means to satisfy modern exigencies and to help the resolution of the urban problems: the Information and Communication Technologies diffusion. The role of ICT in cities'

planning and management is destined to bring improvements in terms of citizens' life quality under many aspects, such as enhancing the process of, information sharing and of virtually connecting the citizens to the core of the *digital city*.

Therefore, the modern city management solution directly derives from the concept of the *smart city* that not only does exploit the ICT, but in the best cases produces new knowledge and promotes the city sustainability, helping in reducing resources waste and CO2 emissions, increasing infrastructures efficiency and safety, favouring the renewable resources energy production and protecting the cultural heritage.

The smartness of a city is measured in its capacity of integrating in one platform the manifold initiatives related to a great number of different contexts. A focus on the Colombian city of Medellin has been made because it well shows how the change into a *smart city* does not only affect the people's life with respect to the new infrastructures provided, the care for the environment, the attention to cultural opportunities, but it is also been an impressive opportunity for the moral rebirth of its population.

Other cases as well have reported, as for instance Copenhagen, with its waste transforming plant, an architectural and recreational landmark to be enjoyed by all its citizens and tourists, or the case of Cagliari in Italy to stress how the role of ICT can help the change of a city's liveability and security. All those cases represent the evidence of the fact that the *smart city* model is not only the product of a one-direction flux emanated from above - that is from the city's management to arrive to its citizens – but also it is a two-direction flux having as a starting point the inhabitants of a city, actively engaged in the search for the solution of their problems. They can really act as one of the fundamental parts in the urban areas objectives reaching and in the innovation transforming process.

The connection between the city changing process and the technological innovation is destined to become more and more tight. Therefore, the *smart city* model is no more one of the options at disposal, but an option that cannot be discarded in the world as it is presenting today.

Developing hypothesis on the future city shape is a very complicated, which may also appear even pleonastic, due to the fact that in the last decades some experts have been predicting disappearance of the cities, caused by the invading digitalization revolution. In today's real world, instead, technology does represent an indispensable tool, crucial for identifying and solving more and more complex issues. The emergence of one time unconceivable problems and needs does require a continuous process of adaptation and transformation. In this frame, the *smart city* fits as the place, the setting and the creative environment where solutions can be created and enacted.

References

- Cocchia A., Dameri R.P. (2013) “*Smart and digital city: twenty years of terminology evolution*” in ItA/S 2013, *X Conference of the Italian Chapter of A/S*, Milano, 14 Dicembre 2013
- Dameri R.P., Rosenthal-Sabroux C. (2014), *Smart City. How to Create Public and Economic Value with High Technology in Urban Space*, Switzerland, Springer International Publishing AG
- European Commission (2010), *How to Develop a Sustainable Energy Action Plan (SEAP). Guidebook*, Luxemburg
- European Commission, Mobility and Transport DG (2011), *Intelligent Transport Systems in Action, plan and legal framework for the development of intelligent transport systems (ITS) in Europe*, Luxemburg
- European Commission (2012), *Smart Cities and Communities. European Innovation Partnership*, (2012) 4701 final, Brussels
- European Parliament-Internal Policies DG (2014), *Mapping Smart Cities in EU*, Luxemburg
- Iacovone D. (2014) *I servizi di pubblica utilità tra Stato, mercato, regolatore e consumatore*, Bologna, Il Mulino
- ISTAT 2011, *Cittadini e Nuove Tecnologie*, Roma 18 dicembre 2011
- Riva Sanseverino E., Riva Sanseverino R, Vaccaro V. (a cura di) (2015) *Atlante delle smart city. Comunità intelligenti europee ed asiatiche*, Milano, Franco Angeli
- The European House-Ambrosetti, ABB Group (2012), *Smart Cities in Italia: un’opportunità nello spirito del Rinascimento per una nuova qualità della vita*, Milano
- European Commission 2010, *A Digital Agenda for Europe*, COM(2010), Brussels
- European Commission 2010, *The European Strategic Energy*, Brussels
- UN Agenda 2030, New York, 2016
- UN-Habitat 2012, *State of the World Cities 2012-2013, Prosperity of the Cities*, Nairobi, Kenya
- Ipcc 2018, *Sixth Assessment Report, (AR6)*, Seoul, South Korea
- Technology Plan, *Toward a Low-Carbon Future, Luxemburg, How to Develop a Sustainable Energy Action Plan (SEAP)*, Guidebook, Luxemburg

Marciano C. 2015, *SMART CITY. Lo spazio sociale della convergenza*, Edizioni nuova cultura, Roma

Rhodes and Shwartz 2013, *A Vision Becomes Reality*, Corporate Stories, Munchen

Energy&Strategy Group(2014), *Rinnovabili non Fotovoltaiche Report*, Maggio 2014, Politecnico di Milano

Janssens-Maenhout G., Oliver J.G.J., Peters J.A.H.W. (2012), *Trends in Global CO2 Emissions.2012 Report*, The Hague, Pbl Netherlands Eaa; Ispra, Jrc

Morabito R., Ronchi E., (a cura di)9 (2012), *Green Economy per uscire dalle due crisi. Rapporto 2012*, Milano, Edizioni Ambiente

Unep (2012), *Towards a Green Economy: Pathways to Sustainable developmen and Poverty Eradication*, Geneva

World Business Council for Sustainable Development (2004), *Mobility 2030: meeting the challenges to sustainability. Report 2004*, Geneva

World Business Council for Sustainable Development (2010), *Vision 2050: The new agenda for business*, Geneva

United Nations(2015), Department of Economic and Social Affairs, Population Division, *World Urbanization Prospects: The 2014 Revision*, New York

Sitography

AA. VV: (2013), *Smart Cities: theorethical framework and measurement experiences*. MPRA Paper 5020, 26 September.

Available at the address: https://mpra.ub-muenchen.de/50207/MMPRA_paper50207.pdf.
Last access: 14/3/2019.

Innova Puglia (2012), *AgID 2012, Architettura per le comunità intelligenti. Visione Concettuale: raccomandazioni alla pubblica amministrazione*. Available at the address: [hhttps://www.innova.puglia.it/documents/10180/38425/ArchSC.pdf](https://www.innova.puglia.it/documents/10180/38425/ArchSC.pdf). Last access: 3/4/2019.

Visit Denmark (2017), *Amanger Bakke/ Copenhill*. Available at the address: <https://www.visitdenmark.it/denmark/explore/amanger-bakke-gdk108237>. Last access: 15/4/2019.

ANCI (2013), *Vademecum per la città intelligente*, Osservatorio nazionale Smart City, FORUMPA; Rome, October.
Available at the address: <http://osservatoriosmartcity.it/il.vademecum/>. Last access: 20/02/2019.

Osservatorio Smart City (2013), *Cassa Depositi e Prestiti SPA 2013, Smart City. Progetti di Sviluppo e strumenti di Finanziamento*. Available at the address: <http://osservatoriosmartcity.it/smart-city-progetti-di-sviluppo-strumenti-di-finanziamento-lindagine-di-cassa-depositi-prestito/>. Last access: 3/3/2019.

Comune di Cagliari (2018), *Comune di Cagliari. Smartcityness 2018*. Available at the address: www.smartcityness.it/project/comune-di-cagliari/. Last access: 22/2/2019.

European Platform on Sustainable Urban Mobility Plans (2014), *Guidelines. Developing and implementing a sustainable Urban Mobility Plan*.
Available at the address: <http://www.eltis.org/files/sump.Guidelines.en.Pdf>. Last access: 14/2/2019.

Fondazione Impresa (2011), *Definizione di Green Economy*. Available at the address: <http://www.fondazioneimpresa.it/arcchives/1386>. Last access: 20/1/2019.

Corriere dell'Economia (2018): *Huawei e Università di Cagliari, al via una cooperazione*. Available at the address: <https://www.corrieredell'economia.it/2018/09/21/huawey-e-università-di-cagliari-al-via-una-cooperazione/>. Last access: 14/3/2019.

FORUMPA (2018), *ICityRate2018-La classifica delle città intelligenti italiane. Settima Edizione*. Available at the address: <https://www.forumpa.it/ICityrate2018la-classifica-delle-città-intelligenti-italiane-settima-edizione/> Last access: 4/3/2019.

ISTAT (2017). *ISTAT 2017, Cittadini e nuove tecnologie*. Pdf document. Available at the address: <https://www.istat.it/it/archivio/cittadini/-e-nuove-tecnologie>. Last access: 11/3/2019.

TDM Project (2017): *Tessuto Digitale Metropolitano:TDM*. Available at the address: www.tdm-project.it/ Last access: 21/3/2019.

UN (2013): *UN Sustainable Development Goals*. Available at the address: <https://sustainabledevelopment.un.org>. Last access: 30/3/2019.

UN Environment Agency (2015): *About green economy/UN Environment*. Available at the address: <https://www.unenvironment.org/explore-topics/green.economy/about-green-economy>. Last access: 5/5/2019.

Tan Wee Kwan (2016), *Medellin, from violence to urban innovation*. Available at the address: <https://www.enterprisainnovation.net/article/smart-city-profile-medellin-408607735>. Last access: 5/4/2019.

UN Agency for Climate Change (2018): *UN Report on Climate Change*. Available at the address: <https://www.un.org/en/sctions/issue-depths/climate-change/>. Last access: 12/5/2019

UN Report: *'Nature's Dangerous decline Unprecedented; Species Extinction Rates Accelerating'*. Available at the address: <https://www.un.org/sustainabledevelopment/blog2019/05/nature-dangerous-decline-unprecedented/>. Last access: 22/5/2019.

Greater London Authority (2019): *'London Datastore '*. Available at the address: <https://data.london.gov.uk>. Last access: 6/6/2019

Kaggle Inc: (2018): *'London Smart Meter Analysis Project'*. Available at the address: https://storage.googleapis.com/kaggle-forum-message-attachments/266676/8231/BDA503_Project_SPACE.html . Last access: 17/6/2019

Executive Summary

The tumultuous growth of **urbanization** that has been taking place in all continents since the second half of last century presents problems with respect to the traditional cities that have to be faced in innovative, sustainable and future projected ways.

Policy makers have therefore had to find new solutions to be adopted in the new urban contexts and, thanks to the innovations that have been realized in that same period, a new concept of city has originated, the '*smart city*'. The **definition of '*smart city*'** has been continuously changing since new aspects and needs have been emerging in time too, but today we can in a wide sense say that a city is *smart* when it is intelligent, and it is intelligent when the investments made in the human and social capital, those related to technological innovation, communication and transport are all applied to the benefit of sustainable development, its inhabitants quality of life, a careful management of the natural resources and the active participation of the whole community.

The stress in the definition has more and more been put on the citizens and their needs and now we can say that the *smartness* of a city is a sharing, active, distributive, democratic, society-oriented smartness, such as facilitating the participation and integration both of the citizens and the community with the perspective of sustainability in the management of the resources – the resources being not only the natural and environmental ones, but also the social and economic ones.

The role of **ICT** (Information and Communication Technologies) is essential to a city in order to define it as a *smart city* since the massive use of it is necessary in monitoring and facilitating everyday citizens' actions, in recording results, in sharing informations and data, in enhancing community interplay. ICT is therefore the fundamental element when a *smart city* is to be planned since those technologies affect net connections, advanced transport systems, infrastructures and renewable energies.

A *smart city* therefore, even when it is not a completely sustainable city, is at least a social community in evolution, planned to grow and last in time, to compete as to its economy, welfare and social inclusion.

Studies on the matter have identified six dimensions a city has to possess in order to be defined *smart* and they are: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance.

Smart economy: through new technologies it directs the producing system towards better behaviours with the aim of satisfying companies, citizens and environmental needs. In a

world that is becoming economically and financially more and more complex, the smart economy interacts with innovating elements such as enterprise incubators, research centres or the so-called Living Labs. The Living Labs are a new approach to research activities since they are based on a co-projecting and co-creating vision, that is they invite citizens to co-operate with the reserchers, thus becoming ‘inventors’ or creators of new products aimed at satisfying their own needs.

Smart mobility: it is the new form of mobility that not only reduces waste and pollution, but also improves logistics and transport infrastructures and reduces costs. Mobility and movements of people and goods are now to be planned through ICT and made easier and cheaper so that the standards and everyday quality of life can be environmentally sustainable and responsive. *Smart mobility* offers to citizens more comfortable and sustainable solutions through continuous updating: fast lanes, cycle paths, pay tolls, car sharing, car pooling are just a few examples of the new ways that *smart cities* are encouraging citizens to use.

Smart environment: protection of the environment is a central issue in a *smart city*: ‘green’ themes like sustainability and energetic efficiency are involved in it. In the creation of a *smart environment* the separate collection of household waste, the recycling processes and the renewable energy sources get a primary role together with the adoption of sustainable buildings and the consequent reduction of pollution due to heating.

Smart people: a *smart city* originates from the participation, the involvement, the dialogue, the interaction, the engagement of each single inhabitant of it. One of the features of the *smart city* is the promotion of its human capital (smart people): there couldn’t be any smart initiatives without ‘smart’ people. The city management’s objective is therefore to develop computer skills in its citizens so that they can have access to the services based on ICT, but their objective is also to stimulate their creativity so that they can take an active part in the innovation process.

Smart Living: it is the way the people in a *smart city* behave: it refers to their life style, to their lives quality and to their consumption habits. It is the field where the most important public actions are taken as to health care, security, tourism and culture. ICT have a central role since through them it is for instance possible to improve services and reduce times in health care services or provide security systems to the advantage of citizens.

Smart governance: The aim of smart governance is to link and integrate all the public, private, civil and European bodies in order to let the *smart city* work efficiently as a complex organism. The instruments used to create the connection, to grant transparency, to remove obstacles to the innovative development are the ICT and the first step to be made is the creation of a digital identity.

The above features are the first real attempt to give a definition of the concept of *smart city* and to provide a frame of a smartness city assessment. They are the result of the work carried out between 2013 and 2014 by the Politechnics in Wien and Delft and the University in Ljubljana. Indicators inside their researchers' teams have then been identified through which it is possible to classify a city *smartness*. On the basis of the cities strength and weakness points policy makers find and plan the political choices best suited to solve the problems and turn their city into a smart one.

In Italy **FORUMPA Srl FPA** creates an annual report and a list of the smartest Italian cities among regional capitals based on the indicators related to the six thematic areas already seen plus one: Smart Economy, Smart Living, Smart Environment, Smart People, Smart Mobility, Smart Governance and Smart Legality. From their synergy a synthesis value is obtained: the ICity Index. In 2013 the "*Vademecum for the smart city*" was published by the Smart City National Observatory and ANCI, together to the above mentioned FORUMPA. Its aim was to provide with researches, analyses and plan models those Italian administrations wishing to start a change into smartness. Four pre-requisites are listed for the administrators that feel the need to change their city into a smart one: to have an idea of the city, to have a plan, to have the resources, to have the needed organization. The *Vademecum* presents too the seven steps the city change programmers have to go through, all originating from the city specific features and the potentialities it presents toward changing: analyzing the territory, knowing its needs and its resources, mapping the stakeholders, involving stakeholders and citizens, organizing the governance competences and the smart city financing, measuring and monitoring the results.

The **ICRate 2018** presents the classification of the 107 Italian provincial capitals into five analysis macro dimensions each containing three indexes: Economy (Economic Solidity, Job Opportunities, Innovation and Research), Society (Education, Social Inclusiveness, Touristic Attractiveness), Environment (Air and Water Quality, Urban Green Areas, Territory and Soil), Governance (Citizens Participation, Legality and Security, Digital Transformation), and Functional Services (Energy, Urban Waste Treatment, Sustainable Mobility). Each index is defined through a different number of indicators that in total are

107. As a conclusion it is possible to state that in this last edition the level of the objectives a city has to face has been improved.

In the **ICityRate 2018** Milan confirms as the most advanced Italian city trying to make the widest use of the urban *smartness* instruments to promote and manage development in sustainable ways. It is followed by Florence and Bologna that more and more get a role of reference models for the other urban realities. 11 out of 21 cities in the first positions belong to the group of the “Small Capitals”. Among them we find Bergamo, Parma, Pisa and Reggio Emilia but also Padua, Ravenna Modena Mantua and Bolzano. All of them, but Pisa, located in the area made up by the Northern-Eastern regions and Lombardy. Even if they present differences, the model applied seems to be founded on an approach tending to a well-balanced search for the objectives of intelligent and sustainable growth in all the different dimensions. A novelty is the dynamism presented by seven urban realities all in Northern Italy – Podenone, Cremona, Udine, Treviso, Biella, Lodi and Belluno – that gain the most significant improvements in the general chart thanks to the combination of innovating areas, good Functional Services Management and Legality and Security. The most imponent progresses have in fact been made by small or medium size cities (all below 100,000 inhabitants). A few of these cities (Belluno and Pordenone, but also Treviso, Lodi and others) are characterized by their excellent performance in Innovation and Research thanks also to the presence both in the urban area and in their territory of the concentration and promotion of productive innovation. The traditional distance between North and South is confirmed in the urban conditions not only in the traditional disadvantaged areas as Job Opportunities and Economic Solidity but unfortunately also in the more innovating sectors Innovation and Research, Digital Transformation and Energy. It will be necessary to get to the 43rd position in the general list – between the intermedium and the medium-high - to find Cagliari, the first in the South and in the Isles, and then to go down to find L’Aquila, Lecce, Pescara and Bari at the 67th position. All the last twenty positions are held by Southern cities. Cagliari stands out for its very good placement, from the 47th in 2017 to the 43rd, thanks to its very high values in Urban Green Areas, Education, Security and Legality. But it is thanks to its administration interest toward Innovation that Cagliari is going to be one of the smartest cities in Europe. The Sardinian capital for some time has been at the centre of researches as to *smart development of the cities in the new millenium*, at the **CRS4 (Centro di Ricerca, Sviluppo e Studi Superiori in Sardegna)** at Pula - 15 kilometres from Cagliari

- inside the Regional Scientific and Technologic Park, a system of more than 50 companies working in the sectors of ICT, biotechnologies and energy and attracting researchers - and capitals - from all over the world. A very important project that has been started at the CRS4 is that of the “Tessuto Digitale Metropolitano TDM” in collaboration with the University of Cagliari. The project (2017-2021) aims at offering innovative and smart solutions to increase city attractiveness, resource management efficiency and the safety and quality of life of citizens, through the study and development of enabling technologies and innovative vertical solutions for the protection from environmental risks, the energy efficiency awareness and the cultural heritage management. Methods and applications are being tested and validated in the city of Cagliari, using advanced communication infrastructures and a widespread distributed sensor network.

Some of the indicators used in the 2018 edition of the ICityRate have been changed to suit better the new needs originated by a transforming reality but above all to fit with the goals listed in the **UN Agenda 2030** for sustainable development. The goals are 17 with 169 associated targets which are “integrated and “indivisible”. The Agenda was issued in New York at the Nations Headquarters on 25-27 September 2015 on the occasion of the celebrations for the UN seventieth anniversary. Its declared aim is to stimulate action over the next 30 years in issues of critical importance for humanity and planet such as sustainability and climatic changes. Also, the goals contained in **Europe 2020** have been taken into consideration in framing the Italian ICityRate. Europe 2020 is a 10-year strategy proposed by the European Commission on 3 March 2010 for the advancement of the economy in the European Union. It aims at "smart, sustainable, inclusive growth" with greater coordination of national and European policy. It follows the Lisbon Strategy for the period 2000–2010.

Europe 2020 strategy identifies five headline targets the European Union should take to boost growth and employment: to raise the employment rate of the population aged 20–64 from the current 69% to at least 75%; to achieve the target of investing 3% of GDP in R&D in particular by improving the conditions for R&D investment by the private sector and developing a new indicator to track innovation; to reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if the conditions are right, increasing the share of renewable energy in final energy consumption to 20%, and achieving a 20% increase in energy efficiency (**20-20-20 target**); to reduce the share of early school leavers to 10% from the current 15% and increase the share of the population

aged 30–34 having completed tertiary education from 31% to at least 40%; to reduce the number of Europeans living below national poverty lines by 25%, lifting 20 million people out of poverty. Within the above presented international frame and the agreements subscribed, a great number of experts, national agencies and institutional bodies are working in Italy on different political levels in order to produce proposals to help Italy change into a smarter country and confronting their efforts in a lot of different meeting opportunities, the most important of them being surely the annual House-Ambrosetti Meeting. The **Italian Digital Agency (AgID)** has been identified as the agency better suited to accompany the Italian public administrations in their transforming process into *smart cities*. AgID is an Italian public Agency started in 2012 under the Government of President Monti working under the controlling and addressing power of the Cabinet and acts in conformity to the functions and tasks given to it by law. Its task is to manage the implementation of the Italian Digital Agenda's objectives, in coherence with the EU Digital Agenda and to contribute to the diffusion of new information and communication technologies, with the aim of fostering innovation and economic growth. It coordinates the activities of the State, the regional and local administrations, designing and monitoring the evolution of the IT system of the Public Administration.

There are a great number of **smart urban solutions all over the world**, even though a fully *smart* city doesn't appear to exist. Usually *smart* projects and actions are made on already existing urban areas, therefore focusing on specific aspects and that is what has happened with all the existing *smart cities*. Hong Kong has focused on mobility and has introduced the "*Mobility Card Octopus*" that can be used on the local transportation means but is also usable for other kinds of public services and can even be used as credit card. Singapore has concentrated on the Health System, and in 2009 has started the project "*National Electronic Health Records*" involving all the health public structures. Thanks to it is possible to access to any information in every citizen's medical record in real time, thus greatly reducing costs. London has instead reached great results investing on digital technologies. Other important European cities are on the way to success in trying to change into *smart cities*. Good examples are Barcellona, Helsinki, Manchester, Wien and Barcellona. In all of them the factors leading to the successful realization of the different projects can be resumed in the following three ones: having a clear vision; involving citizens and local enterprises; enacting the processes efficiency.

A very striking example of *smart city* is the **Colombian city of Medellin**, a city that has gone from being known for its security problems to being an international reference for technological and social innovation, urban transformation, equity, and citizen participation. A city where the homicide rate was up to 10 years ago of 381 for 100,000 residents and has now reduced by 80% through a policy that has seen the citizen and his trust in institutions at the center of the transformation process into a *smart city*. This process has given back dignity to the citizenship because centered around a change where every citizen is protagonist and proud of his new, innovative city. Medellin has implemented a series of strategies developing the capacity and the organic structure of all the agencies that control mobility, the environment, and security, and all of them share one characteristic: they are aimed at serving the citizens, and they have created mechanisms to communicate and interact with them to promote the continuous improvement of smart services. Through the Program “**MDE: Medellin Smart City**” Medellin is implementing projects to create free Internet access zones, community centers where ICT can be accessed, a Mi-Medellin co-creation portal, open data, online transactions, and other services that aim to achieve citizen participation, open government, social innovation in problem solving, and project sustainability. Based on the slogan: “Medellin: From Fear to Hope”, its Government has worked on reducing poverty and violence by simultaneously attacking both problems. The idea was to increase opportunities for both employment and business generation and reduce social inequality through educational policies and specific architectural projects. By means of integrating architectural projects such as parks and libraries in marginalized sectors, and modernization of schools within the framework of “Medellín, the most educated” policy, the indexes of violence and insecurity have been reduced, as well as the social exclusion, within very few years. The city today can boast Colombia’s only municipal rail network that has won a bevy of global awards since it opened over 20 years ago: modern, efficient, clean and cost-effective the Metro is integrated with Metrocable, a gondola system that carries commuters from the mountains above the city down to the valley and city center. The Library Parks - located strategically in vulnerable areas of Medellin taking into account demographic, urban, social and cultural aspects, in which it was necessary to raise the quality of life of the citizens and rebuild the social fabric for governance - contain beautiful buildings whose projects were oriented towards the urban and architectural transformation of the city, thanks to the innovative designs that attract the attention of the citizens. *El Cinturon Verde Metropolitano*, or metropolitan greenbelt, almost 50 miles

long (75 kilometers), whose project is being built in four phases and seeks a completion date in 2030, includes community gardens, recreational spaces, hiking trails and improved housing for some of the city's poorest residents. So far, the city has planted more than 120,000 native plants and trees on 85 hectares of land helping restore the ecosystem on the sloping outskirts of the city. Of this rehabilitated land, almost 2,500 m² has been transformed into terraced gardens – mitigating the risks of climate change by better protecting the land and its residents from landslides while providing residents with spaces to grow food. Other important projects are related to public health, transparency and governance. What up to twentyfive years ago was a place of poverty, corruption and fear, thanks to the brave choices made by its political leaders and to their capacity of vision, has now become one of the smartest cities not only in South America but in the world.

At the basis of any *smart city* project **protection of the environment** and **sustainability** are the issues that cannot be any more eluded, both linked to the problems of the natural resources' scarcity and the demographic increase. A new economic model called **Green Economy**, whose objective is keeping together both the scarcity of the existing resources and the sustainable development, is therefore being studied and applied wherever it is possible. The demographic growth, accompanied by the increasing urbanization of the world's population, is an issue that is menacing the management and liveability inside urban areas and is causing a new awareness as to the inefficiency of the existing models and the need for completely different actions by the politic authorities. The concept of *Green Economy* is in progress and therefore it is difficult to find a definition both univocal and exhaustive, but we can refer to the UNEP (United Nations Environment Programme) according to which it is to be meant as “a kind of economy whose goal is human wellness and social equity, significantly reducing environmental risks and ecological scarcity”. *Green economy* is therefore a theoretical model of economic development considering, beside the benefits resulting in a given productive contest, also the environmental damages caused by the whole transforming process, with the aim of optimizing the economic circuit and granting future generations needs. Six strategic sectors through which it is possible to develop *Green Economy* have been identified and they are: energy efficiency and conservation; renewable sources development; resources efficient usage, waste prevention and recycle; sustainable mobility; eco-innovation; ecologically quality agricultural production. The energetic efficiency and the energy rational use are the two pillars of energy conservation. Through the first one we mean the reduction – keeping the

same objective to reach and by the use of the right processes and technologies – of the primary energy consumption. Through the expression ‘rational use’ instead the optimization of energy use - with respect to the needs thus reducing both consumption and costs - is meant. A further solution helping not to cause permanent environmental damages to a manifold number of *habitat* and to protect the life of future generations is the use of renewable energy sources. Some renewable resources (the solar irradiation, the wind, the tides and the marine streams) can be used to produce energy (chemical, mechanical, thermal or electrical) and are called **renewable energetic sources (RES)**. In Italy as well, the RES has acquired a great importance and in 2018 they have supplied 32,4% of the total both for industrial and for domestic use. RES is considered energetic flux sources, in opposition to stock energetic sources and their present use doesn’t affect the future use of them. Those usually exploited in electric power generation are: the hydraulic source, the geothermic source, the aeolian source, the solar source and the biomasses. Studies and researches are at present being made to get to the power production through the wave motion and the tide-moving force too. At the basis of *green economy*, the precept of the waste management is tightly related since a greater waste production is the result of the greater usage of resources and of energetic and material consumption. The fourth sector of *green economy* is sustainable mobility meant as the ability of meeting the desires and needs of the citizens to move freely, to communicate, to exchange and establish relationships without putting at risk other human and ecological essential values both for today and the future. At present the transportation sector is one of the most responsible for gas emission with greenhouse effect and in general for the global pollution levels. In agriculture the present one-dimensional physical and chemical production systems should be replaced by an agricultural paradigm that rely more on biology and ecology and meet global food needs based on the soil, water, land and fertility resources without compromising the capacity of future generations in meeting their environmental, food and resource needs. The EU commission has felt the urgency to improve its policy and on 1 June 2018 it presented legislative proposals on the common agricultural policy (CAP) beyond 2020. These proposals aim to make the CAP more responsive to current and future challenges such as climate change or generational renewal, while continuing to support European farmers for a sustainable and competitive agricultural sector.

When dealing with *green economy* it doesn't seem possible not to make mention of a phenomenon that in the last years is having enormous effects on the world environment, on man's life conditions and health. The **climatic crisis** is a change in the long run of the atmospheric phenomena due to the increase of the Earth's temperature caused by the exceeding amplification of what is a natural phenomenon: **The Glasshouse Effect**. The world's leading climate scientists have warned there is only a dozen years for global warming to be kept to a maximum of 1.5C, beyond which even half a degree will significantly worsen the risks of drought, floods, extreme heat and poverty for hundreds of millions of people. The WMO (World Meteorological Organization) Greenhouse Gas Bulletin reports on atmospheric concentrations of greenhouse gases in the earth's atmosphere. The report says that levels of heat-trapping greenhouse gases in the atmosphere have reached another new record and there is no sign of a reversal in this trend, which is driving long-term climate change, sea level rise, ocean acidification and more extreme weather. The report's findings are impressive: it finds that species of all kinds — mammals, birds, amphibians, insects, plants, marine life, terrestrial life — are disappearing at a rate “tens to hundreds of times higher than the average over the last 10 million years” due to human activity.

The average abundance of native species in most major land-based habitats has fallen by at least 20%, mostly since 1900. More than 40% of amphibian species, almost 33% of reef-forming corals and more than a third of all marine mammals are threatened. The reasons for this **biodiversity crisis** can be found in five main factors, but the presence of humanity affects them all. It is also important to stress that, while the biodiversity crisis is related to, and fueled by, the climate crisis, it's also distinct from it. The five factors are: 1 - Changes in land and sea use. The area of the world that has been unaltered and untouched by humans is shrinking all the time, and when it shrinks, so does room for nature. A third of the world's land, the report finds, is currently reserved for agriculture or livestock and around 100 million hectares of tropical forest disappeared between 1980 and 2000. 2 - Direct exploitation of organisms, as for instance hunting and poaching. 3 - Climate change, which increases hardships for species in so many ways, from the polar bears in the Arctic losing ice to hunt upon to the fact that when ocean waters warm, they cannot hold as much oxygen or sustain as much life. 4 - Pollution. One example for all is the huge amount of plastic that enters the oceans every year. 5 - Invasive alien species:

due to a globalized world, species from one continent can move to another, where they don't have natural predators, and dominate the environment.

Other notable findings of the Report include the facts that: three-quarters of the land-based environment and about 66% of the marine environment have been significantly altered by human actions and on average these trends have been less severe or avoided in areas held or managed by Indigenous Peoples and Local Communities; more than a third of the world's land surface and nearly 75% of freshwater resources are now being exploited: the value of agricultural crop production has increased by about 300% since 1970, raw timber harvest has risen by 45% and approximately 60 billion tons of renewable and nonrenewable resources are now extracted globally every year – having nearly doubled since 1980; land degradation has reduced the productivity of 23% of the global land surface, up to US\$577 billion in annual global crops are at risk from pollinator loss and 100-300 million people are at increased risk of floods and hurricanes because of loss of coastal habitats and protection; in 2015, 33% of marine fish stocks were being harvested at unsustainable levels: 60% were maximally sustainably fished, with just 7% harvested at levels lower than what can be sustainably fished; urban areas have more than doubled since 1992; plastic pollution has increased tenfold since 1980, 300-400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are dumped annually into the world's waters, and fertilizers entering coastal ecosystems have produced more than 400 ocean 'dead zones', totalling more than 245,000 km² (591-595) – a combined area greater than that of the United Kingdom.

The present climate and environmental crisis due to a great number of related factors - among which the Greenhouse Effect, pollution of waters, seas and oceans, deforestation are only just a few examples – claims for new strategies to be adopted by governmental authorities and, as to the urban areas, the smart city model offers the most complete solution. One last example is provided by **Copenhill in Copenhagen** where one of the most imposing problems inside urban areas, that of waste treatment, has been brilliantly solved. Innovative technology and architecture have been used to integrate and form a functional model in which a waste-to-energy plant is welcomed by citizens since is not only one of the best performing European plants in terms of energy efficiency, waste treatment capacity, and environmental consideration, but also in terms of visual attractiveness and sport facility. It treats around 400,000 tonnes of waste annually

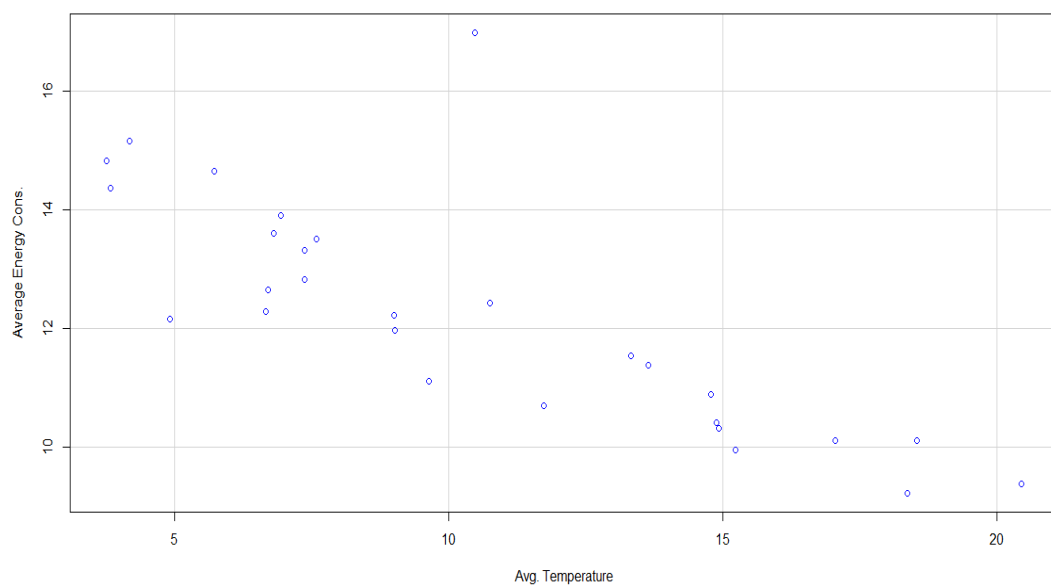
produced by 500,000 – 700,000 inhabitants and at least 46,000 companies supplying a minimum of 50,000 households with electricity and 160 households with district heating. Moreover, 100 million litres of spare water are recovered through flue gas condensation and 90% of metals from waste amounting to 10,000 tonnes of metal a year is being reused. Copenhill is the testimony of how innovation can help sustainability in the fight against the environmental crisis. Thousands of start-ups are at work in a great number of critic areas trying to provide innovating solutions as for instance in re-forestation or in green energy production. Innovation and sustainability are therefore two terms that more and more go together in the attempt to overcome the present environmental crisis and make the different living contexts safe, healthy and ethical for their inhabitants.

One last example of the role of ICT as to the creation and development of a smart city is the London Database. Published primarily to improve transparency and accountability and launched in January 2010, which originally hosted some 200 datasets.

Today it is considered one of the first city-platforms of its kind to make public data open and accessible, and a marker of London as a leading smart city at a global level. The Datastore has also been through several iterations, improving its design and functionality—most notably in 2015 with a complete revision. Today the Datastore is constituted by almost 800 datasets and 3,000 files (mostly excel or csv) available on open licence. Examples include population estimates, cycle flows, house prices, ambulance incidents, crime rates and international visitor numbers, benefit claimants, obesity prevalence, school grades and number of fires. Currently, the aim of the Datastore, as when it was established, is to make London's data accessible for to everyone and encourage its use to fully spread the potential social, economic and environmental value that can bring.

In the end, to present the use of the Datastore and to prove what has been described above, an analysis of the London Datastore consisting in two different analysis hav: the first one examines the correlation between the average energy consumption and the average temperature during a 4- year period that goes from 2011 to 2014. With respect to the same period, the second analysis investigates the correlation between total energy consumption and smart meter user count.

From the same dataset described previously, subsequently we investigate the relationships between energy consumption, average temperatures and the use of Smart Meters. In particular, we use two scatterplots to evaluate correlations: in the first plot (a) we depict the average energy consumption and the average temperature. As we might expect, the consumption reduces as the temperatures raise, but we do not see a clear negative correlation that would have been the signature of highly optimized consumptions.



The graph above has the average temperature on the X axis and the average energy consumption on the Y axis. High average temperature values, high average temperature values, minimum values of average energy consumption. Therefore, the presence of a negative correlation between the two variables is confirmed.