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2nd International Conference on Green Energy Technology (ICGET 2017)

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PREFACE

It is our great pleasure to welcome you to 2017 2nd International Conference on Green Energy Technology (ICGET 2017) which will be held in SAPIENZA University of Rome, Rome, Italy during 18-20 July, 2017. ICGET 2017 is dedicated to issues related to Green Energy Technology.

The major goal and feature of the conference is to bring academic scientists, engineers, industry researchers together to exchange and share their experiences and research results, and discuss the practical challenges encountered and the solutions adopted. Professors from Italy, Canada, USA, Poland are invited to deliver keynote speeches and plenary speeches regarding latest information in their respective expertise areas. It will be a golden opportunity for the students, researchers and engineers to interact with the experts and specialists to get their advice or consultation on technical matters, sales and marketing strategies.

This proceedings present a selection from papers submitted to the conference from universities, research institutes and industries. All of the papers were subjected to peer-review by conference committee members and international reviewers. The papers selected depended on their quality and their relevancy to the conference. The volume tends to present to the readers the recent advances in the field of E Green Energy Technology and various related areas, such as Novel Energy Conversion Studies for RESs, New Approaches in Lightings, Renewable Energy Systems in Smart Cities, Catalysis and Hybrid RESSs, Renewable (Green) Energy Systems and Sources (RESSs) as Wind Power, Hydropower, Solar Energy, Biomass, Biofuel, Geothermal, Energy, Wave Energy, Tidal energy, Hydrogen & Fuel Cells, Energy Storage and etc.

We would like to thank all the authors who have contributed to this volume and also to the organizing committee, reviewers, speakers, chairpersons, sponsors and all the conference participants for their support to ICGET 2017.

Prof. Marco Casini
SAPIENZA University of Rome, Italy
July 31, 2017

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Peer review statement

All papers published in this volume of *IOP Conference Series: Earth and Environmental Science* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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Green Technology for Smart Cities

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Green Technology for Smart Cities

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Abstract. In view of the enormous social and environmental changes at the global level, more and more cities worldwide have directed their development strategies towards smart policies aimed at sustainable mobility, energy upgrading of the building stock, increase of energy production from renewable sources, improvement of waste management and implementation of ICT infrastructures. The goal is to turn into Smart Cities, able to improve the quality of life of their inhabitants by offering a lasting opportunity for cultural, economic and social growth within a healthy, safe, stimulating and dynamic environment. After an overview of the role of cities in climate changes and environmental pollution worldwide, the article provides an up to date definition of Smart City and of its main expected features, focussing on technology innovation, smart governance and main financing and support programs. An analysis of the most interesting initiatives at the international level pursued by cities investigating the three main areas of Green Buildings, Smart grid-Smart lighting, and Smart mobility is given, with the objective to offer a broad reference for the identification of development sustainable plans and programs at the urban level within the current legislative framework.

1. Introduction

Global population increase, progressive decrease of energy sources and their consequent higher cost, climate change and air pollution are some of the main problems that the cities of the future will have to cope with to survive, transforming into Smart Cities and focusing on Green Building and Smart Mobility.
Because of the low energy efficiency of buildings and transportation systems, the cities of today are responsible, on average, for 70% of greenhouse gases emissions and over 60% of energy consumed worldwide [1].
The global increase of carbon dioxide emissions, whose values, equal to over 32 Gigatonnes per year in 2016, exceeded over 50% of those in 1990, caused the increase of CO_2 concentration levels in the atmosphere, by now stably higher than 400 parts per million (which has not been occurring for 300 millions of years) [2].
2016 was also the hottest year ever recorded in NOAA's 137-year series, since measurements began in 1880. Remarkably, this is the third consecutive year a new global annual temperature record has been set [3]. The average global temperature across land and ocean surface areas for 2016 was 0.94 ℃ (1.69 ℉) above the 20th century average of 13.9 ℃ (57.0 ℉), surpassing the previous record warmth of 2015 by 0.04 ℃ (0.07 ℉). This marks the 40th consecutive year (since 1977) that the annual temperature has been above the 20th century average. To date, all 16 years of the 21st century rank among the seventeen warmest on record (1998 is currently the eighth warmest). 2017 lends itself to being a record year too. In fact, the global land and ocean surface temperature during January-April 2017 was 0.95 ℃ (1.71 ℉) above the 20th century average of 12.6 ℃ (54.8 ℉). This was the second highest such period since records began in 1880, behind 2016 by 0.19 ℃ (0.34 ℉) and ahead of 2015 by 0.10 ℃ (0.18 ℉).
The issues of acoustic pollution and air quality typical of urban centres go in addition to the climate changes. In the EU, buildings alone are responsible for 40% of the final energy use, 36% of CO_2 emissions and above 40% of Particulate Matter emissions (PM_{10} and $PM_{2.5}$). Current mobility systems based on fossil fuel, besides being responsible for above 25% of polluting emissions, are unsuitable to the needs of urban areas, making movements

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difficult especially during rush hours, with journey speeds around 7-8 km/h (the same speeds recorded in 1700) [4]

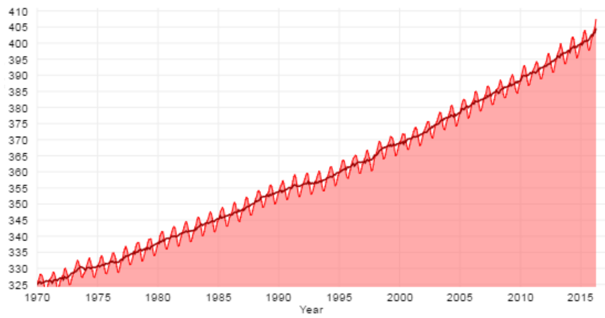
Every year worldwide 12.6 million people die because of environmental pollution, equal to one fourth of the total deaths. Air, water and soil pollution, chemical exposure, climate changes and ultraviolet radiation contribute to the increasing of over 100 illnesses and health damages [5].

Atmospheric pollution is the fourth risk factor for deaths on a global level, and undoubtedly the main environmental risk factor for lungs and heart diseases: over 5.5 million people die every year all over the world because of air pollution, more than Finland, Slovacchia and Sicily inhabitants. Italy hits the record of dead from smog with 59,500 premature deceases from $PM_{2.5}$, 3,300 from Ozone and 21,600 from NO_x only in 2012 [6].

These issues are going to increase with the progressive decrease of resources, the consequent increase of energy cost and the population development that is estimated to reach 9 billions of individuals in 2050 (from current 7.4 billions) of which over two thirds will live in the urban centres. These will produce the 80% of global GDP and will consume the 75% of global resources, contributing to create a model of urban-centric development.

The economic resources that the worldwide cities have addressed to adaptation measures to climate changes like protective barriers against inondations, more resilient infrastructures and better draining systems (around the 0.22% of GDP for the developed countries compared to the 0,15% for the cities of developing countries) are already relevant.

Looking at this scenario, cities have to be ready and capable of handling enormous social and environmental mutations, becoming the fulcrum of the fight against global warming and catalyzing investments and policies oriented to sustainability and efficiency in a Smart vision.



N	Year	Anomaly	N	Year	Anomaly
1	**2016**	**0.94 ℃**	6	2005	0.66 ℃
2	2015	0.90 ℃	7	2009	0.64 ℃
3	2014	0.74 ℃	8	1998	0.63 ℃
4	2010	0.70 ℃	9	2012	0.62 ℃
5	2013	0.67 ℃	10	2003, 06, 07	0.61 ℃

Figure 1. World carbon dioxide concentration (ppm) and temperature ranking (1880-2016) [3]

2. Becoming a smart city

A Smart City, or intelligent city, is a city capable of improving its citizens' life quality, offering a lasting opportunity for cultural, economic and social growth in a healthy, safe, stimulating and dynamic environment [7].

A Smart City is a city that guarantees:

- economic competitivity (smart economy), innovation, enterprise, economic image and brands spirit, productivity, job market flexibility, international integration, transformation capacity;
- training and social interaction of citizens (smart people), qualification level, long-term training, social and ethnic plurality, flexibility, creativity, cosmopolitanism and mental opening, participation to public life;
- administration functioning and services (smart governance), participation to decisional processes, public and social services, transparent government activity, politics strategies and perspectives;
- availability of information and communication technologies and modern and sustainable transportation systems (smart mobility), local accessibility, international accessibility, availability of IT infrastructures, sustainable, innovative and safe transportation systems;
- high environmental quality (smart environment), attractiveness of natural conditions, pollution, environment protection, sustainable management of resources;
- life, culture, health and safety quality (smart living), social structures, health conditions, individual security, dwellings quality, educational structures, touristic attractiveness, social cohesion.

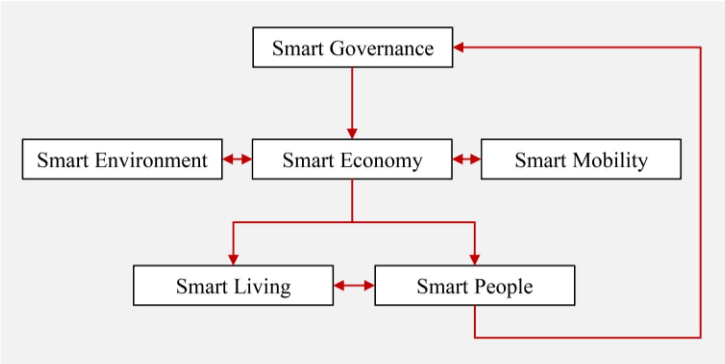


Figure 2. Smart City model

2.1 Technologic innovation

Today, reaching these strategic goals is possible also thanks to the availability of cutting-edge Technologies that are changing the aspect of the city, functioning of services and users' behaviour: renewable energies, advanced materials, innovative transportation systems, ICT, broadband, geolocation systems, Internet of Things, smartphones and tablets, social networks, city apps and urban data.

The long-term predictions by Navigant Research track, for the next eight years, a consistent growth of the market related to Smart cities that in 2023 will be valued for about 25.3 billion euros. This really consistent amount means that the 85% of urban projects will focus on the use of technology to produce digitalized services and improve the efficiency in the city. The segments of the Smart city world that will lead the growth include:

- smart grids, the intelligent grids capable of exchanging information with the administrations and regulating the energy flows;
- latest generation public illumination, LED lamps monitoring traffic and urban pollution levels, improving safety;
- smart mobility, hybrid and electric vehicles, smart parking, bike and car sharing;
- technologies related to the resilience in the city to cope with the meteorological phenomena related to climate change;
- smart systems to avoid hydric resources waste;
- all the devices linked to the urban data, constituted by all the data that the city produces daily, measured and translated into facts, figures and views.

In particular, regarding the urban data, according to Eric Schmidt, Executive Chairman and ex CEO at Google, the entire amount of data collected from the dawn of humanity to 2003 is equivalent to that today is produced in two days. This phenomenon of enormous proliferation of information, to which we often refer as “Big Data”, involves the need of filtering and making this new asset of information accessible.

By 2020, the users connected to mobile devices will be 5 billions and a half, around the 70% of global population. There will be more people with a phone (5.4 billions) than those with electricity (5.3 billions), water (3 billions and a half) and cars (2.8 billions). Growth will be also lead by fourth generation web and, mostly, by videos: these will represent alone the three fourths of mobile traffic. The increasing of users in the five years from 2015 to 2020 will be twice more rapid than that of global population.

Internet traffic from mobile devices will reach a volume of 367 exabyte per year. A quantity of data that is not easy to visualize: it is equal to seven thousand billions of videoclips on YouTube, or to sending or receiving 28 images per inhabitant of the world, per day and for a year.

Regarding the Urban Data in Chicago, currently there is a highly innovative project called “Array of Things”, promoted by the Computation Institute of Chicago University with the purpose of extending the Internet of Things to the urban scale.

The project involves the construction of a network of 500 sensors placed at strategic points in the city to measure all "vital parameters" and make it more efficient, livable and safe. In particular, the sensors will have the task to measure and make available, in real time, data such as: temperature and air pressure, wind, precipitation, lighting level, vibrations, pollutants (CO, NO_2, SO_2, Ozone), noise levels, pedestrian and vehicular traffic, surface temperature.

2.2. Smart governance

Particular importance in the development of a Smart City is given to the Smart Governance tools such as: Digital Democracy, Open governance, Citizen Empowerment, Participated Urbanism and Urban Data.

Digital Democracy is based on the implementation of information technologies, communication and social media in the service of political and governmental processes. If applied well, it produces a wider participation of citizens and a more transparent administration. Digital democracy also serves to increase the common responsibility between government agencies and the participant public.
Open governance refers to accessibility of citizens to information, data and governmental processes to favor the widespread participation and collaboration in the city's decision-making processes. This commitment often exploits technology to make it easier to facilitate a more active and open communication between the citizens and government, leading to a more efficient use of funds and a better quality of life for the inhabitants. Open governance aims to make the urban administrations more responsible to their citizens, increasing the legitimacy of the rulers.
Citizen Empowerment measures the consciousness of the citizens that their actions can contribute actively to decision-making processes and to changes in the city. By creating communication opportunities and participation, citizens feel called to contribute to the city with their own time, their own energy and ideas.
Finally, participating urbanism is the condition, often facilitated by technology, in which citizens have the ability to collect and share data, ideas and proposals with the city's governing bodies. The idea is based on the fact that members of the community are experts in the related urban situations and they already have knowledge and solutions for multiple issues. Participating urbanism allows professionals to identify actual needs and utilize knowledge and local human resources, rather than imposing the change from above.

3. Financing and support programs

Several cities in Europe (London, Amsterdam, Vienna, Barcelona, Stockholm) and the world (New York, Los Angeles, Seattle, Seoul, Melbourne, Vancouver, Shenzhen) have started in the last ten years to address their own efforts towards the development of sustainable mobility, the energy regeneration of building stock, the increase in energy production from renewable sources, the improved management of waste and the implementation of ICT infrastructures. There is not an existing city, big or small, that has not launched at least one project to be able to enjoy the title of "smart", focusing essentially on digital technology, environmental sustainability, civic initiatives, mobility and businesses.
In Europe, the Covenant of Mayors program was launched in 2008 (and updated in 2015), being the main European movement brought forward by local and regional authorities with the goal of increasing energy efficiency and the use of renewable energy sources in their territories. Through their commitment, the signatories of the Pact aim to reach and go beyond the European objectives of reduction in CO_2 emissions by 2030. In order to translate their political commitment into measures and tangible projects, the signatories of the Covenant undertake to present a Sustainable Energy and Climate Action Plan (SECAP) which outlines the main actions they intend to launch until 2030 for climate change mitigation and adaptation activities.
There are also numerous initiatives and programs promoted on a European and international level to stimulate the transition to an "intelligent, sustainable and inclusive urban model". Concerning Europe, worth noting are the two initiatives started by the European Commission "Smart Cities and Communities European Innovation Partnership (SCC EIP)" and "Stakeholder Platform Smart Cities", with the goal to launch innovative projects in urban areas integrated in the fields of energy, transport and information and communication technologies (ICT), as well as identifying and disseminating needs and information among all interested parties, public and private.
In addition to these, financing programs Horizon 2020 (€ 6 billion), Connecting Europe Facility (€ 6 billion) and the Cohesion Funds 2014-2020 (€ 23 billion for renewable energies, energy efficiency, and smart grids and mobility) are provided.
In particular, the Horizon program through the Call "Smart Cities and Communities" finances innovative projects on an urban scale regarding energy efficiency of buildings, the development of intelligent networks (electricity, district heating, telecommunications, water, etc.), energy storage, electrical mobility and intelligent charging infrastructures, the use of the latest generation of ICT platforms (130 million euros in 2016 alone).
As for Italy, in March 2016 through the Smart City Address Act, the Ministry of Economic Development (MiSE) has launched its first intervention program for the Smart cities by allocating 65 million euros. In particular, the program includes both promotion in urban areas of more efficient energy infrastructures and services and the activation of large pre-commercial contracts, aimed at responding to the most innovative needs expressed by the local administrations.

4. The main areas of intervention

Among the areas of intervention that characterize the transformation process of cities into Smart Cities, of particular interest are those addressed to energy and environmental efficiency of existing buildings, the introduction of renewable energy sources on an urban scale and the launch of smart mobility plans. These areas of action are in fact the most effective way to reconcile environmental objectives (reduction of energy

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consumption and polluting emissions), economic goals (reduction of management costs for citizens and for public administration, development of businesses and rising employment levels) and social goals (improvement of the welfare and quality of the services).

According to International Renewable Energy Agency (IRENA), more than 9.8 million people were employed in the renewable energy sector in 2016 [8]. Renewables are directly supporting broader socio-economic objectives, with employment creation increasingly recognised as a central component of the global energy transition. Solar photovoltaic (PV) was the largest employer in 2016, with 3.1 million jobs - up 12 per cent from 2015 - mainly in China, the United States and India. In the United States, jobs in the solar industry increased 17 times faster than the overall economy, growing 24.5 per cent from the previous year to over 260,000. New wind installations contributed to a 7 per cent increase in global wind employment, raising it up to 1.2 million jobs. Brazil, China, the United States and India also proved to be key bioenergy job markets, with biofuels accounting for 1.7 million jobs, biomass 0.7 million, and biogas 0.3 million. The number of people working in the renewables sector is expected to reach 24 million by 2030, more than offsetting fossil-fuel job losses and becoming a major economic driver around the world.

In the European Union, the renewable energy sector records in 2015 over one million employees, with a turnover of about 143.6 billion euros. In Italy, renewable energies give work to 82,500 people. Italy is fourth in the European green job ranking behind Germany (347,400), France (169,630) and Great Britain (92,850). Also, in Italy there are 20,000 employees in the wind, 19,000 in biomass, 10,000 in photovoltaics, 8.500 in the field of heat pumps, 5.500 in geothermal, 4,500 in hydroelectric, 5,500 in biofuels and 5 thousand in biogas.

4.1 Green buildings

The construction industry is one of the cornerstones of priority intervention for the achievement of the objective of a "smart, sustainable and inclusive" growth and for a transition to an economy based on efficient use of resources and low carbon emissions. Currently, in fact, over 40% of the final energy consumption in the EU-27 is absorbed by houses, public and private offices, shops and other buildings (43% is used by households, 44% by industry and remaining 13% from the services). In residential homes 67% of consumption is used for heating of environments, 15% for lighting and the use of electric equipment, 14% for heating of water and the remaining 4% for kitchen appliances [9].

From numerous studies emerge that the building industry presents a potential for improvement of energy efficiency that can be estimated, in 2020, in about 30% of current consumption and which can be exploited with effective interventions also in terms of costs [10]. There is also an enormous existing building potential of unused space usable for the integration of renewable energy sources. 40% of the total electricity demand of the European Union in 2020 could be satisfied if all roofs and the appropriate facades of European buildings were covered with photovoltaic panels [11].

In addition, in Europe, the population spends almost 90% of their time inside buildings: a bad design of buildings or inadequate construction methods may have a negative effect on the health of the occupants and can make maintenance and management of the buildings themselves extremely more expensive, starting from heating and cooling, with strong repercussions especially on older people and the most disadvantaged groups of the population.

As for buildings, the goal is therefore to promote the energy upgrading of existing buildings, and public ones in particular (communal buildings and primary schools), through: measures to reduce dispersion through the building envelope (energy sufficiency measures); the promotion of the use of cleaner energy sources (replacement of diesel fuel with natural gas) and renewable energy sources (solar thermal, solar photovoltaic, heat pumps) for air conditioning and hot domestic water production (clean energy measures); the efficiency of heating systems and a constant monitoring of their emissions (energy efficiency measures). Various cities have provided rewarding systems for condominiums that adopt more efficient solutions. The interventions aiming to reduce energy consumption and atmospheric emissions also concern the public lighting systems.

More and more numerous in Europe are examples of solar retrofit of existing historic buildings, from photovoltaic coverage of the historic bridge of Blackfriars (completed in January 2014) until the eco-renovation in 2014 on the first floor of the Eiffel Tower in Paris, which includes the integration of wind and photovoltaic technologies. The City of Paris also launched in 2014 the maxi urban redevelopment project wanted by the Mayor Anne Hidalgo representing the deepest transformation of Ville Lumiere for 150 years. The project "Reinventing Paris" is all about sustainable technologies and green buildings: green roofs, urban farms, urban forests, biofaçades, aquaponic farming, photocatalytic concrete are just some of the features of the 22 winning projects that will transform the French capital.

The city of Seoul has instead started the construction of an urban park of 10,000 square meters in place of a highway now dismantled. Seoul Skygarden designed by MVRDV will be a botanical encyclopedia with over 250 different species of trees sorted according to the Korean alphabet. The conversion, which will allow citizens to take a shortcut to get to the rail station, will allow you to travel in 11 minutes instead of 25, walking through trees and shrubs and looking at the city by 17 feet height.

4.2. Smart grid and smart lighting

Interventions for reducing energy consumption on an urban scale driven by Smart Cities are focused also on the improvement of the municipal electricity grid to make it a 'smart grid', and on increasing efficiency of public lighting with the replacement of outdated lamps with last generation LED lamps, the introduction of photovoltaic or wind power plants, to the introduction of sensors for real-time data detection.

The city's power grid needs a smart system able to manage, in a dynamic way and in real-time, both the inversion of flows of energy, from peripheral nodes distributed in the territory towards the center of the system (distributed generation), and any local energy surpluses due to renewable sources, balancing demand and supply.

In this vision, with Resolution 87/2016/R/eel, the Italian Energy Authority (AEEGSI) presented its minimum features for new smart electricity counters (version 2.0) that, according to distributor choices (the subjects holding the measurement activity) will progressively take the place of the first generation installed since 2001 and whose useful life (15 years) ended at the end of 2016. The new generation of smart counters promises to be more smart and user-friendly compared to the previous one. In particular, electric gauges will be able to provide a detailed report to the users on their consumption to facilitate efficiency and savings choices.

Particularly interesting in the field of smart grids are the projects for the realization of microgrids of communities aiming to sharing clean energy such as that carried out by New York start-up TransActive Grid in two districts of Brooklyn in New York (Park Slope and Gowanus). The project envisages the realization of a network of transactive grid, meaning that it is based on a transaction and active in both directions instead that one way. Within this network each individual, with his/her own home, constitutes a hub. To get involved, in addition to physical connection, it is necessary to enter into special contracts with the house neighbors, giving or buying an amount of energy. The difference with the traditional energy supplies, where the private buys from the government or from a huge company, is the relationship with the other network hubs. Transaction security, and warranty that the computer system (Ethereum) that regulates the whole microgrid can not be tampered, is given by the use of a blockchain system, the same that regulates the transactions of the virtual coin bitcoin.

For what concerns public lighting, particularly interesting is the smart cities project by Sap and Philips that kicked off in 2016 in Buenos Aires, where intelligent urban lighting systems will be installed on 91,000 street lamps, controlled by the Philips Citytouch system interfaced with the platform Hana by Sap and with which it is expected a reduction of over 50% of consumption.

Real time data capture by the connected lamps will show the public administration information useful on the traffic, the outflow of the waters after rains, crowding at the public transport stops and the availability of parking lots. The control of road lighting will also help increase security levels.

Other innovative systems such as the one patented by the company EnGoPLANET and installed in 2016 in the city of Las Vegas expect integration of lighting with floor piezoelectric tiles able to transform the mechanical energy of the pedestrian passage into electric energy. The system is completed by sensors of motion to adjust the levels of illumination, USB charging devices or wireless pads and additional sensors which measure air quality, temperature, precipitations, in addition to video surveillance cameras for vehicle traffic analysis.

4.3. Smart mobility

Intelligent mobility is one of the key aspects of a Smart City, towards which cities worldwide are starting the most interesting transformations, either through large structural investments, and low cost initiatives that act on social innovation and on raising public awareness.

In particular, the interventions for a Smart mobility brought forward by the Cities concern:

- enhancement and efficiency of the system of public transport and a modernization of the related means of transport with vehicles that use low-emission combustion engines, electric or hydrogen motors, up to the introduction of driverless vehicles;
- promotion of the use by citizens of electric and hybrid vehicles, even with the installation of new charging columns (as required by the EU) and the activation of electric cars rental services, and the introduction of smart charging systems (vehicle to grid and vehicle to building);
- enhancing bike sharing, car sharing and car pooling policies;
- implementation of early warning systems for conveying traffic and of parking addressing systems and the management via smartphones of the access to restricted traffic areas and pay parking;
- digitalization of the public transport system with the introduction of smart palettes and panels with a variable message at public transport stops and applications dedicated to info-mobility that can provide useful information about urban lines, waiting times, possible criticalities and atmospheric disturbances directly to the users' smartphones;

- introduction of interchange parking spaces where to leave own's car to continue with other lower environmental impact means;
- promotion and development of pedestrian traffic activating policies to encourage walking even through the retraining of the paths, the improvement of lighting and the introduction of dedicated signage;
- introduction of intelligent traffic lights taking real-time count of car flows as now happens in several cities in the United States;
- introduction of intelligent streetlights capable of automatedly modulating lighting according to the intensity of the transit and that, through a survey in real time of the detected data, are able to provide public administration useful information;
- realization, as in Netherlands and France, of solar photovoltaic cycle paths.

Concerning the electric car market, in 2015 there was a global growth of 65% compared with 2014 (of which 36% of the total in the United States, 27% in Europe and 24% in China) [12]. Today the United States hold 46% of the market, Japan, second country, is included in the RoW (Rest of the World) which has 27%. Still behind European Union and especially China, which have respectively 18% and 8% of total sold electric cars. For the year 2021 the situation will be completely different: the European Union should represent 37% of the market and China, in the strongest growth, would be around 30%. In 2025, 8% of cars in the world will be electric, against the current 0.6% of 500 thousand in 2015.

In 2015, Australia inaugurated an electric bus with 1000 km of autonomy able to travel from Sidney to Melbourne without ever charging the battery. The vehicles, built by Brighsun in Melbourne, mount a high performance lithium ion battery, combined with an electric motor and a regenerative braking system. On the other hand, the world's first hydrogen tram is Chinese. Produced by a public company, it is the first to mount fuel cells and can travel 100 kilometers with nearly 400 people on board. In 2015 it began to run on the tracks of Chinese city Tsingtao. It reaches a maximum speed of 70 km/h and thanks to the fuel cells it incorporates, the public vehicle only releases water. Refilling takes only three minutes, and once the tank is loaded the tram can travel for up to 100 kilometers. In the city of Tsingtao, that means it can cover the urban path from terminal to terminal three times in a row. Inside it offers 60 seats and 320 standing, for a total of about 380 passengers.

In the Netherlands, instead, the world's first solar bicycle path was inaugurated in 2014 and has produced in 6 months 3000 kWh electricity. Just 70 meters long and with integrated photovoltaic panels, the cycle track connects Krommenie and Wormerveer, two suburbs of Amsterdam.

France, on the other hand, announced the realization of 1000 km of photovoltaic road in 5 years that will provide energy to 5 million people, 8% of the French population. Works began in spring 2016. The infrastructure will be paid with an increase in taxes on fossil fuels contributing for around 300 million euros to the project.

According to the French Agency for the environment and management of energy, 4 meters of "solarized" road are sufficient to meet one family's electrical needs, without counting the heating. One kilometer of these panels is able to give electricity to a community of 5 thousand inhabitants.

5. The virtuous examples of London and New York

Among the cities that are most engaged in programming in smart mobility and energy retrofit of existing buildings, the first places definitely belong to London and New York, the latter winner of the City Climate Leadership Awards 2014 for the category "Energy Efficient Built Environment". Both cities are characterized by the fact that over 75% of their greenhouse gas emissions are due to buildings, 80% of which will be still standing in 2030 (2050 in London). Their renovation is therefore an indispensable goal to face the challenge of climate change and ensure a high quality of life for citizens.

With the two RE:FIT programs, reserved to commercial buildings and public bodies, and RE:NEW, addressed to housing, the city of London has set the goal to reduce carbon emissions by 60% by 2025. The two programs are alongside other important initiatives oriented to a timely monitoring of emissions (London's GHG inventory) and to the promotion of sustainable mobility for the improvement of air quality through the replacement with electric vehicles (New Taxi for London) of all taxis in the city, responsible alone for about 35% of PM_{10} emissions and more than 15% of city NO_x emissions. London is also committed to investing more than £300 millions so that by 2020, all 300 one-storey buses working in central London will be electric and the over 3,000 two-storey buses will be hybrid (to date they are already over 1,300). In March 2016 the city also inaugurated the first five entirely electric two-storey buses. Manufactured and equipped by the Chinese company BYD, the new EV Buses, with 10.2 m length and a capacity of 81 passengers, have an autonomy of 305 km and will be in service on Route 98.

After an inquiry involving millions of citizens, London capital also launched the London Infrastructure Plan 2050 (LIP 2050), a series of interventions for a London Smart City that will surpass 1800 billion euros [13].

The plan, approved by the Citizens Council, will affect the adaptation of infrastructures, building heritage, schools, energy efficiency of buildings, the promotion of green technologies and the expansion of green areas:

42% of funding (£547 billion) will be allocated to the building industry, to improve the structures of the capital; 35% (466 billion pounds) will serve to make the urban mobility system smarter and more efficient - among the various interventions, a wider and more efficient cycle path system; 11% will be intended to improve the energetic system and to pursue the goal of reducing by 80% carbon emissions in the atmosphere by 2050.
In addition, 68 billions will be used to improve school buildings, 49 billion are destined to the improvement of water and energy efficiency, 22 billion will go to expand the green areas, 14 billion are destined to make the waste management smarter, 8 billion will make London an interconnected and digital Smart City.
Thanks to the London Infrastructure Plan, it is expected that in 2050 the UK capital will be greener, cleaner and more efficient and according to estimates it will go from 8.6 millions of inhabitants to 11, who will enjoy advanced services in a sustainable and digitized environment.
Finally, in 2016 London started a remarkable project of Smart city. The British capital has studied an interesting green finance plan to support innovation and sustainability projects in the urban sphere. The financial market can be crucial to accessing new economic resources useful for the development of smart city projects, environmental sustainability, energy efficiency and resilience. This initiative could yield 100 billion a year of green bonds to be put on the market to give birth to new projects in the field of sustainable mobility, intelligent services, the use of big data, monitoring traffic flows and urban efficiency.
To put in practice the interesting green design three strategies have been identified. The first envisages increasing trust in green bonds through the improvement of transparency and the accreditation of operators. The second one will see an increase of information addressed to operators of the industry, businesses and citizens. The latest strategy aims at promoting the green finance with every means available and the development of a new financing model studied ad hoc for Smart City projects.
London, the capital of world finance, dues its success to fast economic development, quality labor, cost of living, and infrastructures optimization, international popularity and the technology sector.
The city of New York has adopted in 2007 a global sustainability plan, the PlaNYC, to reduce urban greenhouse gas emissions by 30% by 2030. To achieve this, the city has issued under the “Greener, Greater Buildings Plan" (GGBP), a set of energy efficiency standards in particular addressed to the properties of larger dimensions (over 50,000 square meters) which, though being only 2% of all the properties of the Big Apple, are responsible for the 45% of carbon emissions. In 2007 the city has also launched the volunteer program NYC Carbon Challenge, initially reserved to Universities and Hospitals and later extended from 2013 to multi-family residential and commercial buildings, aimed at reducing emissions by 30% in 10 years.
These and other virtuous examples carried out in other urban realities show how cities can play a key role in combating climate change and how the challenge of efficiency improvement and reducing emissions can be a strong change engine that can improve economic competitiveness, environmental and social quality.

6. Conclusions

Resilient, attractive and competitive cities make up an indispensable prerequisite to face the challenges that the society of the third millennium will have to face in the next years.
From the analysis of the numerous initiatives carried forward by worldwide cities, it emerges that many smart city projects are today still mostly focused on individual areas such as energy efficiency in buildings, flexible public transport services, digital infrastructures, smart grids, etc.
To turn cities into smart cities it is indispensable that such initiatives are carried forward within a systemic and integrated approach, capable of making the best use of infrastructures and encouraging the interoperability and scalability of solutions.
The challenge for cities is to be able to integrate the new enabling infrastructures and sensors technologies with existing structures on the territory, exploiting synergies and interoperability between systems in order to deliver added value services for citizens, thus contributing to improve their quality of life.

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