The Lean
Urban Policies' Design

A values-centered method for sustainable urban planning.

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XXIV cycle

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March 2015

UNIVERSITÀ DEGLI STUDI DI PALERMO
Dottorato in fisica tecnica ambientale
Dipartimento Energia, Ingegneria dell'Informazione e Modelli Matematici
ING-IND/11

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CICLO XXIV
ANNO CONSEGUIMENTO TITOLO 2015

“Ever tried. Ever failed. No matter.
Try Again.

Fail. Fail again. Fail better.”

Samuel Becket, *1983 Worstward Ho*

Acknowledgements

Prof. Eng. Aldo Orioli for his time and his patience in having me as researcher.

Prof. Arch. Ignazio Vinci for his faith on my path and his wise mentorship.

Università degli Studi di Palermo board of directors and staff for their availability and their interest in my studies. Especially Rector Lagalla, Dean Micari, Prof. Carta and Dr. Semilia.

Università degli Studi di Palermo, Scuola Politecnica, Department of Energia, Ingegneria dell'informazione e Modelli Matematici students, professors and researchers.

"RE.S.E.T. Rete di laboratori per la Sicurezza, Sostenibilità ed Efficenza dei Trasporti della Regione Siciliana", which is funded by the PO-FESR Sicilia 2007 - 2013- Asse IV, obiettivo operativo 4.1.2, Linea d'intervento 4.1.2.A and especially Professor Rizzo for his generous availability and his lighting suggestions and Eng. Lo Casto.

This work was carried out within the research project "TrafficO2 - social network for communities' urban mobility" which is funded by PON R&C 2007 - 2013 Asse II, obiettivo operativo 4.2.1.3, progetto PON04a3_00451. Prof. Profumo, Prof. Calderini, Prof. De Marco, Dr. Cobis, Dr. Delli Carpini and the MIUR PON R&C staff for the chance they gave us.

Istituto Superiore Mario Boella board of directors and its Smart City program for the opportunity given in conducting my research with their economic help and supervision, especially Eng. Calia, Dr. Ferrero, Dr. Pacifici, Dr. Vesco, Dr. Ferro and Eng. Osella.

Professors Eng. Arch. Ratti and Eng. Biderman for the great chance and for the research questions they suggested me.

M.I.T., Architecture Faculty, Department of Urban Studies and Planning, Senseable City Lab, directors, researchers and fellows especially Prof. Britter, Prof. Sassen, Prof. Gonzalez, Kristian Knockel, Luigi Farrauto, Michael Seltz, Tony Vanky, Gabriele Musella, Damiano Gui, Benedikt Gross and Riccardo Campari.

Ines Bajardi & Partners for "Lampedusa Social Market". Especially Claudio Esposito, Gian Maria Socci, Carla Ferrer, Marco Jacomella and Andrijana Sekulic.

Michael Gerbino and Irene Ajovalasit for the language help provided, Claudia Rizzo for the help provided in the first chapter, Caterina Impastato for the help provided in the second chapter, Giuseppe Filippi and Alessandra Barbaro for the help provided in the third chapter.

This work it would not be possible without Push - no profit civic startup, especially for the effort of Roberto Filippi, Mauro Filippi, Andrea Tosatto, Eliana Amato, Alessandro Riva, Angelo Marchesin, Giuseppe Valenti, Mirko Mignini, Giorgia Teresi, Elena De Francisci, Alessia Torre and our lawyer Maria Graziano.

Gianluca Barranca, Giuseppe Crescimanno, Marco Ferruggia, Eleonora Saitta, Lucia Bargione and Luca Savettiere for their warm friendship.

Caterina Impastato for her patience and her help in passing through trouble times.

Domenico Schillaci and Francesco Massa for being precious comrades by my side in many adventures.

My family especially my grandmother Rosalia, my aunt Annamaria, my uncle Emanuele, my cousins Marco, Valentina, Chiara, Eleonora and their family for their help and support.

My awesome American family especially aunt Wega and uncle Bob for their outstanding generosity and comprehension.

My mother, my sister and her family for their love and their faith.

A mio padre

Index

The Lean Urban Policies' Design

Introduction

"Relentless and haphazard development has created a way of living that brings us to a point of reckoning regarding energy, climate change, and the way we shape our communities.
The answer to these crises is sustainable development, a thoughtful combination of good urbanism with renewable energy sources, state-of-the-art conservation techniques, new green technologies, and integrated services and utilities."
P. CALTHORPE. *Urbanism in the age of climate change*, Washington 2011, p.2

"Best defined as the art of shaping and composing the built environment, urban planning and design both seek to understand and analyze the variety of forces - social, economic, cultural, legal, spatial, ecological, and aesthetic - that affect how we live. The complex challenges facing the cities today - scarcity of resources, growing economic divisions, social and ethnic tensions, and rampant sprawl, among others - are forcing a reconsidering of urban design as a discipline."
T. HAAS, *Sustainable urbanism and beyond*, New York, 2012, p.2

"The issue for me is about the way authorities have been approaching plan making in the past […] Where they have not update plans for 20 years, it is not difficult to understand why they are saying that 12 months period is not sufficient. The N.P.P.F. (National Plan Policy Framework) is a tool to foster a behavioral change. It is about trying to get authorities to understand that this is a continuous thing. […] Your plan should be always deliverable."
S. QUARTERMAIN, *Planning magazine*, July 9th 2012.

I used the previously quoted excerpts, attempting to clarify the goal of this doctorate thesis in a brief manner, which is the intertwinement of themes that are commonly addressed in territory design.
In these past years, the necessity and urgency has emerged for policies tied to an alternate development to be efficiently applied, and not limited to single operations. The policies must be defined by a clear and effective method of action.
Explained by Enzo Mari's lecture on the project and it is meaning:
From the application of an empiric method one can (almost always) come up with a theory.
This fact is what has driven my research in the university field: by exploring possible solutions to real world problems, seeking for a conceptual matrix through which it would be possible to define a more effective approach for urban planners to improve the cities sustainability.
Bateson would define "the structure that defines" … "everything" that belongs to the urban environment, that is the conceptual surface on which today it is possible to clearly map the most holistic and strategic actions in a project for the territory.

Starting again by investigating what are the relationship among human being, built environment and natural sources, in fact, we think it is possible to enrich the sustainable urban planning policies with new contents and possibly, new tools.
By describing the frame, the objective is to define the most effective method, to be able to convey an effective project action and governance for the territory, to achieve predefined social and energy based objectives.
The research will focus on those tools (top-down and bottom-up policies) that today have this specific purpose and action-research studies made in order to possibly deduct some assumptions for a general method:

1. City, urban environmentalism and sustainable development.
2. Policies for efficiency, present and future expectations.
3. Action research studies
4. Discussion: the Lean way to urban policies' design

By analysing the common methodological characteristics these two different approach have, we have found a possible link with the application of the "lean" method, directly borrowed from economy's application, to what is involved in the process of "values-centered" project for the territory.

The "lean process" and its logics seem to answer to the need of "circular" planning processes (integrating top-down and bottom-up strategies) our cities need.
Applying the lean thinking method on an urban scale aims to generate, for whom is in charge of urban planning, the ability to clearly find value and engage policies on more levels and objectives, making them effective through an iteration process of optimization of all resources, to be able to simplify the dynamics and finally render the complex project for the territory simple and sustainable.

"The battle for a more sustainable future will be won or lost in cities"

World Urban Campaign, *2012 Manifesto for Cities*

1. City, urban environmentalism and sustainable development.

In this first chapter it is presented the main subject of the research: the contemporary city and the directions of its development.

1.1 Definitions

The cities and energy sources have always had an understanding and codependent relationship: birth, growth and extinction of the urban experiences has in fact always coincided with their relationship to the source of energy supply.

However, what is the meaning of city and what are we referring to when we speak about energy?

The city, from Latin *civitas*, represents the place of a stable human settlement in which actions are focused for growth and development of civilization. Energy, on the other hand, consists in having Aristotle's "ability to implement" that in classic mechanics becomes the ability of a physical system to develop force through work.

The tight knot that tied the two terms together has in fact found the concepts of development and growth. So much so, its is importance to underline how both terms "settlement" and "system", are seen as measurable and finite concepts.

From buildings to architecture, from craftsmanship to industry, all the possible ways of implementing and modifying reality need work therefore energy.

The term energy has vast meanings, including everything that man needs to be able to express work. For an ancient city, it is energy consisted in men and their ability to accomplish work: it is main resources for development, present *in-loco*, had to be able to maintain a balance with the surrounding environment, actual place of production, in a system of dependence to the natural resources, which are the only "bio-fuel" for men and animals.

The reality remained unvaried for centuries, not until new systems were discovered, through the use of easily traceable resources, which were able to lift from labor men and beasts. From this moment on, cities were subjected to an accelerated development, consequently had a relentless and often apparent demographic, economic and social growth that led to the first concerns regarding urban organization.

After the industrial revolution cities were not able to autonomously stay balanced, to stay "naturally" in an ecological balance with the surrounding environment. In the attempt to create order, the first city organization "models" were developed, some of which are still referred to devise new cities. 3.

The escalation begun with the second industrial revolution and has not stopped since. Cities continued to exponentially grow becoming the place were currently 50% of the world population resides.

In this chapter the main themes that will be discussed are the city models, from the birth of the urban concept and the development models, the hardware and software of a device accomplished in its integrity.

The city will be described according to its main phonotypical characteristics; the development models, which guided cities in their growth through the phases that brought to the current international political agenda regarding climate change; the reconversion of the energy models and the sustainable development as a priority to face the future of our civilization, and finally the necessary instruments to achieve these objectives. The brief history digression, limited to the past fifty years of urban politics, will serve as a frame of reference through which the connections between development, energy, urban politics and the used planning instruments will be highlighted.

“The pseudoscience of planning seems almost nevrotic in its determination to imitate empiric failure and ignore empiric success.”

Jane Jacobs, *The Death and Life of the Great American Cities.*

1.2. Cities

Since ancient times the city is thought of the way to offer men a better life. The Romans and the Athenians had begun research to create the ideal city, from a special point of view. Nevertheless, the first projects that were realised inspired as an urban and architectural reflection came to light in the Renaissance in the 15th century. In this period the architect Leon Battista Alberti is a pioneer in the future discipline with his work in *De re aedificatoria* (edited between 1443 and 1452), a revisited critique of the vitruvian work *De Architectura* which has the objective of being the first modern volume on the theory of architecture.

And this was only the beginning. In the 16th century the new literary genre “utopia” was born, thanks to the humanistic philosopher Thomas Moore. From the Greek origin (*ou-topos,* which means contemporaneously “in no place” and “place of happiness”), the aim of utopia is to create an ideal society without imperfections, therefore creating projects of “good society”. The Thomas Moore model, antagonising the British society of the time, is characterized by paying attention to the organization of space and the aspects of planning which would significantly influence the concept of a city.

In the 18th century, as anticipated, cities grew, multiplied and transformed thanks to new energy vectors that drove new production models. In this historical contest the first urban professionals rise who try to apply to the urban fiber a change inspired to the sanitary principals of the period. This is when the pioneers of the humanistic and hygienic school of thought of the second half of the 19th century imprint their observations based on three principles of reorganization: hygiene, light and circulation. The use and abuse of energy is concept intrinsically tied to progress, therefore immune to reasoning, afterthought and optimization processes.

This reorganization was not enough: cities continue to have social frustrations and tensions of all types, of which poverty, promiscuity, unemployment, lack of housing; problems that will become recurring in the industrialized countries.
Urban professionals and architects try to find solutions which forecast a return to man-sized projecting. For example, in 1898 the urbanist Ebenzer Howard presents his concept of eco-city: surrounded “green” areas to satisfy the citizens nutritional needs; this model was implemented in North London in 1903.
Nonetheless, a demographic expansion continues in the 20th century cities. There is a necessity to offer housing to the workers flowing into the urban centers causing mass urbanism: this is when there is a proliferation of large construction projects in the suburbs of European cities, and single family housing in North America.
Meanwhile, urbanists and architects continue to dream of an ideal city. In 1933, at the International Congress of Architecture in Athens, the Swiss architect Corbusier launches the concept of functional city, fundamentally organized in four independent areas, each corresponding to a specific function: lifetime, work, amusement and transportation.
Once again the paradigm misses its placement and its consequent conservation of resources.
Highly criticized in the sixties, Le Corbusier’s urban planning model inspired many great urbanists in the rebuilding of European cities after the Second World War.
It is with this same impulse that in Italy, the instruments of urban organization are born; like building plans or much more complex general zoning plans. As the years passed, these plans, although brilliant examples of application (e.g. Zoning Plan of Val d’Aosta in 1943), have often suffered the lack of policies capable to express shared values, being diminished to simple zoning instruments and interpreting the territory as a dry patchwork of functions.
At the beginning of the past century, along side to the attempt by urbanists and architects of defining the ideal city, some literary writings and film productions have done the opposite by imagining an urban future far from ideal and suggest an apocalyptic vision of cities, where men vanish and nature takes back its territory. These scenarios could be observed in films such as “The Day After Tomorrow”, by

Roland Emmerich, which showcases megalopolis washed away by the effects of climatic mutations; or “Blade Runner”, by Ridley Scott, where planet Earth had become unlivable due to pollution and overpopulation; or furthermore, “Brazil”, by Terry Gilliam, in which a hypothetical future world is governed by pettiness and bureaucracy.

The city of the future causes two types of representations for those who plan, imagine or dream it. On one side there are the philosophers, urbanists and architects who try to plan the ideal city by focusing on man’s wellbeing, modernity and progress. On the other, artists, writers and filmmakers, each influenced by scientific studied and their own perceptions in their given eras, depict the city as a place of disorder, chaos and anguish, subject both to disorder and authoritarian derives. Whichever approach is used for such projections, these have an element of affinity that consist in providing a topic for reflection on humanity’s destiny, which is what we are interested in.

1.2.1. The perceived city

Due to the born of the cybernetic thinking and the perceptive psychology that studies about spaces, their meanings and the way how people fit in were flourished (Canter, 1977).

The famous “Image of a city”, MIT prof. Lynch Ph.D. thesis, highlights which mental mechanisms create the city’s tale, which common characteristics belong to the citizens impressions’ abacus and how often these projections diverge from the planned values.

Later on this topic arch. Robert Venturi in “Learning from Las Vegas” has described the design language's complexity theme as a necessary characteristic of the urban design, prodromal to the city comprehension itself.

But the speculations regarding city’s perception became richer with the introduction in our society’s systems of the new media and most of all of internet (Bonaiuto et al., 2006.)

Virtual space and faster connections speed defined new paradigms of space and time, able to generate communities and places without time and without physical space. Saskia Sassen argues that technology hacks city, and citizens that live the physical space through a new interface are the city hackers. So in one hand we have a new way to comprehend the urban facts, different then before because faster, global and cross medial, in the other hand we have a new field of action, something that we can describe as urban user experience. So this new frontier, well defined in Robin Kitchin and Martin Dodge "Code/Space", opens the software culture to the urban shapes, triggering new mechanisms of city's perception and government's and citizens' actions.

Due to these new epistemological insights, urban design finds clearly towards what it has to address policies and actions to reach his objectives, as the viably development, environmental sustainability and energy efficiency at the urban scale (Craik and Zube, 1976).

1.2.2. The growth of the urban organism

Today almost 50% of the world population lives in cities. According to demographic growth estimates in 2033 urban areas will contain roughly 5 billion people, a population equal to the entire world population in 1987.

As much as the planet's urbanization has advanced through time, only recently it has been subjected to such acceleration: until the 19th century, only 10% of the world population lived in an urban environment.

As previously mentioned, the growth in urbanization is triggered in Europe following the Industrial Revolution: while the improvement in agricultural production vacates labor, simultaneously the reduction of mortality increases population; urban and industrial activity offers employment opportunities with exponential growth, creating greater population affluences towards the cities.

From the socio-economic point of view, the urban transition entails many different situations from one area to the other: in the Northern countries the urban growth represented a crucial engine for progress of society, while, in opposition, in the impoverished countries urban growth causes difficulties regarding housing, labor, transportation and pollution, which evidently slow down the growth itself.

1.2.3. The global city

The "global cities" have a prominent role in the world's economic and political systems: in fact, they comprise one of the main sources of wealth and technological innovations (Abrahamson, 2004). Most global cities currently register superior incomes to those of certain countries: for example Tokyo's gross national product is twice as higher as Brazil's.

If until now most of the global cities have been in Northern countries (Paris, London, New York, etc.), now they are also becoming a reality in emerging countries (Mumbai and Shanghai) and also in other growing countries. Their main characteristic consists in gradually loosening their respective national restrictions (Sassen, 2010).

As the cities grow, they become globalized and gain power; in fact, the megalopolises convey the theme of their governance more pressing. Their power to influence or harm goes beyond the strictly municipal aspect, so much so, in some cases they are in conflict of interests with the countries they belong to. For this reason their current management means will require reinventions or, recalibration and rebalancing. A possible outcome of this growth is that the national urban network will be displaced in favor the relationship ties that these global cities have established between each other, therefore subtracting them selves from the control of the State (Sassen, 2013).

1.2.4. The marginal cities

As much as the urbanization phenomenon is, on a historical level, economic and social progress, many countries have clashed over it.

These countries are for the most part concentrated in the southern hemisphere, in areas that have become marginal as a cause of the global economic development processes.

The challenge that the developing countries should take during their transition is proportional to their urban growth: every month the cities in the south absorb an additional 5 million people that is 95% of the world's urban growth. At this pace, the urban population in developing countries would double by 2050. The UN forecasts that two thirds of the 6,3 billion citizens, at which point would populate the planet, will live in Africa and Asia, where most of the world's poverty, precariousness and inequality will reside.

Among the socially discriminatory factors, the housing problem is without a doubt in first place. In fact, it would be necessary to invest funds, which the states, the private sector or the populations in question don't dispose of: the countries that will be subjected to a rapid urbanization in the next decades, are those which at this point represent the majority of people that live below poverty level.

Realistically, regardless of the increase in income that urbanism favors, the difficulty that many states face is the ability to answer to the demand of sanitary, educational and social infrastructures, which do not favor better living conditions for who reside in their cities. The spontaneous formation of vast settlement in high-risk areas is a key factor in the increased victims from natural catastrophes. Also, the lack of drinking water and proper sewerage systems offer optimal conditions for the rise of some diseases. Furthermore, the lack of educational and social infrastructures don't allow citizens to modify their behavior that would increase awareness and avoid environmental risks.

Sanitary and social insecurity must also be associated to the physical insecurity caused by urban violence, crime and illicit activities. In all countries it is observed that accelerated urbanization stimulates an increment of informal economy. Limited resources in states favor uncontrolled development of urban gray areas, such as the Brazilian *favelas.* Often, in these cities the police force becomes a protection agency for the privileged classes, therefore becoming responsible for the creation of dual cities and fragmentation of the already weak society.

The marginal cities and their growth process is the true challenge that the current generation of urban planners face.

1.2.5. The urban weight

The city is not only a generator of wealth but it is also a great consumer of the ecosphere. Currently, cities absorb 75% of the energy produced in the world and emit 75% of greenhouse gasses on the planet; besides depleting resources, ecosystem degradation, pollution, soil erosion etc. As urban population grows, cities represent a determining parameter in the battle against global warming.

Developed countries that are 80% urbanized, have almost no impact ecologic problems tied to the urbanization project. At the same time, the cities functions and processes of social and economic organization are energy consuming.

Used materials, lack of isolating materials, inadequate heating systems: in the northern cities the habitat represents the first sector in energy expenditure. Although, thanks to increasing energy efficiency in houses and offices becoming a main source of potential energy.

The city's special organization, collective transportation system and the distances that separate residential areas to the financial areas, are other factors that determine energy consumption and greenhouse gas emissions.

It is evident that different approaches taken by northern and southern countries, the impact on the environment goes beyond the space they occupy in the territory. This impact is measured through the concept of ecological footprint.

1.2.6. The sustainable city

In the northern cities, where the urban fiber has been part of the territory for a long time and there is a structured base of urban planning, the evolution will have to be unavoidably based on life, consumption and mobility models (Sassen and Dantan, 2011). Local public policies will have to be implemented to modify behaviors: fiscal implementations of waste recycling and habitat energy improvement, promoting office localization and transportation sharing, rationalization of public lighting and optimization of natural light sources, development of devices for increasing urban transportation flow etc.

In the southern countries on the other hand, the emerging concept of sustainable city clashes not so much with the already existing urban organization but with the precariousness of its citizens, with the lack of financial means of the states and with the deficit of public sensibility. Consequently, in these countries the theory of sustainable city could only be realized in terms of: the population having better access to drinking water, sanitary equipment and depletion infrastructures, all elements that will help slow down degradation.

1.2.7. Ecopolis

We can imagine three possible scenarios regarding the future of cities.

In the first case, the current trends show an expansion of the urban territory starting from the large agglomerations.

The second scenario foresees the birth of ideal cities from the ground up, transforming utopia in reality.

In the third, the current city allows its development into a future city through collective infrastructures and technologies, which progressively will answer to the needs of ecological and social sustainability (Scandurra, 1995).

1.2.8. The postindustrial city

The city of the future will be Korean and should be operational by 2020: the *Ubiquitus City* by Songdo, will be characterized mainly by its information technology density and will be destined to host the south Korean public research centers. To entice companies to relocate to this city, its creators offer an ideal urban space. Its features will range from security and comfort, sophisticated technologies starting from geographic information systems that will assist its citizens daily at any moments.

In the scope of new urban paradigms environment and sustainability will become essential topics. Accordingly, these topics activate innovation with the goal to reduce the ecological footprint: from the production of renewable energy for self-sufficient energy, to development of collective and individual transportations, from thermo isolation of buildings to complete recycling of waste products and to biological production.

All elements that accompanied to the creation of green areas pedestrian friendly, contribute to the improvement of the quality of life of urban populations.

> "Any intelligent fool can invent further complications, but it takes a genius to retain, or recapture, simplicity."
>
> E.F. Schumacher, *Small is Beautiful*.

1.3. Urban environmentalism

There are two significant dates that can be distinguished concerning the so-called "environmental theme". The first date is 1972, year in which the civil society submitted a report to the press of the Massachusetts Institute of Technology (MIT) in Boston; the reknown *The Limits to Growth* recognizes the depletion of resources and the limits to the growth system proposed by the UN at the Stockholm Conference which argued theories on smart use of resources. Whereas, the second date coincides with 1987, year in which the Brundtland Commission Report "*Our Common Future*" was published, which identifies the limits of growth not in the scarcity of resources, but in the ability of the planet (biosphere) the very effects of human activity.

1.3.1. The origin of the environmental issue: its literary account

Between the 1960's and the 1970's intense debates on the relationship between man and environment, causing vast literary productions. In fact, a new (scientific and social) self-consciousness emerges, which does not consider man as a ruler of nature, but as an integrating part of it: man's world domination does not any longer appear to be a realistic hypothesis.

How does this change occur? In the fifties and sixties the industrialized countries underwent a considerable expansion, which corresponded to a considerable increase in income per capita of the population. The technological development and the distribution of produced wealth created the illusion of "unlimited growth", which would have maintained its unaltered rate through time. At the time, the unequal growth rate between industrialized countries and did not appear to be a problem, because it was thought that the non-industrialized would eventually catch up.

Towards the end of the sixties the first effects of the unlimited growth model were observed, at which point they become relevant and no longer avoidable. The effects become apparent in one way with the exploitation of resources, in another with pollution and environmental decay. Furthermore, the increasing levels of well-being favor an exponential growth of the population, allowing a vicious spiral to take place: increase in food production and resource consumption, increase in pollution and so on.

Therefore, the economic model is faced with a new issue: attribute a market value to the natural resources, the so-called social and environmental costs.

One of the first texts that expose the effects of new technologies on the environment is *Silent Spring* by Rachel Carson, which describes drastic changes tied to pollution produced by chemical agriculture to land and wells in the United States territory.

In 1971 the book *The Closing Circle* is released, which fiercely contests the dominating economic model on which the so-called "consumer society" is based on, and focuses on the apparent irresolvable conflict between economic growth and maintaining an environmental balance.

As far as the theme of energy consumption, 1973 is a historic date because it marks the division between two eras: in connection with the Kippur war (between Israel and Arab states), the illusion of being able to use an infinite amount of energy (oil) at a low cost ends. For this reason, starting with the date previously mentioned, a debate starts on a global scale on the use of energy sources and on humanity's fate facing problems connected to intense exploitation of resources.

In this debate it is important to discuss the role that the engineer Adriano Olivetti and the leading class assumed during the Olivetti industries experience in Ivrea. The holistic model connecting cities, society, labor, energy and growth suggested through texts, projects and solutions represented an extraordinary Italian experience, between the forties and fifties, which became an international benchmark for the application of a sustainable approach in an economy of capitals.

In fact, it was not a coincidence that "Club di Roma" of Aurelio Peccei, former director of Olivetti industries, commissioned the Report.

A premonition to the importance of the energy subject was the Report of the Massachusetts Institute of Technology (MIT) in 1972, *The Limits of Growth*, which alerts politicians and scientists on the dangers tied to the, at the current time, production methods, along with forecasting the planet's collapse.

Therefore, from this period on the central theme became the problem of non-renewable energy and its conservation, given the fact that they are not reproducible once used, in which case no longer available. The environmental issue, the protection and development of nature clash with the dominant economic interests and rules. Schumacher, in line with Olivetti's vision of economy's role and the concept of scale, anticipates the main knot of the environmental issue comprised in what will sub sequentially will become concept of sustainable energy, which is the problem of energy consumption tied to the use of fossil fuels.

Schumacher is not the only economist that discussed the matter. In fact, in 1980 Geremy Rifkin publishes *Entropy. Into the Greenhouse World*, where the history of urban development coincides with the history of the development of the rising energy consumption.

However, not until 1983 when Eugene P. Odum definitely lays the scientific basis of ecology with his reknown text *Basic Ecology*, which systematically illustrates the concepts of ecosystem, environmental systems, metabolism, complexity, resilience, predation, co evolution etc.

1.3.2. The MIT Report and the debate on expandable resources

At the time of the MIT report, the concept began to spread of the coming of a technological era would have modified the collective and individual behaviors of society, that is, the dominance of the economic and technological development could have implicated the loss of environmental values and society's ideals. Therefore, the focus of the debate is the issue of the limits of environmental growth and the potential role of technological innovation in removing such limits.

<<For many […] the new frontier is called science and technology, to which has the role to move the limits of the possible. However, for others the known and unknown resources that Earth has, are not sufficient for a long period to allow the actual and potential rates of usage: it is therefore necessary to confront as of now the problem of

a more national resource exploitation, in order to avoid catastrophic consequences in the near future (Bresso M., 1982)>>

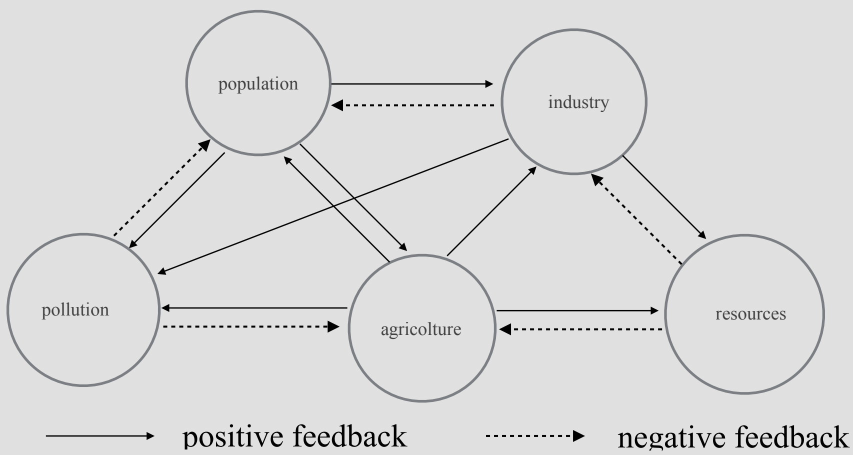
The report had the objective to define the limits that Earth places on human activity: which is the degree of compatibility between human activity and limited dimensions of the planet in terms of space and resources, through the determination and study of the *main factors* that cause the dynamic behavior of such system. For such purposes, a mathematical model (World3) has been devised, which describes the trending lines of the system, the way in which they interact between each other and the eventual consequences of these trends.

The model elaborated by J.W. Forrester tended to highlight in a finite way the exponential growth of any subsystem, which would clash with the limits of availability of base resources. This model identifies five synthetic variables considered fundamental to represent the system made of a combination of over 150 simple variables.

These variables are:

- Population;
- Agriculture (food production, ground fertility, expansion, loss of land);
- Economy (industrial production, service production, job positions);
- Natural non renewable resources;
- Pollution.

Fig.1 - MIT main model's elements



The most relevant part of the report leads to the conclusion that the actual growth trends of population and industrialization are in conflict with the material factors, the resources, which constitutes the base for every growth process.

The resources are identified as:

- Food (farmable land);
- Raw materials;
- Fossil fuels;
- Nuclear fuels.

If only agricultural production would double or quadruple (as indicated in the curve in the figure), the effects would consist in pushing back a few decades the “crisis point”. Analogous considerations can be made for raw materials, the withdrawal of which grows more rapidly than the population.

The availability of resources is not the only issue engaged in the report; higher limits are imposed by the planetary ecosystem. The latter mentioned, is capable of absorbing human waste products and converts them, through a series of cycles, into new resources. However, once the saturation level is passed the waste products start to accumulate in a toxic and excessive way with no possibilities of disposal.

For this reason the population growth and development of the economy entail an increase of energy consumption, 97% of which comes from fossil fuels. These excessive consumptions cause negative effects such as an increase of carbon monoxide into the atmosphere, or the increase in nuclear waste tied to the use of nuclear energy.

In synthesis, the Report’s conclusions are the following:

1. With the hypothesis that the current growth rate remains unaltered in five main sectors (population, industrialization, pollution, food production, natural resource consumption), humanity is destined to reach the natural limits of growth within the next hundred years. The most probable result will be a

sudden and uncontrollable decline of the population level and of the industrial system.

2. It is possible to modify this development trend and to determine an ecologic and economic condition of stability that can be brought into the future. The condition of global balance can be defined to satisfy human's material needs, and that everyone will have equal opportunities to accomplish their own human potential.
3. If humanity will opt for the second alternative, instead of the first, the probabilities for success will be greater, as soon as operating in this direction will begin.

1.3.3. The Stockholm conference, the normative approach and *basic needs*

The United Nations Conference on the Human Environment was held in Stockholm in 1972, is where for the first time Maurice Strong, secretary general, launches the term eco-development, till then defined as "*a development strategy founded on the judicious use of the local resources and on the practical knowledge of farmers, applied to Third World countries*" (Sachs I., 1992)

The central theme of the Conference was the relationship between development and environment and between man and nature: an interesting starting point for the observation made on sustainable development, which was further elaborated subsequently in the Brundtland Report.

The Conference, at which point focused on the crisis of the dominant economic model, was projected towards the attempt to find a growth model that would be coherent with rules of preserving and developing the environment. One of the most significant results was a document by the ONG, called "*Towards a human economy"*, which tries to trace a new road to find a common ground between economy and environment. For this reason, from then on the term development assumes a broader meaning, which included also civil, social, cultural and spiritual development of society.

By now, the consciousness that the planet's evolution, intended as a global environment, is getting closer to a critical point from which outcome can influence humanity's survival. Evolution is not determined by the relentless laws of nature, but by man's activity on nature:

Man has forged his destiny through a history of decisions he is responsible for; the course of that destiny can be changed with new conscious decisions, with a new affirmation of will. To start he needs a new path. (Daly H.E., 1992)

The new growth model to be followed has to be based on the parsimonious use of resources; the application of new technologies can't be finalized to the increase in profits and consumptions, or to the production of waste products, but should be aimed to the satisfaction of the fundamental human needs; which other than material well-being, should include freedom, auto determination, security, environmental quality and ecological balance. Obviously, not to be confused with Marx's *natural needs* known as the basic material needs expressed by the impoverished population. The fundamental needs, which are discussed, are both material and immaterial, and can't be reduced to a food ration, medical cures or a shelter.

"Fundamental needs are the ones society, or local community, defines by establishing, for itself and in the context of its abilities, tangible contents in function of social objectives that it wants to reach. Whether material or immaterial, the needs can't be established from the outside, but identified by civil society acting upon a project of civilization. […]"

(Sachs I., 1992)

”Cities are leftover baggage from the industrial era, […] we are headed for the death of cities due to the continued growth of personal computing, telecommunications and distributed production.”

Peters and Gilder, *City vs. Country: Debate about the impact of technology on location*

1.4. Eco-development and future generations

A new concept emerges from the Stockholm Conference, other than the attention to *basic needs*: eco-development. The meaning of this term is that of development that privileges the dimensions of the villages and community economy, along the same lines of what Olivetti individualized in "*The man's city*". Therefore, it represents a new vision of the world that places man in a different position compared to nature: a cautious behavior regarding new technologies is accompanied by a grater respect of the ecosystems, the natural cycles and exhaustibility of resources.

Eco-development is based on five elements:

- It has to be endogenous;
- It has to count on its own forces;
- It has to use *basic needs* as a starting point;
- It has to remain flexible to institutional changes.

The base to these new concepts is the attention that finally is replaced in regards to the future generations.

We did non inherit the land from our fathers. Our children lent it to us. To whom one day we will have to give it back.

Buddha's Indian proverb that inspires Schumacher's economy, invites us to design a world to leave behind in better conditions, or at least not in worse ones.

1.4.1. The Brundtland report and sustainable development

In 1987 the World Commission on Environment and Development report, better known as the Brundtland Report, discusses the problem of the impact of society on the environment and all of its mid to long term consequences, including the evaluation of the damages caused by the future generations due to the reduction of the reduction of natural assets from the process of economic growth.

If, in fact, the MIT Report had the merit of finding, as far as resource finiteness, an important limitation to the economic growth process, the Brundtland Report takes a step forward by discussing sustainable development. In comparison to the MIT Report, which projects a global environmental collapse by the 2000's, the Brundtland Report, however, argues that:

There are no exact limits in terms of growth of population and of resource use, but once exceeded an ecologic disaster would take place. For the consumption of energy, raw materials, water and land there are different limits; many of which are expressed in terms of raising costs and decreasing profits, instead of a sudden disappearance of a base of resources (WCED, 1988).

The new limits expressed by the Brundtland Report are in fact: not absolute limits but, imposed by the present state of technological and social organizations […] and by the ability of the biosphere to absorb the effect of human activity (WCED, 1988).

These limits paradoxically appear when the developments of science and technology corroborate the belief that man is able to invent new resources that can substitute the traditional ones.

However, the use of new technologies implicates new problems (for example nuclear waste from nuclear energy) because they have limited abilities to solve the environmental issues.

The new limits are of physical and biological nature, such as the hole in the ozone layer, the raise in anhydride levels in the atmosphere, the extinction of many animal and plant species, waste problems, conflicts on the uses of water etc. To correctly confront the environmental issue means adopting lifestyles "*compatible the ecologic resources of the planet*".

For this reason, the sustainable development is "*a process of change in which resource exploitation, direction of investments and institutional changes are made compatible with the future needs, besides the previous needs*" (WCED, 1988).

The sustainable development is intended as a development that satisfies present needs without compromising the ability of future generation to satisfy theirs.

The satisfaction of human needs and aspirations constitutes the main objective that could be considered "sustainable" for the following conditions:

a) The objective must satisfy the primary needs of all populations at the same time, in other words that everyone is given the possibility to aim for a better life.
b) The rate of depletion of non-renewable resources must impact the least every future opportunity (WCED, 1988).

The first definition introduces the concept of *globalization*. In fact, the environmental issue can't be efficiently confronted by relying simply on technological solutions; however, it must be confronted through undoing social limits for development represented by economic and social imparities between the different countries.

Also, the concept of globalization must be seen as *internationality*, which places a solution scale for environmental conflicts: this could be defined as local solutions only if designed by referring to the global planetary scale (defined with the neologism *glocal*); as much as policies can't be adopted that unload on their neighbours damages created locally.

In conclusion, the concept of globalization can't be untied to the *intergenerational* concept: where there is the necessity to go towards the destiny of future generations.

The second concept introduced is *sustainability*.

Renewable resources, such as forests and anima populations, can still be exploited only if their regeneration and natural growth is allowed. In fact, these resources are part of a complex and interconnected system, and the maximum sustainable output has to be established based on the effects on the entire planet. As far as non-renewable resources, for example fossil fuels and minerals, their use should be weighted according to the development of technologies, which allow for a decreased use and the possibility of their substitution. In other words, sustainable development requires that the decline rate of non-renewable resources preclude future opportunities the least.

1.4.2 The sustainable development and its history

Subsequently to the Stockholm Conference and the Brundtland Report, the United Nations Conference on Environment and Development (UNCED) held in Rio de

Janeiro in 1992, sustainable development is addressed as the common objective to necessarily include in the action plans for specific economic, social and environmental initiatives of the 21st century: in fact, Agenda 21 states the following: Governments […] should adopt national strategies for sustainable development […]. Such strategy should be designed using and harmonizing specific sector policies. The objective is to ensure an economic development responsible for society, while protecting the environment's fundamental resources for the benefit of future generations. The national strategies for sustainable development should be designed through the greatest possible involvement and the constant evaluation of the situation and ongoing initiatives.

Agenda 21 commits the involved governments to elaborate, by 1996, the "Agendas 21" at a local level and the *indicators of "sustainable development"*.

The huge success of this concept is probably due to, other than to the authority of the organization that developed it (WCED), its ability to trigger new explorations in all disciplinary fields of social sciences: urban science, economy, sociology, etc.

From the Agendas 21 many types of approaches have been defined to approach sustainability and sustainable growth.

1.4.3 The sustainable growth

The soft approach attempted to bring qualitative changes through the hypothesis of reduction of consumption and of polluting agents. There is an admission of existing biophysical limitations, which is why the economic system would have to adapt each time so these limits are not surpassed. This approach can be defined as "sustainable growth", because it is founded on the hypothesis that the different resource groups are replaceable and on technological innovation.

Development sustainability, according to the "London school of thought", has to be founded on the following conditions:

1. The environmental resources are not always replaceable;
2. The conditions of ecosystem sustainability are not fully known;
3. All extinction processes are irreversible
4. Intra- and inter-generational equality.

It is easy to sense that this approach can only work with a drastic change in lifestyle models produced and generated in the years of the great consumption expansion.

Another approach is the one that evaluates an energetic analysis, which deems non-sustainable any process with a negative energetic balance or that, subtracts non-renewable resources from future generations.

According to this approach, sustainable development is rendered difficult by the limitations imposed by the second law of thermodynamics, the entropy law, which states that to entirely recycle resources it is impossible (or possible only with the use of enormous quantities of energy), which entails in the long run an unsustainable pressure on the environment due to the production of waste.

The bio-economic program is articulated in seven points:

1. End production of all military facilities;
2. Inter-generational equality;
3. Control over demographic growth;
4. Ban “luxury goods” and useless consumptions;
5. Recycle objects;
6. Drastically reduce energy consumptions;
7. Produce more durable goods through a design that makes them more durable.

According to H.E. Daly sustainable development is of the “stationary state”, “*development without growth. That is, a qualitative improvement without a quantitative advent such to exceed the ecosystem's resilience, meaning without exceeding the environment's ability to regenerate inputs of raw materials and to absorb outputs of waste products”* (H.E. Daly, 1997 and 1991).

Therefore, sustainability has to respect the following limits:

1. The sustainable rate at which a renewable resource is used can't be higher than the regeneration rate;
2. The sustainable rate at which a non-renewable resource is used can't be greater than the rate at which it is possible to replace it with a renewable resource, used in a sustainable matter;

3. The sustainable rate of emission of a polluting agent can't be grater than the rate at which the very agent can be recycled, absorbed or made harmless to the environment.

The authors of the MIT Report, the Meadows, published in 1992 the book "*Beyond the Limits*", in which they argue that the use of resources and the levels of pollution have raised beyond the limits of sustainability.

Humanity has gone beyond its limits. The current course of action is unsustainable. To have a livable future, the must be a future of retreat, alleviation, healing […] World3 had demonstrated that in twenty years some options regarding sustainability have diminished, but some have been opened (Meadows D.H., Meadows D.L., Randers J., 1992) The Meadows elaborate a six point program:

1. Improve the signals. Knowing and observing the population's well-being and the state of the local and planetary springs and wells. Inform, in a timely manner and continuously, the government and the public on the environmental and economic conditions. Reformulating the economic indicators such as the gross national product.
2. Yield quicker response times. Looking for the signals, which indicate that the environment is under stress. Deciding how to address a problem prior to its occurrence, if possible forecast the possible occurrence of a problem, design institutional plans to effectively act.
3. Minimize the consumption of non-renewable resources. Non-renewable resources should be used with maximum efficiency, always recycled, when possible, and only be consumed in the hypothesis of a deliberate transition to renewable resources.
4. Prevent the erosion of non-renewable resources. All non-renewable resources should be consumed at a rate that consents them to reproduce.
5. Use all resources with maximum efficiency. This aspect is essential to sustain the world's current and future population, without causing its collapse.
6. Slow down and stop the exponential growth of the population and physical assets. The first five points can be pursued within limits. For this reason this point becomes essential: it implies institutional and thought changes, and social innovations. It is necessary to define levels of population and industrial production, which are sustainable, and also to define objectives based on the concept of development instead of growth.

"The urbanist's intelligence and passion dig deep in the most complex and delicate subject; he wants to intervene where life is an *undividable unit* of its *processes*, his work and his reality have slowly and laboriously developed a kind of *balance*."

R. Zweteremich, 1948, *Zoning Plan of Val d'Aosta*

1.5. Urban design and the other disciplines: an epistemological review

The complexity that dictates the urban systems and the new development models, the present uncertainty in the environmental phenomena and the lack of linearity of the processes that highlight the necessity for interdisciplinary relationships, specifically the ones concerning natural sciences. There is a demand, most of all, by the urbanist community.

Figure 2 - Sustainable value map (Chris Butters holistic framework)

Society	**Ecology**	**Economy**
1. Aesthetics	1.Land Use	1.Flexibilty
2. Sociability	2.Biodiversity	2.Management
3. Involvement	3.Bioclimatics	3.Communication
4. Variety	4.Energy	4.Services
5. Security	5.Water cycles	5.Finacial
6. Identity	6.Materia cycles	6.Activity
7. Accessability	7.Transport	7.Functionality
8. Sociodiversity	8.Health	8.Cost

Urbanism is developed as a group of hygienic and building guidelines in response to the industrial revolution, which poses the problem for a new form of settlement, meaning the city, where thousands and then millions of people begin to concentrate due to the industries new forms of production.

Therefore, this discipline is developed around the technical knowledge based on functional zoning, which is land organization and management. This conceptual and technical system is proven to be ineffective to confront raising problems, which were the relationship between social projects and urban-architectural projects, the renewed relationship between man and nature and the dismissal of the anthropocentric vision and the new limits imposed by the environmental problem.

At this point, it is fundamental to define in which the direction to look and to begin a new path in the discipline. The conceptual frame is clear; it is necessary to find the courage to overcome the disciplinary barriers to redefine the role of who develops the urban project.

However, transferring concepts from one discipline to another is not always legitimate: it could be a phenomenon caused by trends, or result unproductive and inefficient.

Urbanism has a past that is characterized by various aborted transitions, which produced ambiguity and false scientific results, but on the other hand it developed disciplinary diversifications, such as modelist, designers and analysts.

Obviously, not all of the transitions failed. Some were successful, such as the transition from economy, and others like the transitions from ecology are still undergoing experimentation.

If what Isabelle Stengers is true, the adaptation of concepts to a discipline become legitimate, productive and fertile when it allows progress for the disciplinary knowledge regarding the concept. This means that the adaptation of a given concept is meaningful when it gives adequate instruments to confront the new problems rising from the scientific community of the given discipline.

Therefore, it is necessary to verify is such adaptation is pertinent, and also if it is fertile; two aspects that are often dependent on each other.

The question, asked by Isabelle Stengers, is if there are criteria to define how scientific is the transition of concepts from one discipline to another. Scientific philosophy gives us three possible approaches to evaluate these transitions:

- The first approach is based on the idea that it is possible to identify a series of concepts with inter-disciplinary value, meaning that its possible to recognize the presence of unvaried elements within any disciplinary field.
- The second approach states that the opportunity to transfer concepts from one discipline to another can't be tied to an abstract "scientific" definition, however it must be tied to the ability to establish relationships between the different subjects studied. Therefore, the purpose becomes to *research the analogies between*

apparently different phenomena, to fine tune the general definitions that consent finding the analogies, to attempt transferring concepts each time the possibility to operate in an analogous way is foreseen.

- The third approach is opposed to defining any objective criteria to evaluate how legitimate a scientific operation is, including, therefore, transferring concepts from one discipline to another.

“Energy is the life blood of our society”

European Commission’s communication, *Energy 2020 — A Strategy for competitive, sustainable and secure energy.*

2. Policies for efficiency, present and future expectations.

In this chapter we introduce what policies and tools European (and Italian) designers and planners are dealing with to transform the urban context.

2.1 European urban metabolism

Researchers have compared cities to biological organisms. Organisms need energy and resource inputs, transform them to do work, and produce waste, much like cities do. Defined as “the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste”, Urban Metabolism (UM) emerged in the late twentieth century as a systems-based approach to understand urban trajectories of resource use, waste production, and associated impacts on the environment. Some ecologists have been uncomfortable with the urban metabolism framework as they point out that only individual organisms have a metabolism, and thus UM is improper biological analogy. Instead, some have suggested that cities are more like ecosystems—the summing up of many metabolisms. Yet urban metabolism is the term of art in the industrial ecology community, and increasingly in geography, planning, and other related disciplines, and it offers a vivid image that many understand. Thus, urban metabolism provides a metaphorical framework to examine the interactions of natural-human systems and provides a basis upon which to consider sustainability implications.

Beside the two distinct theoretical approaches, mass balance accounting and Odum's energy method, the biggest challenge facing urban metabolism is the integration of political, demographic, economic, and geographic factors that govern or influence a city or region's urban metabolism.

Any city's metabolism is the result of human agency—the ability to exploit ecosystems and their services. This involves scales of governance, institutional rules and conventions, multiple economic forces, and capital flows that shape specific places.
Here is where the UM framework is weakest and needs the most theoretical development, and where this work tries to give a humble contribute.

2.1.1 The healing policies

International and national policies are pointing out how a UM view of the urban process is the only key we have to face the future of our cities (Bajardi, 2009).
The well being of our people, industry and economy depends on safe, secure, sustainable and affordable energy able to feed the urban system.
At the same time, energy related emissions account for almost 80% of the EU's total greenhouse gas emissions. Since 1993 Cities for Climate Protection Campaign (CCPC) promoted by ICLEI when the international debate was just starting, 600 local administrations from 30 different countries voluntary were involved in developing emissions reduction policies.
The European Council in 2007 adopted ambitious energy and climate change objectives for 2020 – to reduce greenhouse gas emissions by 20%, rising to 30% if the conditions are right, to increase the share of renewable energy to 20%, and to make a 20% improvement in energy efficiency.
The European Council has also given a long-term commitment to the decarbonisation path with a target for the EU and other industrialized countries of 80 to 95% cuts in emissions by 2050.
Nevertheless, the existing strategy is currently unlikely to achieve all the 2020 targets, and it is wholly inadequate to the longer-term challenges.
EU energy and climate goals have been incorporated into the Europe 2020 Strategy for smart, sustainable and inclusive growth, adopted by the European Council in June 2010, and into its flagship initiative 'Resource efficient Europe'.
European Commissioner for Energy Günther H. Oettinger argues:

“The energy challenge is one of the greatest tests faced by Europe today. Rising energy prices and increasing dependence on energy imports jeopardise our security and our competitiveness.

Key decisions have to be taken to reduce drastically our emissions and fight climate change. What is more, huge investments of around €1 trillion will be needed in the next decade to make Europe’s installations and infrastructure fit for the future. It is high time that Europe got its act together. Thankfully, the 2020 strategy provides a solid and ambitious European framework for energy policy based around five pillars of action.”

To face the “ambitious framework” EU Commission seems had borrow the Gene Sharp’s method to trigger and run a democratic revolutions.

The top-down energy strategy really seems to have the aim of building and leading a bottom-up energy revolution.

Energy efficiency is the “pillar one” of the European 2020 energy strategy and the other are Building a pan-European integrated energy market, Empowering consumers and achieving the highest level of safety and security, Extending Europe’s leadership in energy technology and innovation, Strengthening the external dimension of the EU energy market.

According to the energy efficiency domain, European Commission defined specific actions that each member state has to take:

Action 1: Tapping into the biggest energy-saving potential — buildings and transport

Action 2: Reinforcing industrial competitiveness by making industries more efficient

Action 3: Reinforcing efficiency in energy supply

Action 4: Making the most of National Energy Efficiency Action Plans

Therefore, at the international policy scale, EU defined roles and tasks for each government, leaving them the internal strategy to follow.

2.1.2 Climate plans

A BIARI (Brown International advanced research institute) research program analysed almost 100 climate plans and pointed out a constant common structure despite the territorial characteristics change.

Following what they defined best practices of the international scene.

Tab. 1 - International Best Practices analysed by BIARI

	City, Region	Level	Country	Year	
1	PHILADELPHIA - Local Action Plan for Climate Change	Local	Pennsylvania	2009	Adaptation and green building
2	KENEE - Climate Action Plan	Local	New Hampshire	2000	Green buildings green power recycling
3	FREIBURG - Action Plan for Climate	Local	Germany	2013	Energy resources political engagement
4	SACHSEN - Aktionsplan Klima und Energie Sachsen	Regiona l	Germany	2013	Renewable energy
5	LISBON - Plan of Action for the Sustainable Energy of Lisbon	Regiona l	Portugal	1970	Energy efficiency, renewable energy monitoring transports, energy saving.
6	BARKELEY - Climate Action Plan	Local	California	1970	Zero waste local food, sustainable mobility and renewable energy
7	MARTINEZ - Climate Action Plan	Local	California	2013	Public education renewable energy, sustainable buildings, reduction of GHG emissions and alternative transport
8	MIDDLESBROUGH - Climate Change Community Action Plan	Local	England	2011	Adaptation, education, communication.
9	HAMBURG - The Action Plan Builds on a Threefold Strategy	National	Germany	1970	Buildings, climate change, emission, energy, land use, mobility, technology, transport and water
11	WELLINGTON - City's 2010 Climate Change Action Plan	Regiona l	New Zealand	1970	Green technologies, mitigation, greenhouse
12	CAPE TOWN - Climate Change Programme	Local	South Africa	2006	Water management, biodiversity conservation, energy security
13	HESPERIA	Local	California	2013	Adaptation, sustainable transport and compact urban growth with T.O.D.
14	HELSINKI - Metropolitan Area Climate Change Strategy	Local	Finnland	1970	Sustainable energy city development and greenhouse adapting plicies
15	PITTSBURGH - Climate Action Plan	Local	Pennsylvania	2013	Recycling and waste management, green building, transportation
16	PERTH - Regional Climate Adaptation Action Plan 2009 - 2013	Regiona l	Australia	2009	Public health reducing CO_2 emissions, water resources management, transport and energy networks
17	KING COUNTY - Climate Change Plan	Local	USA	2006	GHG reduction, green building, sustainable transportation.
18	TURIN - Turin Action Plan for Energy	Local	Italy	2014	Smart mobility and energy efficiency.
19	WORCHESTER - Climate Action Plan	Local	Massachusetts	2007	Energy efficiency, smart mobility, renewable energy and waste management.
20	SAN FRANCISCO - 2011 Climate Action Strategy (CAS) Trasportation System	Local	California	1970	Sustainable transportation system

21	COPENHAGEN - Climate Plan	Local	Denmark	2009	Urban development, transportation, buildings efficiency adaptation
22	BOSTON - Sparking Boston's Climate Revolution	Local	Massachusetts	2014	Environmental monitoring facilities, utility and governmental services, energy resources
23	DUBLINO - Sustainable Energy Action Plan	Local	Ireland	2010	Renewable energy network, transportation
25	LONDON - London Plan 2011	Local	United Kingdom	1970	Adaptation
26	CANARY ISLAND - Canaria strategy to cope with the climate change	Regiona l	Spain	2008	Islands vulnerability mitigation, energy self-sufficiency
27	PORTLAND - Climate Initiative	Local	Oregon	2009	Public participation, adaptation, mitigation
28	MADISON - Climate Protection Plan	Local	Wisconsin	2002	Education, participation of citizen
29	OSLO - Municipal Master Plan	Local	Norway	2008	Transportation, urban sprawl and air quality mitigation
30	TORONTO - Clinton Climate Initiative	Local	Canada	2007	Mitigation, energy efficiency and community engagement
31	MONTREAL - Community Sustainable Development Plan 2010-2015	Local	Canada	2010	Waste management, energy efficiency and smart transportation
32	STUTTGART - Climate Protection Programme	Local	Germany	1997	Climate change, energy, transport, air pollution, water and land Use.
34	MEXICO CITY - Climate action program	Local	Mexic	2008	Eco-transport, sustainable housing, solar-energy, green roofs, urban retrofit
35	HONG KONG - Climate Change Strategy and Action Agenda	Local	CHINA	2013	Low carbon city, mitigation and adaption strategies
36	MALMO - Climate smart Malmo	Local	Sweden	2009	Transportation, energy and consumption
37	STOCKHOLM - Stockholm Climate Initiative	Local	Sweden	2007	Public participation, economic benefits
38	MIAMI - MiPlan	Local	Florida	2008	Buildings, energy, transportation and land use adaptation
39	GIRONA - Pla Local de Mitigació del Canvi Climàtic a Girona (PMCC)	Local	Spain	2011	Renewable energies and energy efficiency mitigation
40	ROTTERDAM - Climate Initiative	Local	Netherland	2007	Public participation, economic benefits
41	VANCOUVER - Plan for the city of Vancouver	Local	Canada	2008	Climate change and emission reduction
42	BELGIUM - Plan National Climat 2009-2012 de la Belgique	National	Belgium	2009	Reduction in greenhouse effect and national adaptation strategy
43	NEW DELHI - Climate Change Agenda for Delhi 2009-12	Local	India	2014	Energy conservation, solar-water heating systems efficient, street-lighting and efficient use of water pumps
44	INDIA - National Action Plan on Climate Change	National	India	2008	Economic development reduction of CO_2 emissions
45	EBRO DELTA - Strategy of Prevention and Adaptation to Climate Change	Local	Spain	2008	Risk analysis, vulnerability analysis and adaptation measures
46	LONDON - Climate change in a London Plan	Local	United kingdom	2014	Reducing pollution developing a low carbon economy consuming fewer resources
47	LISBON - Energy - Environmental Strategy	Local	Portugal	2008	Monitoring resources management for sustainable development and urban management mobility.
50	DENVER - Greenprint Denver	Local	USA	2005	Waste disposal system, water management and sustainable transportation

51	CHICAGO - Climate Action Plan	Local	USA	2008	Energy efficiency, renewable energy, transportation, reduced waste adaptation
52	BILBAO - Plan Local de Accion contra el Cambio Climatic	Local	Spain	2009	Energy efficiency, sustainable mobility and adaptation
53	MUMBAI - Disaster Management Action Plan	Local	India	2007	Mitigation climate and governance
55	CALIFORNIA - Climate adaptation strategy	National	USA	2009	Resilience manage climate impacts
56	EDINBURGH - Sostainable Edinburgh 2020 action plan	Local	United kingdom	2007	Reduce carbon emissions energy efficiency renewable energy.

Source: Elaborated by the author (this study is reachable at www.iuav.it/climatechange).

All of these documents are mainly composed by:

- a general analysis of the climate changes effects on the large and the local scale.
- how local strategies are referred to national and international policies
- a baseline emission inventory also by sector
- reduction policies and actions
- the implementation method: financial plan, timeline, engagement strategies with the administration operative sectors, engagement strategies with citizens, communication strategies, valuation systems etc.

But not all the plans take into account urban planning; they deal with this topic mainly giving advice for singular issues as buildings, urban transports, and renewable energies.

A special chapter of the British Planning Policies Statements (PPS), for example, points directly to the local urban plans.

Adaptation strategies are mainly soft, involving behavioral changes and public administration innovative processes or hard, based on retrofit interventions and technological innovation.

2.1.3 EU engagement strategies with local Governments

In order to be more effective, EU Commission tried to build a direct dialogue also with the local entities, also the tiniest, truing to foster from above and with who have really the control of the urban policies.

So, lots of cities started to point more ambitious objectives (London's task is to cut emission for the 38% by the 2020 and for the 60% for 2025) and developed their own structure plan in order to do it, but the majority is still in standby.
To foster this ambition, EU has developed local policies of voluntary solutions called "the Covenant of Mayors" and "the Pact of Islands" literally born to build an international mayors' network that, independently from the local state government, share the EU 2020 energy mission.
Joining these programs means applied new volunteer practical planning tools: the Sustainable Energy Action Plans (SEAP) and the Sustainable Urban Mobility Plans (SUMP).
There are incentives from the EU, of course, that should foster local communities to fix ambitious energy policies, as specific funding programs (ELENA - www.eib.org/elena -as an example) and benefits in order to reach other EU commission fund opportunities.
Upon these two lines, the top-down (from Europe to Countries) and the bottom-up (from Cities to Europe) since 2007, European countries and single cities are developing their own strategies and tools, trying to address the common european energy objective.

2.1.4 Voluntary local energy policies: the Covenant of Mayors

The Covenant of Mayors is the mainstream European policy framework uniting local and regional authorities in a common commitment to improve the quality of life of their citizens through the implementation of sustainable energy policies.
After the European Union climate and energy package was adopted in 2008, the European Commission launched the Covenant of Mayors to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. The crucial role, played by local and regional authorities in addressing energy and environment challenges and using resources efficiently is becoming more apparent than ever.

Through the Covenant, over 4,000 mayors and equivalent city leaders have pledged to adopt a sustainable energy action plan, outlining how they intend to reach the EU 20 % CO2 reduction objective by 2020.

Over 1,500 action plans of this nature are now under implementation in European cities, setting the stage for thousands of measures and initiatives to be rolled out in the fields of transportation, housing and urban development. These actions aim is not only to benefit the over 165 million inhabitants impacted by the initiative; they pursue to generate new economic opportunities in crisis-stricken cities through the implementation of sustainable energy projects.

This formal commitment has to be achieved through defined crucial steps: the completion of a Baseline Emission Inventory (BEI), the development of a Sustainable Energy Action Plan (SEAP) and the development of other kind of Action Plans mostly focused in the specific urban domain (as the Sustainable Urban Mobility Plans).

2.1.5 Action Plans

They are all the specific instruments of intervention in urban policies.

These plans can respond to three different models of urban governance.

The first one is a self-governing model, in which the local government can manage the own activities and can intervene on its properties.

Another way is governing by provision, supply services through municipal agencies of services such as energy, transport, water, and waste agencies. Though enabling refers to the coordination role of the local government and the promotion of public-private partnerships, including the voluntarily participation of citizens.

A more traditional form of government is by regulation, providing sanctions and sets of regulations.

2.1.6 The Sustainable Energy Action Plans

The planning process follows several steps, after the political commitment and signing of the Covenant, and with the adaptation of the city administrative structures, the research for partnerships and with the work organization begin. Building support from stakeholders and involving the civil society are prerogatives for the plan.

According to the SEAP Guidebook stakeholders and the citizens involvement is the starting point for stimulating the behavioral changes that are needed to complement the technical actions embodied in the SEAP. This is the key to a concrete and co-coordinated way to implement the SEAP. Citizens and other stakeholders should be involved in various degrees during the elaboration process, from building the vision to defining the objectives and targets and setting the priorities.

A Baseline Emission Inventory to identify the best fields of action and opportunities for reaching the local authority's CO2 reduction target. It defines concrete reduction measures, together with time frames and assigned responsibilities, which translate the long-term strategy into action. Signatories commit themselves to submitting their SEAPs within the year following adhesion.

The SEAP should not be regarded as a fixed and rigid document, as circumstances change, and, as the ongoing actions provide results and experience, it may be useful and or necessary to revise the plan on a regular basis.

It is necessary to remember that opportunities to undertake emission reductions arise with every new development project to be approved by the local authority. The impacts of missing such an opportunity can be significant and will last for a long time. This means that energy efficiency and emission reduction considerations should be taken into account for all new developments, even if the SEAP has not yet been finalized or approved.

The guidelines, by the European Commission Joint Research Center (JRC), developed to implement a SEAP are filled with tips and suggestions in order to develop easy feasible and effective plans from one urban context to another.

The document describes different phases of the process, and the most interesting thing, is that it also gives a timeline to implement each step.

The goal is to get to the final reporting moment in two years.

PHASE: Initiation

1. Political commitment and signing of the Covenant
2. Adapt city administrative structures
3. Build support from stakeholders

PHASE: Planning phase

4. Assessment of the current framework (with the Baseline Inventory): Where are we?
5. Establishment of the vision: Where do we want to go?
6. Elaboration of the plan: How do we get there?
7. Plan approval and submission

PHASE: Implementation phase

8. Implementation

PHASE: Monitoring and reporting phase

9. Monitoring
10. Reporting and submission of the implementation report
11. Review

Also planners are fostered to fill specific fields in order to plan forces and find time and metrics to keep under control the whole planning process.

JRC suggested a layout contents:

1. SEAP Executive Summary
2. Overall strategy

A. Objective(s) and Targets

B. Current framework and vision for the future

C. Organisational and financial aspects:

• coordination and organisational structures created/assigned;
• staff capacity allocated;
• involvement of stakeholders and citizens;
• budget;
• foreseen financing sources for the investments within your action plan;
• planned measures for monitoring and follow-up.

3. Baseline Emission Inventory and related information, including data interpretation
4. Planned actions and measures for the full duration of the plan (2020)

• long-term strategy, goals and commitments till 2020;

• short/medium term actions.

For each measure/action, specify (whenever possible):

- description
- department responsible, person or company
- timing (end-start, major milestones)
- cost estimation
- estimated energy saving/increased renewable energy production
- estimated CO_2 reduction

Moreover, the SEAP has to contain a coherent set of measures covering the key sectors of activity: not only the buildings and facilities that are managed by the local authority, but also the main sectors of activity in the territory of the local authority: residential sector, tertiary sector, public and private transport, industry etc.
The attempt of a holistic approach to the energy theme is due to the long-term vision planners have to use in the environment domain. This means that before starting the elaboration of actions and measures, establishing clear objectives is highly required.

2.1.7 The Sustainable Urban Mobility Plans

Long-term vision, holistic approach, metrics and time effective planning are also the main characteristics of other kinds of action plans.
In the Action Plan on Urban Mobility published in 2009, the European Commission proposed to accelerate the uptake of Sustainable Urban Mobility Plans in Europe by providing guidance material, promote best practice exchange, identify benchmarks, and support educational activities for urban mobility professionals.
EU transport ministers are supporting the development of Sustainable Urban Mobility Plans. The conclusions on the Action Plan on Urban Mobility of 24 June 2010 state that the Council of the European Union "supports the development of Sustainable Urban Mobility Plans for cities and metropolitan areas [...] and encourages the development of incentives, such as expert assistance and information exchange, for the creation of such plans".

In March 2011, the European Commission released its Transport White Paper "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" (COM (2011)0144 final). The Transport White Paper proposes to examine the possibility of making Urban Mobility Plans a mandatory approach for cities of a certain size, according to national standards based on EU Guidelines. It also suggests exploring to link regional development and cohesion funds to cities and regions that have submitted a current, independently validated Urban Mobility Performance and Sustainability Audit certificate. Finally, the Transport White Paper proposes to examine the possibility of a European support framework for a progressive implementation of Urban Mobility Plans in European cities.

As argued in the guidelines released for planners and city managers, a SUMP is "…a strategic plan that builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles to satisfy the mobility needs of people today and tomorrow for a better quality of life in cities and their surroundings."

A Sustainable Urban Mobility Plan aims to create a sustainable urban transport system by:

Ensuring the accessibility of jobs and services to all;

Improving safety and security;

Reducing pollution, greenhouse gas emissions and energy consumption;

Increasing the efficiency and cost-effectiveness for the transportation of people and goods;

Enhancing the attractiveness and quality of the urban environment.

It suggests an integrated approach that considers practices and policies of different policy sectors, authority levels, and neighboring authorities.

In many cases, plan development is driven by a city's mobility or transport department. However, the policy relevance for Sustainable Urban Mobility Plans is not limited to mobility and transportation, and it is one of its characteristics to involve other municipal and regional departments (for example, land-use, environment, economic development, social inclusion, health, safety) in the planning process. It is a significant challenge to address deficits in integration and cooperation, but is also a main source for innovation and improvement.

A clear vision, objectives and a focus on achieving measurable targets, which are embedded in an overall sustainable development strategy, are necessary.

The plan should be based on a long-term vision for transport and mobility development for the entire urban agglomeration.

It should cover all modes and forms of transport: Public and private, passenger and freight, motorized and non-motorized, moving and parked.

A strategic vision provides a qualitative description of a desired urban future and serves to guide the development of appropriate planning measures.

The vision needs to be specified by concrete objectives, which indicate the type of change desired. Changes and impacts also need to be measurable, requiring a well thought-out set of targets that focus on selected areas and indicators.

A review of transport costs and benefits, taking into account wider societal costs and benefits.

Measure selection is guided not only by effectiveness but also by value for money.

Especially in times of tight budgets for urban transport and mobility, it is crucial to get the most impact possible for the resources spent. This requires a basic assessment of options with an eye on costs and benefits, including those that cannot be easily measured or valued such as those related to greenhouse gas emissions or air quality impacts.

The European Commission emphasizes in its Transport White Paper (2011) the importance to proceed with the internalization of external costs for all modes of transport applying common principles while taking into account the specificity of each mode.

Developing and implementing a Sustainable Urban Mobility Plan should be understood as a continuous process, which comprises eleven essential steps. The graphical overview of this process presents these steps in a logical sequence. Realistically these activities can run partially in parallel or include feedback loops.

A detailed description of all the steps and activities can be found in the Guidelines "Developing and Implementing a Sustainable Urban Mobility Plan".

The Guidelines include good practice examples, useful tools and references that further illustrate the entire plan making process, following we report the main points:

Starting Point: "We want to improve mobility and quality of life for our citizens!"

Determine your potential for a successful SUMP.

Define the development process and scope of plan.

Analyze the mobility situation and develop scenarios.

Develop a common vision.

Milestone: Analysis of problems & opportunities concluded.

Set priorities and measurable targets.

Develop effective packages of measures.

Milestone: Measures identified.

Agree on clear responsibilities and allocate funding.

Build monitoring and assessment into the plan.

Adopt a Sustainable Urban Mobility Plan.

Milestone: SUMP document adopted.

Ensure proper management and communication.

Learn the lessons.

Milestone: Final impact assessment concluded.

As for the SEAP also the SUMP, plans strike down to the planning process critical point: be effective.

To do so it uses a powerful combination of social engagement (politics, stakeholders and people), reasonable objectives, economic sustainable actions and finally metrics and indicators to follow the plan actuation and evolution.

”Urban Energy Plans quality is tightly related with the integration and the influence capacity upon the ordinary urban planning tools.”

Ezio Micelli, *I nodi del rapporto tra Energia e Pianificazione*

2.2 The Italian scene

As previously pointed out (Chaps. 1.4.1 and 1.4.2), the Report of the Brundtland Commission, the Green Paper on the Urban Environment and Rio Summit of 1992, stated the necessity for cities to have a role of greater responsibility in defining strategies to support sustainable development and environmental protection.

After the Rio Summit, a series of other initiatives, based on a voluntary implementation, supported this orientation; Agenda 21, C40 Cities and Covenant of Mayors, identify local governments as key players for the energy planning and management.

Despite local governments acquiring larger responsibilities on energy management and energy policy definition, and the launch of experimentations in the definition of local action plans for energy, these instruments and the same approach to the urban energy issue result to be mono-disciplinary and scarcely integrated within the urban governance on a more complex level.

Through the next confrontation between case studies (Bologna, Modena, Trento and Venezia), which includes both traditional and innovative experiences, it is possible to mark differences and limits in the implementation of the “Piano Energetico Comunale (PEC)” (Municipal Energy Plan), the local energy plan mandatory in Italy for municipalities with over 50.000 inhabitants.

Fig. 1 - Methodology of the italian municipal energy plans.

"ENEA" methodology	**"Ambiente Italia" methodology**	**Innovative approach**
	Information Phase	
- Municipal energetic balance - Elaboration of scenarios and trends - Potential local resources study - Definition of metrics and indicators	- Municipal energetic balance - Elaboration of scenarios and trends - Potential local resources study - Definition of metrics and indicators - *Environment critical point analysis*	- Municipal energetic balance - Elaboration of scenarios and trends - Potential local resources study - Definition of metrics and indicators - *Energetic consumption spatial characterization* - *Energetic sources identification*
	Action Plan	
	Self-governing	
	Energy efficiency intervention on public proprieties	
	Goods and service by provision	
- Energetic grids	- Energetic grids - *Integrated resources planning*	- Energetic grids
	Interventions support through enabling	
- Renewable energy technologies promotion	- Renewable energy technologies promotion	- Renewable energy technologies promotion - Retrofit intervention promotion
	Regulation	
- Buildings energy standards	- Buildings energy standards	- Buildings energy standards - *Norms for buildings orientation, heat island reduction and S/V value*
	Actuation tools	
- Financial incentives - Obligatory energetic certification - Construction norms with restrictions depending on the building energy performance.	- Financial incentives - Obligatory energetic certification - Construction norms with restrictions depending on the building energy performance.	- Financial incentives - Obligatory energetic certification - Construction norms with restrictions depending on the building energy performance. - *Infrastructure cost reduction.* - *Volume incentive.*

Source: Elaborated by the author.

2.2.1 Italian Municipal Energy Plans

Introduced by the Italian national law n.10/1991, "Norme per l'attuazione del Piano Energetico Nazionale in materia di uso nazionale dell'energia, di risparmio energetico e di sviluppo delle fonti rinnovabili di energia", it was created to integrate the tools of urban planning with a plan for energy efficiency and use of renewable sources. According to the law the energy plan is subordinated to the main urban plan.

A PEC consists of 3 parts:

a knowledge part

a proactive part

an implementation processes.

The knowledge part aims to define the local energy balance (supply and demand), the so-called "Bilancio Energetico Comunale (BES)" (Municipal Energy Balance).

Analysis for the energy efficiency of buildings is essential. To assess the demand for energy, the territory is divided into areas of demand and historical value and are built based on energy consumption.

The proactive part makes an energy zoning. Once the objectives of the PEC are identified, the strategies for creating efficiency are described in sub-sectors: plants, fuels, waste, transport and environmental protection.

The implementation part provides rules to follow for the building envelope, for the heating and air conditioning systems and lighting.

2.2.3 Italian limits in planning processes

The limits for the implementation of these kind of plans, also seen in the case study, may be attributed to four causes: skills, policy making process, lack of integration and regulatory chaos.

Institutional capacity is the first factor that affects the success or failure of a plan. Competences of local governments, political leadership, financial resources and presence of professional and technical support are factors that certainly influence the results.

The second aspect to take in consideration is the entire policy making process and how the planning process is structured. Contents, priorities and instrument choices are directly linked to the results. The policy tool approach can compromise the success of public interventions.

Instruments, programs, plans, public-private agreements, regulations should be mixed and integrated according to the contexts, problems and different models of urban governance.

Lastly the implementation strategy points out another system fragility: local governments produce instruments that act locally and refer to many different limits depending on the territory regulation. By creating diverse metrics and goals, even in very close environments, is even more difficult to foster new policies.

2.2.4 Italian cases: Bologna, Modena, Trento and Venice

The case studies are relative to four chief towns of Italian provinces that have developed plans following two different methodologies (Enea and Ambiente Italia) and featured a combination of different tools, policies, plans, programs to reach the goal of reducing energy consumption and promoting of renewable energy sources use.

Tab. 1 - Case study cities profiles.

	Bologna	Modena	Trento	Venice
Population	380.181	184.663	116.298	270.098
Municipal Area [squared km]	140,845	183,663	157,90	414,570
Population density [Pop./KmSq]	2.699,3	1.010,5	729,850	652,869
Natural gas consumption [Mc/Pop.]	571,7	640,7	630,4	619,5
Electric consumption [Kwh/Pop.]	1.304,5	1.189,3	944,1	1.170,4
District heating volume [Mc/Inh.]	19,8	5,5	0,0	0,0
Solar panels [mSq/1.000 Inh.]	0,6	3,0	4,6	0,7
PV panels on municipal properties [Kwh/1.000 Inh.]	5,2	0,1	0,6	0,5

Source: municipal statistic bureau, ENEA, Legambiente, Ecosistema Urbano (2010).

Bologna shows a great experience of participation in projects related to the energy sector (Aalborg signatory, Agenda 21 etc.) and develops its first PEC in 1999, revised in 2007 in conjunction with the design of the new urban structural plan. In this occasion the first PEC was revised changing methodology and adopting the database of the urban information system, while the urban structural plan integrated analysis, objectives and energetic strategies from the PEC. An accurate work was made to connect energy aspects and territorial development, identifying similar areas (for morphology and energy profiles) of the city and giving for them different guidelines for energy consumption reduction and including the use of renewable sources of energy. The following step for Bologna was the signing of the Convent of Mayors in 2008 and SEAP adoption.

Modena presents similar characteristics, experience and sensitiveness to the energy issue with a particular effort made in the direction of an integration of the PEC with the main planning instruments. First of all, the Modena PEC, approved in 2005, follows the conformity with the provincial energy plan. The Geographical Information Systems, base of the urban city plan, made possible the analysis of consumptions giving them spatial references. The revision in 2007 of both instruments, including the building regulation, made their integration stronger in favor of a better attention to environmental protection. The identification of homogeneous areas and the adoption of a parametric system allow for evaluating possible scenarios of transformation and better energy policy choices. Modena also joined the Convent of Mayors in 2008.

Between 1995 and 1999 Trento attempted with no results, under the office environmental services and with the support of the Istituto di Ricerca Ambiente Italia, to adopt a municipal energy instrument. In 2006 the city raised the issue of energy planning introducing a participatory process and designing two pilot actions about energy features of the buildings and a series of information sessions on energy efficiency addressed to the community. Trento followed mainly the self-governing and regulation approach in its energy efficiency politics, lightning, private housing etc.

A dedicated office, Companies and Citizens Bureau, promoted the regulation for spreading sustainable construction.

Venezia adopted its PEC in 2003 and revised it in 2009, through a more participatory approach. In addition to providing measures for the reduction of waste in municipal buildings and on public transport, Venezia PEC provides specific actions for the two industrial districts in the area, Porto Marghera and Murano Island. District heating systems provide heat and/or energy for the city. Inside the construction regulation it is been included a special regulation for the energy efficiency and in conformity with the EU and national laws made mandatory the energy certification for every new building. For the adaptation of the planning instrument in the area Campalto, criteria of bioclimatic architecture also were included following governance by regulation approach.

From the brief excursus on the four local experiences described, some common problems and recurring themes emerge. A first aspect to be considered is the positive trend for the local contexts to accumulate skills through the experiences.
Planning practices generate learning processes that lead to an improvement of institutional, political and technical capacity in dealing with complex issues related to energy and environment as seen in most of the cities analyzed. Political and technical leadership are crucial engines that catalyze financial resources into the environment matters. In this regard Modena and Bologna have had the strength to take advantage of international and national opportunities, participating in innovative projects and building innovative policies. Trento followed the definition of its energy policy but gave the technical role to the Provincia Autonoma di Trento, who had a stronger role regarding competencies and financial tools. In other cities the intervention of external agencies (Enea and Ambiente Italia) lost the possibility to gain competencies inside the local administrations. As shown in the Bologna and Modena experience, a positive approach was adopted in order to integrate analysis, objectives and strategies from both the urban structural plan and from the energy plan and trying to create a relationship between the rules inside the building regulation and the energy plan actions.
In general, energy plans reveal a gap between objectives extracted from the analysis phase and actions and strategies taken.

Sometimes, despite a detailed analysis phase and a remarkable specification of the actions to pursue, the plans remain unfulfilled with an exception for the regulative dimension.
Strategies also are usually recurrent in the several energy plans adopted in Italy: proposing the increase of energy efficiency, increasing sustainable energy sources, reducing energy and transport demand.
The greatest difficulty found, consists in dealing with problems in a systemic perspective, focusing on the relations between the multi-dimensional issues in the field. The challenge to improve the effectiveness and efficiency of the energy plans calls for the same challenges that have to be faced by general planning. Integration of actions at the horizontal level and cooperation between different institutional subjects at vertical level should be pursued. Considering financial difficulties affecting the local governments and that environmental issues require to be managed at a larger scale, the national, regional and provincial level should promote transformation processes each according to its competence and ensuring cooperation.
In conclusion, the crucial node for a more effective implementation of energy plans is to consider them less as sector-based plans and more as an urban policy that embraces an interdisciplinary approach.

2.2.5 Genova SEAP - Genova Smart City

The city of Genova was one of the first Italian cities that signed the Covenant and developed the planning task. Genova, moreover, used the SEAP tool to flourish a more complex development strategy for the territory. The planning team considered and reinterpreted three key elements of the EU policy: renewable energies, technologies to pursue the reduction of the European energy needs and the introduction of the Smart City policies inside the SEAP tool.
The first two points belong to the Covenant institution (2009 EU Commission directive and 2008 Strategic Energy Technology Plan) and the Genova Sustainable Energy Action Plan describes with almost 80 different actions the way to reach those objectives.

The other contents represent a conceptual evolution of the SET plan, triggering innovation in processes and system towards urban sustainability (connectivity, information, decision supporting systems, info mobility, etc.).
The Genova SEAP takes place within the ordinary municipal policy program: in accordance with the existing planning tools, synergy with the strategic projects and with the relative European urban visions.
The plan logic is based on two complementary approaches: a quantitative one (measures of impacts) and traditional territorial planning one (the better place to measure the feasibility of the chosen policies).
The first part of the work, as we already saw for the other cities, it is basically the BEI (Baseline Emission Inventory) developed by the University of Genova and continuously updated by the brand new authority (born mainly for this reason) “Energy Data Bank”.
The second part of developing of the plan was particularly lucky because the municipal planning departments were working at the same time for the “Municipal Urban Plan”, the “Municipal Mobility Plan” and they were starting a review of the “Municipal Regulatory Plan”. This condition gave to the SEAP a special synergy with the short term / long term governance prospective, putting it as guide and method to act and monitor the solutions proposed.
The practical objectives, the concreteness of the SEAP translates the policies intentions in powerful indicators that allow rapid tests of the long-term visions. In Genova the SEAP was drafted on a strategic level, as guide-plan for the all the metropolitan issues, stimulating the local government to census endogenous and exogenous proposals and fostering the public-private liaisons.
One of the products of this complex planning process was the creation of “Genova Smart City Bureau” a non-profit association leaded by the Municipality through the business manager Gloria Piaggio. The organization involves lots of big, medium and small companies/entities that after the subscribing process (they pay different fees in order of the company dimension) start doing network and more complex proposals to pursue the Municipality’s vision.

The basin of companies/entities and proposals is incredibly rich and heterogeneous, from freight logistic companies to the University of Genova Philosophy Department, from the LED street illumination project to the info mobility app. “Obviously to reach the smart city, we need to involve research, finances, companies and municipality and therefore planning tools must be integrated and planners must be updated” said Gloria Piaggio, “We asked municipal managers to translate the ‘smart policies’ into their specific programs. The organization is also working in a side-up way to hear the ‘civil society’. Smart city planners have to hear the territory and this may looks like an artesian work, but we have to deal with our Mediterranean culture and our specific roots”.
The organization also tries through communication activities to foster changes in citizens’ behaviors mainly in domestic energy demands and urban mobility: “… having smart people is a fundamental assumption for the city transformation process”. Genova Smart City worked with the municipality of Milan and Turin and with the Italian Ministry of University and Research to share and scale the results already reached.

According to the Genova Smart City organization there are no recipes to transform a stupid city into a smart one, but the only thing to bear in mind is the “citizens quality of life” and working hard with sustainable resources in order to improve it.

"Smart city is a city that wants to improve the quality of life of its inhabitants through sustainable development, high technology and research related to innovation. [...] I would not say 'project', but rather a process that aims to transform the city. To achieve this, there are european bids and other opportunity. It should also encourage citizens to change their behavior through training, awareness and communication."

Gloria Piaggio, *Apr. 2013 author interview*

2.3 From sustainable buildings to sustainable communities

Improving the energy efficiency of cities is the first step of transformation that is part of the present. The international community has already recognized the importance of promoting sustainable development in production models, lifestyle and consumptions. On one side there is a shortage of resources and on the other an inability to use resources available. Models and tools are changing.

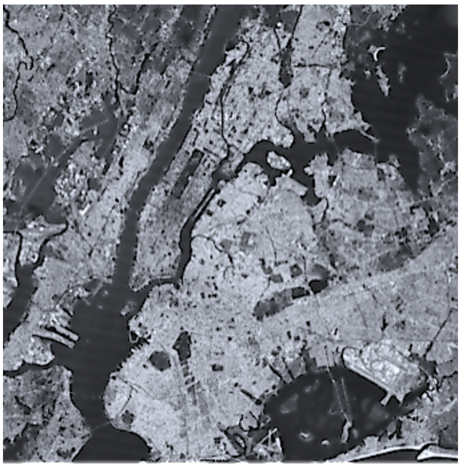
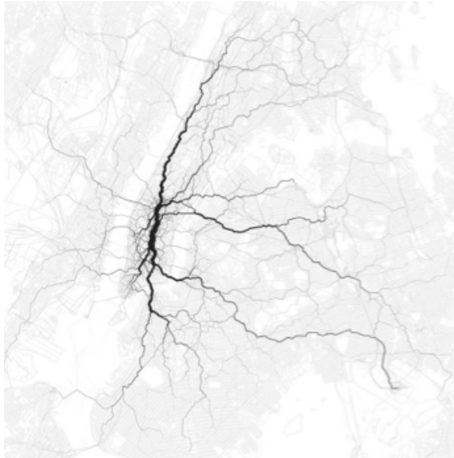
From the point of view of those dealing with innovation and sustainability, the core issue is to identify possible directions of change in terms of contents and methodology. Through a pragmatic approach, from the observation to the deployment of applications, is possible to increase experience and knowledge, avoid bad practice and find new instruments and processes. In this way both process and products result changed, alike in a production process. Is it possible to considerate in the same terms for the redefinition of urban interventions?

The development of urban sustainable design models, more often, is seeking contacts with social science and new communication technologies.

The main reason is due to the capability to reach the motivations that foster people, and the diverse social categories that shape the urban communities, to make the right choice in the domestic energy consumption domain and in urban transports.

And so it is not only about top-down policies, but also and definitely about bottom-up effects driven by citizens' lifestyles and different ways to live and perceive the city itself (Rosenberg and Hovland, 1960).

FIg. 2 - New York by google maps and Eric Fischer New York twitter use elaboration .

Source: Elaborated by the author and Eric Fischer.

The two images above represent, visually, two different ways to see the city, on the left as a tumor cell because of what we already said: cities are ill bodies with a not sustainable metabolism for the environment.

But cities are made by people, and because of new technologies, the chance to gather and keep together best individual practices was never much easy. The image on the right (elaborated on twitter data by Eric Fischer) represent the same city, but this time it does not show its physical (ill) structure but, as a neuronal cell, its potential collective intelligence.

Using the 'Urban Metabolism' metaphor, in order to improve the "body" performance we should operate upon the 'nervous system' i.e. the people that actually "use" the city, too often, improperly.

2.3.1 Behaviors and Energy

When it comes to discussions about energy and climate, the focus is nearly always on technology. We wonder whether coal can be cleaned and solar panels made efficient, if there might be a breakthrough in algae biofuels or carbon storage. In short, we think about hardware.

But a traditionally overlooked area of energy innovation is experiencing a boom in research attention: human nature. Engineers and power companies are now drawing on lessons from the social sciences, trying to understand the behaviors that shape energy use and how people can be persuaded to use less energy in the first place.

The potential savings are enormous. According to a recent report from the American Council for an Energy-Efficient Economy, an energy industry think tank, the U.S. could cut energy consumption by one-quarter without hurting its economy. Another analysis pegged the potential household savings offered by such simple measures as carpooling and window sealing at 7 percent of total U.S. carbon emissions, an amount roughly equivalent to the yearly emissions of France.

Ed Vine, an efficiency researcher at Lawrence Berkeley National Laboratory said: "In the last few years, there is definitely been a lot more interest in behavior. In order to achieve our energy-saving goals, it can't just be technology by itself."

Most of the people working on energy efficiency are engineers, who tended to view challenges as essentially technical. If they designed better systems, of course people would use them, because that would be sensible. Human nature is not always sensible, though. Witness the long struggle to make energy-efficient light bulbs mainstream, or the way most people still prefer to raise the thermostat rather than put on a sweater.

Eventually, as economists Hunt Allcott and Sendhil Mullainathan would write in Science in 2010, engineers and policy experts needed to confront "a more complex, less idealized, view" of energy choices. They would have to engage with the social sciences, with psychology and sociology and anthropology, and use randomized trials and iterative designs.

"Engineers do innovative things, and that is still continuing, but engineers are not great at understanding human behavior", said cultural anthropologist Susan Mazur-Stommen, who directs the Behavior and Human Dimensions Program at the American Council for an Energy-Efficient Economy.

The influence of social scientists can be seen in the agenda from this year's Behavior, Energy and Climate Conference. There are talks about improvements in modeling human behavior, the roles of social networks, and the methodological details of conducting ethnographies.

Many of the talks at the conference involved how to frame energy-saving programs, or analyzed the influence of promotions. Simply signing pledges, for example, seems to have long-term effects, and it is better to emphasize a few key behaviors rather than presenting long lists of possible changes.

Mazur-Stommen mentioned burgeoning interest in applying principles of game design to energy programs. Her own pet project is the Tamagotchi Building Project: an attempt to envision how buildings can be anthropomorphized, so that energy-efficient acts feel like gestures of affection. “People inhabit their buildings for much of each day,” said Mazur-Stommen. “Would not it be great if we could enter a more nurturing relationship with them—if we could think of them as pets?”

2.3.2 Academic experiments on behavioral changing projects

Mazur-Stommen’s architectural Tamagotchis are still hypothetical, but the “The Lambent Shopping Trolley Handle” and “Pulse of Tidy Street Project” are academic experiments the have been already done.

Open University Pervasive Interaction Lab Professors Jon Bird and Yvonne Rogers experimented in real context (goods consumption and energy consumption) at least four key challenges when designing for behavior change:

- increasing awareness of a behavior
- motivating people to change
- facilitating change
- sustaining change

They demonstrated that salience and social norms could be effective behavior change techniques that help address the first three challenges.

Fig. 3 - The Lambent Shopping Trolley Handle and Pulse of Tidy Street Project

Source: http://www.changeproject.info/projects.html

The Lambent Shopping Trolley Handle clips onto any supermarket trolley and incorporates a display connected to a scanner to provide shoppers with nutritional, ethical and environmental product information. The display consists of 16 multi-color LEDs which allow product information to be visualized via changes in pattern and color. These product properties can be nominal (for example, it is organic or contains nuts), ordinal (for example, has low, medium or high food miles), as well as a combination of the two at the same time.

They found that when the Lambent Shopping Trolley Handle displayed the food miles of products, 72% of the time shoppers were nudged to select products with lower food miles compared to when they shopped without the handle. There was no nudge effect for shopper's favorite products (for example, a particular brand of chocolate) or items that they strongly disliked (for example, blue cheese). When shoppers saw that the average food miles of the items they had selected was above the norm, they tended to scan more products and select ones with lower food miles.

For the "Pulse of Tidy Street Project" they decided to create a large-scale visualization of the street's electricity usage by spraying a display on the road surface using chalk spray. The design was created in collaboration with Brighton-based street artist Snub. For the first three weeks of the project, we updated the public display each day and represented how the average electricity usage of the street compared to the Brighton average. They used a low-tech approach to measuring each household's electricity usage: asking them to read their meters each day and enter the reading into the project website. This website also provided each household with graphs showing how their electricity usage was changing over time.

After 3 weeks, the average electricity usage on Tidy Street had reduced by 15%. After 6 months, only three households were still regularly recording their electricity readings and two of these showed a significant reduction in electricity usage.

The Tidy Street project suggests that over time their effectiveness can diminish and that the key challenge is finding ways to keep people motivated to change their behavior.

2.3.3 Companies engaged with energy savings and service design

Few companies have already started taking social insights to market.

The most prominent is Opower, which works from the premise that behavior changes are frequently motivated more by peer pressure, rather than virtue or even self-interest. Opower contracts with utility companies to give personalized assessments of household energy use, which is compared to neighborhood patterns and accompanied by savings advice. So far, they haveve consistently achieved energy savings of around 2 percent.

Another company, Bidgely, has developed algorithms that pull appliance-specific energy signatures from household electricity patterns, and then provide suggestions on how to cut back. According to preliminary research by Bidgely, this results in average energy savings of 6 percent. Further hinting at the market's possibilities, Apple recently announced its entry into home energy management, and Google purchased smart-thermostat maker Nest Labs in January 2014.

2.3.4 Governments and service design

As we have already seen, in this domain the chance to use of new media technologies to influence citizens is raising attention. Smartphones or better information systems through personal mobile technologies, particularly, seem to have most power due to the real time one-to-one dialogue with the citizen. The "big data" issue, furthermore, is bringing new roles, skills, and methods to public administration.

The Boston and Philadelphia New Urban Mechanics, the UK Government Digital Service, and the San Francisco Code for America are literally micro startups inside the civic institution department of planning.

It is just beginning and looks promising what possibilities lie for civic technologists to collaborate with placemakers.

In a 2012 author interview of New Urban Mechanics co-chair Chris Osgood emerged the new attitude of American local government in using new tools (new media and technological ones) to save resources and provide better services.

“Citizens connect mobile application”, for example, allows the city of Boston in saving money and carbon dioxide emissions. Boston's citizens can easily report neighborhood issues such as potholes, damaged signs, and graffiti through the smartphone app released by the seven people team hired by Mayor Menino. The city of Boston saves because less employees have to check the city, they just go there when a citizen reports something.

This link between technology innovation domain and planning domain is tighter everyday.

On February 2014 Jennifer Pahlka, from Code for America, was awarded with the prestigious Kevin Lynch Award by MIT. The award (presented biannually for outstanding scholarship and practice in urban design, planning and landscape design), according to Eran Ben-Joseph, head of MIt is Department of Urban Studies and Planning, “…recognizes Jennifer Pahlka’s impact on the growing trend toward valuing the everyday citizen’s view of his or her community. A grass-roots perspective is a vital component to urban design and planning.”

Kevin Lynch defined the efficient city as one that “offers a high level of access without any loss of local control.” Pahlka and Code for America work towards providing local residents with more access and control over city government functions. By enabling citizens to report transparently on the small urban problems most affecting their daily lives, Code for America facilitates a more responsive local government at a fraction of the traditional costs. Lynch believed policy makers and planners could not understand any site without first talking to the people who used the space; but lamented that doing so was often beyond economic feasibility for projects. Code for America uses new technology to bridge that communication gap between the planners and residents that are possible even in these austere times.

Code for America former project manager Joel Mahony on November 2012 told us that bringing technologies to public service it is a “big mission” but governments have to understand that this are feasible and sustainable policies (also economically) and they don’t need IBM or Microsoft engineers to do it. “It is not only delivering software, but bring the Silicon Valley culture, methods and approach into the civic home”.

”The lack of resources is no longer an excuse not to act. The idea that action should only be taken after all the answers and the resources have been found is a sure recipe for paralysis. The planning of a city is a process that allows for corrections; it is supremely arrogant to believe that planning can be done only after every possible variable has been controlled.”

Jaime Lerner, *Architect, urbanist, former mayor of Curitiba, Brazil*

2.4 Two ways for planning sustainable cities

In recent years significant advances in ‘top-down’ and ‘bottom-up’ models have allowed the development of increasingly sophisticated simulation tools for use at building and urban scales. However, such static models can by themselves tell us relatively little about the dynamics of urban retrofit transitions.

Models and tools that engage with users and allow them to explore the potential retrofit futures are essential to expand our understanding of the potential emission reductions. Many current models constrain the users to the ‘standard’ scenarios for future energy usage, where land use change is limited to new build, growth is the only model and societal change is limited to population increase. These restrictions, whilst praiseworthy, fundamentally limit the ‘thinking space’ for the user. Approaches based on group modelling and systems dynamics techniques engage with users early enough in the tool development to allow the resulting tools and data collection requirements to cover the scope of sustainable smart cities cities.

A prerequisite to accommodate this scale of urbanization are without any doubt well-functioning infrastructures for urban areas, ensuring efficient and effective urban processes. As a consequence, investments into urban infrastructure are likely to continue and grow (United Nations Human Settlements Programme, 2012). An accepted idea in this regard is to incorporate modern technology into urban structures. As more citizens (or consumers, depending on the point of view) move to urban areas, actors from the ICT industry naturally become increasingly interested in offering services that are tailored to life in the urban environment. Cities and local governments are at the same time exploring the role that new ICT services and products can play in increasing the quality of life of their citizens or optimizing internal processes. In recent years, this quest is most often captured in the "Smart City" concept (Townsend, 2013).

It originates at the crossroad of technological progress and the realization that urbanization up until today cannot accommodate the expected demographic and environmental circumstances of the future. The Smart City concept has become key in bridging academic research, projects and commercial initiatives exploring the role of technology in urban life. However, given the proliferation of the term, a lot of different operationalisations, approaches and definitions of the Smart City exist today and a lack of overview in thinking about the concept persists. The interest of the public, academics and media has increased in recent years, pushing forward an often almost science-fiction like discourse situated between concerns about control, freedom and privacy, and enthusiastic accounts about increased efficiency, sustainability, and generally a better world and higher quality of life for everyone. However, establishing an all-encompassing, definite definition is as difficult as projects, opinions and initiatives in the field are diverse.

Perhaps the goal then should not be chasing this all-encompassing definition, but rather having a clear overview of what stakeholders are talking about and the different viewpoints on the city of tomorrow.

First, we explore the Smart City as a top-down concept that is dictated by business potential, commercial logic and efficiency thinking, followed by the opposing viewpoint on the Smart City as one that should be predominantly orchestrated from below, by empowered and active citizens.

2.4.1 Top-down and Bottom-up approaches in urban planning

Patchy Healey indicates (1996), two main tendencies have marked the history of town and country planning over the past 50 years. On the one hand there has been a tendency towards centralism and de-politicizing decision-making as well as increasing the role and power of technical experts. On the other hand there have been demands for more participation in decision-making, a call for more accountability on the part of local politicians and officials and increasing criticism of technical expertise. These two tendencies, which are very much at odds with one another, have been labeled as the top-down and bottom-up approaches to planning (Murray et al., 2009).

Among bottom-up approaches, the postmodern and the communicative approaches have provoked the interest of the academic community during the last three decades, although their impact on planning practice ranges from nil to very limited. Concerning the postmodern approach, Philip Allmendinger (2002) and Nigel Taylor (1998) argue that transferring, or even to interpreting, the post modern position in the field of urban planning is highly problematic, if not unfeasible. Communicative theory cannot take pride for its applicability, which has been exhausted in small scale practices, like the Planning for Real movement, that enhance citizen awareness and mobilize their participation in planning procedures. In addition, the communicative approach that derives from the Habermasian philosophy remains highly abstract (Allmendinger, 2002) and therefore it is difficult either to guide planning practice or to point out to it as an alternative planning theory.

One of the foremost implications of the highly political character of communicative planning is its focus on theoretical issues pertinent to the normative part of a decision-making, as these issues relate to and support this highly political approach. As a result, it lacks the crucial components of a typical planning theory, equally as much concerning the analysis of urban space as the procedure and the methodology of urban intervention (cf. Murray et al., 2009). Characteristic of this situation is the fact that it cannot be linked to well-established urban planning practices. The elaboration, the criticism, or even the commenting on issues like the classification of urban uses, the practice of zoning and the utilisation of planning standards, which constitute basic features of urban analysis and planning diachronically, are totally absent. This situation reinforces the urban planning theory-practice gap that has been cited and discussed by various scholars during the last two decades (cf. Alexander, 1997, 1999, 2010; Harris, 1997; Allmendinger and Tewdwr-Jones, 1997; Watson, 2008; March 2010; Moroni, 2010; Lauria, 2010, Pissourios, 2013) and leaves the top-down systems and rational planning theories as the main guides of the current planning practice.

Even if planning practice is dominated by top-down planning theories, the quest of a planning system that considers the local needs more studiously and allows greater citizen participation comprises an acceptable objective, as such a system tackles some of the weaknesses of the top-down approaches.

According to Paul Sabatier (1986), "[…] the fundamental flaw in top-down models, is that they start from the perspective of (central) decision-makers and thus tend to neglect other actors. […] A second, and related, criticism of top-down models is that they are difficult to use in situations where there is no dominant policy (statute) or agency, but rather a multitude of governmental directives and actors, none of them preeminent. […] A third criticism of top-down models is that they are likely to ignore, or at least underestimate, the strategies used by street level bureaucrats and target groups to get around (central) policy and/or to divert it to their own purposes."

In this landscape of planning theory, where top-down approaches, despite their weaknesses, rule planning practice and bottom-up approaches are unable to construct an alternative methodology of urban intervention, the purpose of this chapter is to discuss the ways that these two opposite approaches have been challenged in action research studies.

2.4.2 Top-down approach in Smart City planning

"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" (Hall, 2000). The first approach we assess here adheres to top-down dynamics, often closely related to the technologically deterministic idea of a "control room" for the city. It aims at providing an ICT-based architecture to overview urban activities as well as the tools to (automatically) interact with infrastructures and adjust parameters to predefined optima (IBM, 2009). Hall's definition of a Smart City above illustrates the strong emphasis on optimization through technology.

Accordingly, IBM defined the three steps for making cities smarter as instrumentation, interconnection and intelligence.

Apart from gathering the data, a large part of the processes that essentially constitute this approach consists of the calculations, visualizations and predictions based on the gathered metrics: "[T]he development of smart cities involves the application of [ICT], environmental sensors, digital footprints of the inhabitants, manipulation of the resulting data using statistical techniques, and finally the use of complexity modelling and advanced visualisation in order to make sense of it all." (Campkin & Ross, 2013). Providing the systems that are capable of working with these vast data sets, referred to under the moniker of "big data", then becomes an interesting business. This way of making cities smarter therefore promises enormous opportunities for large private companies, such as technology vendors, network companies and software industry players. They are able to provide the corresponding tools to this sort of Smart City and can expect potentially enormous revenue from rolling out their proprietary solutions in large and small urban areas. Several cities have already been convinced of these propositions, with Rio De Janeiro serving as an often cited example (Singer, 2012).

In its most extreme manifestation, a top-down approach translates to cities that are planned, designed and built from scratch with the optimization of urban processes through technology in mind. The examples of Songdo and Masdar can be seen as the pinnacle of this particular vision of the Smart City. But both have been heavily criticized for being sterile, overly planned, prohibitively expensive, anonymous, uniform and conformist (The Economist, 2013) and the result is that these cities struggle to be completed within the predicted budgets and timeframes and/or do not attract enough economic activity (and thus jobs) so that people want to move there. Of course in most cases, technology will need to be integrated into existing urban infrastructure. There are large potential benefits tied to having an integrated Smart City solution in a city: many different services and infrastructure systems can be managed from one central hub, keeping oversight on many divergent aspects of life in the city. The focus on integrated infrastructure and technology is reflected in the following description of what the Smart City is: [A city] "connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city" (Harrison et al., 2010).

The Brazilian city of Rio de Janeiro was amongst the first to implement the integrated Smart City solution developed by IBM; the 'Intelligent Operations Centre'. This solution combines feeds from over 560 cameras and can display over 60 layers of data, gathered from sensors across the city on a map. Installed after a natural disaster that killed almost 70 people, the initial goal of the system was to increase emergency response time, but has evolved into a wider Smart City solution. The mayor of Rio, Eduardo Paes, is one of the biggest proponents of the integrated solution: “I sleep better thanks to it. The worst thing is not having the information, to not have the tools to act. But we do now.” (Soffel, 2013).

The huge economic potential is - at least to the same degree as its potential for improving the urban - the main driving force behind this approach and the main reason for its formation. Many major IT companies and municipalities around the world are looking for their slice of the Smart City pie. Market researchers and consultants of PikeResearch have predicted that global investment in Smart City technology infrastructure will reach $108 billion by 2020 (see Pike Research, 2011).

IBM and Cisco, among others - respectively with their ‘Smarter Planet’ and their ‘Smart+Connected Communities’ initiatives - have already established themselves as distinguished players in the field. They are among those large technology vendors, which have realised the potential of the Smart City and are actively seeking out and soliciting local governments to invest in their respective technologies, already rolling out various initiatives. While these companies are competing, they also appear to be specializing in specific aspects of the Smart City, aptly put by Townsend (2013): “If Siemens and Cisco aim to be the electrician and plumber for the Smart City, IBM’s ambition is to be their choreographer, superintendent and oracle rolled into one”.

2.4.3 Bottom-up approach in Smart City planning

These architectural, topical, infrastructural or top-down viewpoints are juxtaposed against a more experimental, bottom-up understanding of what a Smart City could be. In this perspective, change and improvement comes only from the people “using” the city. It dismisses any form of top-down urbanization, in particular with the involvement of powerful private companies. The bottom-up Smart City is, foremost, about the Smart Citizen; those who live, work, and engage in all kind of activities in the city. Rather than working towards centralization, such a view on the Smart City takes a decidedly distributed approach, supporting and accepting some form of chaos.

Greg Lindsay formulates this as follows: “The bias lurking behind every large-scale smart city is a belief that bottom-up complexity can be bottled and put to use for top-down ends — that a central agency, with the right computer program, could one day manage and even dictate the complex needs of an actual city. The smartest cities are the ones that embrace openness, randomness and serendipity — everything that makes a city great” (Lindsay, 2011).

Embracing this “chaos” has also been referred to as “the default mode of urban development” (Echanove & Srivastava in De la Peña, 2013). It can be experienced in parts of cities, which central planning and control did not steer, often because of their nature as illegal settlements and slums. These settlements seem chaotic, growing ‘by the default mode’, brimming with networks of social and business relations, which are, however, most often not accounted for by decision-makers. Dharavi for example, the biggest informal settlement in Mumbai, is said to constitute up to 25% of the city’s economy. Still, there are neither maps of its streets nor accounts of its economic activities. Although these characteristics have positive impact on the local scale, they often conflict objectives of decision-makers, urban-planners, and dynamics of the globalized economy. Chaotic bottom-up processes oppose the idea of a master plan, an ‘ideal’ state of place. Therefore, the top-down approach to Smart City (in fact, to urbanism in general) often intends to control, rather than find ways to enable and employ this default mode. Since the city is a system of systems put together by people who bring it to life, it is complex and cannot be but dynamic and flexible. Consequently, the solution to urban challenges of the future, a real Smart City, is more than just technological, networked and intelligent: it is about people. The Smart City presents an unparalleled opportunity to enable citizens, connect them and make them ‘smarter’. It has the potential to empower them to participate, encourage them to shape urbanization and make it more sustainable together. De la Peña (2013) compares this complexity of the city with the “non-hierarchical complexity” of the internet: as the Internet is open and participatory, an smart city should actively and consciously enable and encourage citizens to shape their own urban experience.

Examples of these purely bottom-up approaches can be found in citizen initiatives and even (semi)-illegal interventions in the public space, such as so-called guerrilla bike lanes where citizens, unhappy with local biking infrastructure, paint bike lanes on the street without authorization (Muños, 2013). These types of initiatives are also referred to as tactical urbanism (Hamdi, 2004). Tactical urbanism tends to consist of "small scale interventions [that] are characterized by their community-focus and realistic goals" and are often short-term or temporary, cheap and aimed at increasing quality of life in a certain way or addressing a specific neighbourhood concern. However, the instigators of these small projects often hope to achieve more and they actually do effect change: "The goal is not to simply do a cool project that will get cleaned up by the city or thrown away, but to make something – even something temporary – that will change how a place works and is perceived. And once that change has been made, to figure out how it can be made again or made permanent" (Berg, 2012). In such a perspective, what defines the Smart City is not the infrastructures or architecture it offers, but the ways in which its citizens interact with these systems as well as each other.

As we have already argued (chapter 2.3) there are already several attempts in using new way to face the city issues passing through an interactive dialogue with the citizens. The main reason is given by the ability to rapidly reach the different motivations that foster people (Moore, 2011), and, therefore, the various social categories that define the urban community, in choosing or not to be active part of city's rethinking. In fact, starting from this analysis it should be possible to develop solutions with the purpose to implement and induce more sustainable behaviors regarding the use of urban services (Washbrook et al, 2006). In this field, the possibility of using new media technologies to influence citizens' urban transports habits (Gal-Tzur et al., 2014) is raising attention. Smartphones or better information systems through personal mobile technologies, specifically, seem to be the most effective due to the real time one-to-one dialogue with the citizens (Brazil and Caulfield; 2013). Mainly, the companies working on this issue are "for profit" private enterprises, which support the citizens that are becoming increasingly "consumers" of the services the city offers or, "prosumers" of their community (Izvercianu and Branea, 2014).

However, other attempts have been made and guided by “non profit” organizations and research centers, which use similar instruments, such as Social Computing (Kwai Fun IP et al., 2008), and aim to develop social innovation projects with the goal of improving the environment and energy policies (Souza Santos and Kahn Ribeiro, 2013).

2.4.4 Scales and goals: influential factors for processes effectiveness

The efficiency in planning bottom-up approach generally is inversely proportional to the size of the community that is planned.

Participatory processes become cumbersome when the population size increases, slowing down the process of urban intervention, which is already a time-consuming process. In particular, the gathering of the various stakeholders of the community, the arrangement of the procedure in which the open-ended forms of discussion will be held, the arrival at the agreement on conflicted and interrelated issues and the translation of these agreements into planning objectives require the ampleness of time. Thus, in large communities, either the bottom-up processes will be inefficient, due to the slow progress of participatory processes, or techniques of representative participation will be adopted, which degenerate the nature of the bottom-up approach.

Petter Næss (2001) has argued on the weakness of bottom-up approaches in the field of sustainable development, where a higher level of coordination is necessary. The same also applies for objectives that have consequences far beyond the local borders or their planning is affected by the preferences and needs of the residents outside these local borders. Such objectives are related to the location of supralocal facilities, like hospitals, universities and industries, which serve the population of more than one local community, to the planning of the transportation systems and their terminals, like airports and railway stations and to economic and environmental planning by and large. Thus, as Næss (2001, p. 516) concludes, “[…] the local level should not have full sovereignty over such dispositions. Local planning should therefore take place within frames ensuring that consequences primarily manifesting themselves at other scales than the local are also taken into consideration.”

Based on these considerations, the scope of bottom-up approaches seems to be limited to the local planning of small settlements, or to the planning of districts in larger settlements. On these occasions of planning, the higher level strategic planning has already indicated the long-term objectives, for which the contribution of local participation is debatable, and has also resolved the conflict of interests among neighbouring settlements or districts. In addition, because of the small study area, participants are likely to have a clear and comprehensive view of their communities' strengths, weaknesses and opportunities, so their participation in planning procedure can be beneficial to the understanding of local needs, while participatory processes can be quick and flexible.

“The city is what it is because its citizens are what they are”

Plato, *The Republic*

3. Action research studies

As we saw in the last chapter there are many different tools to face the smart city’s sustainable planning and we mostly can divide them in two different kind: top-down (formal urban planning tools) and bottom-up (informal tools).

But are there common values or dependencies that top-down and bottom-up models can share?

Are there any other constrains to implementing these processes? What are they?

What if we plans interconnected top-down and bottom-up strategies?

Keeping these two policies divided, probably, costs us other precious time and resources.

Is it possible to create circular planning processes, or even, empower these tools to better act on a territory?

Trying to answer to some of these questions we have decided to use an action research approach, facing directly the sustainable smart city planning.

We have mostly focused our research on the built environment and, particularly, the marginal cities’ areas in the Mediterranean region. In this specific playground, in fact, because of complex issues due to the climatic conditions, historical urban tissues and because of the lack of past good development policies, the need of new way of planning seems even more urgent.

With a deductive research approach, from the praxis to the theory, we have tested some assumptions and intuitions we have had in these recent years.

In the next part of the chapter we will start treating which main characteristics top-down and bottom-up models generally have, after that we will report our applied experimentations: a top-down proposal for the island of Lampedusa called “Lampedusa Revolution” and a bottom-up project to empower the sustainable mobility in Palermo called “TrafficO_2”.

The first action-research project is a multipurpose action-plan to improve the Island energetic sustainability and, beside a typical top-down approach, tries also to enrich its effectiveness through some bottom-up actions designed to fosters good neighbourhood's behaviors.

The second one, instead, is an action-research study that tries to pursue the objective to improve traffic conditions without using any top-down policies but, through a social network, fostering directly the citizens toward more green behavior in a one-to-one dialogue.

By exploring this two proposals we pointed out the general features these two models should have in order to be effective and meaningful.

"The term utopia is the most comfortable way to avoid what one has no will, ability, or courage to do. A dream seems to be a dream until one does not start somewhere, only then it becomes a goal, meaning something infinitely bigger."

Adriano Olivetti, "*La città dell'uomo" (The man's city)*.

3.2 Lampedusa Revolution

The following action-research study is brought by the necessity to measure the multidisciplinary approaches needed by the Sustainable Energy Action Plans on the Sicilian territory. The objective was to demonstrate how certain action-design strategies are perfectly adaptable in such communities where there are not existing urban planning instruments. Where classical policies strategies have failed for many years, this tools, always in a top-down manner but starting from different planning scale and goals, could give reinforcements (political and economic) to the territory crating more complex processes of urban renewal. Having an holistic approach, in fact, they can aspire to be strategical for many different urban policies and, most of all, be effective and build a change.

The following paragraphs are a synthesis of the most extensive work presented as a final thesis in 2010 for the master CasaClima (thesis supervisor arch. Stefano Fattor, assistant prof. engineer Giuseppe Trombino, engineer Corrado Giacomelli) published as contribute in the 2011 "Cities with no oil" book edited by the Italian Institute of Urbanism and recently finalist at the international competition "FI-WARE Smart Cities Challenge".

3.2.1 Introduction

The objective of reducing climate altering gas emissions and energy consumptions must be pursued also through policies and actions at a local level, other than at a national and international level.

For this reason, the European Commission has launched several projects; among which the Covenant of Mayors, an initiative aimed to actively involve the European cities on a route towards energy and environmental sustainability.
As already argued in the las chapter, the above-mentioned initiative, of voluntary nature, requires the European cities to prepare Action Plans aimed to achieve the objectives set by the European Union by 2020, reducing by 20% their emissions of greenhouse gasses through local policies that improve energy efficiency, increasing the use of renewable energy sources and promoting a rational energy consumption.
Therefore, the European Union requires that actions shall be taken for the top (national and regional commitments), and from the bottom (each individual European municipality) by suggesting the transition from the simple “damage-control” policy to the energy and environmental sustainability policy as the economic and cultural driving force and urban renewal.
The Municipalities who subscribe to the Covenant, through the technical and economic support of the European community, take on the responsibility to gather the complex instruments for analysis and design to regulate the energy, urban and cultural development of the territory.
Northern Europe seems to have accepted the guidelines set by the community. Dutch, Danish, Swedish and German cities, as the most prominent examples, have developed exemplar design projects and sustainable development.
The southern regions still suffer both a normative and design tardiness.
However, this disadvantage can be transformed into an opportunity for development, if in fact the ideal dynamics are structured. An excellent example in Italy is the Autonomous Province of Bolzano where, through a policy conforming to the community objectives and shared throughout the social classes, in few years it was possible to build technical-entrepreneurial satellite activities in which it is the undisputed European leader.
Today, the European community commits most of the economic and financial resources destined to development (PON – FESR etc.) to push administrators and technical advisors to integrate the theme of environmental and energy sustainability within their own policies.

Greece, for example, regardless of the crisis has endured in the past years, in the period when we were studying the phenomenon, has been able to allocate 60 million €, taking advantage of the operational program “Environment and sustainable development” (EPPE – RAA) and of the cohesion Fund, for the project “Bioclimatic Urban Regeneration” that aims to improving the quality of life and of the environment in the areas with climatic problems as well as the reduction of energy consumption to diminish the effects of global warming.

The economic and design resources committed, besides achieving the energy objectives, will allow for the urban relaunch and renewal.

In 2011 over 2100 European communities, of which almost half are Italian Municipalities, have subscribed, or in the process of ratification, to the Covenant of Mayors.

Abruzzo represents a best practice at a European level: a region in which all of the Municipalities participate to the Covenant of Mayors and in which the Regional authorities and Provinces guarantee, as Supporting Structures, an organizational and financial concrete support (integrating the Covenant of Mayors to the FESR) for the execution of the actions.

However, of the 954 subscribing Italian municipalities very few of them (Genova, Torino, Avigliana and Maranello), up to the 2011, drafted the Emissions Inventory and the Action Plan.

Starting from the analysis of the current state of many cities of the south of Italy, characterized by the lack of an integrated urban design, compact building areas, inadequate ventilation of streets and boroughs and the lack public green areas. These components are among the main causes of the microclimate change and thermal degradation of large and small urban centers in the south of the Mediterranean.

In 2011 the government of Sardinia and in 2012 the government of Sicily have signed in Bruxelles the so-called “Covenant of the Islands”.

This is a project supported by the European Commission that will concern all of the European islands, granting them further stability to face the energy policies and to access funds purposely dedicated to the island regions (while we have discussed the thesis none of the Sicilian government seamed to be interested).

The fact concerning Sicily is unique because in 2011 there were only five subscribing municipalities and four “Support Structures” (Province of Catania, Province of Agrigento, Province of Siracusa and Nebrodi Città Aperta) that were voted to the sensitization and the technical and financial support of the initiatives of the individual municipalities.

Sustainability, as an urban and territorial development strategy, is for many administrators and local authorities a shared objective but its applicability becomes unreachable.

The reason of the frustrating lack of commitment (as mentioned the 2011 Italian result of 4 PAES of 954 subscribers) of the local authorities does not seem to be tied to the scarce liquidity that affects Municipalities and Provinces (there are in fact European financing programs – ELENA, JESSICA, IEE and from banks – which almost entirely cover the analysis and design costs), but the immense gap that seems to separate the professionals for territorial design tout court, from those who develop new and complex instruments such as the ones requested by the community development policies.

3.2.2 The islands of Lampedusa e Linosa

The municipality of Lampedusa and Linosa is the most southern in the Italian territory (35°29' N 12°16' E), has a residence population of 5.725 inhabitants, has a territory of 22 km^2, it is the only one that is classified as climatic zone A (568 days - T_{med} min 17,2°C and T_{med} max 21,2°C) and the solar radiation is among the highest registered in Italy. Energy is provided by a diesel oil power station and there are no other vectors of energy provisioning.

In 2009 when we decided to start this research, the Island was outside the Covenant. Lampedusa has become object of our study because it presents itself as a natural laboratory, a perfect system for research: closed and easy to control.

Also, the complete absence of design instruments (the PGR was drafted ten years ago and still has not been approved) makes such design experiment a way to extend the debate on which are the authentic dynamics that move the urban policies in Italy and if the current instruments used in Sicily can honestly be deemed "current" in such complex and articulated realities.

In 2012 the Mayor signed the Covenant, but there are still no plans presented for its asset.

3.2.3 Emissions Base Inventory – EBI (bottom-up approach)

- Island

The energy vector is electric energy produced by the diesel oil power plant of Cala Pisana. The total consumptions were calculated based on the fuel provisioning data from 2008/2009.

The strong touristic trait of the island has created a large residential area, according to the standards much more superior to the residential inhabitants. This notion has allowed us to consider the accommodating and residential sector as a single and wider socio-economic environment.

The data on consumption per sector shows that such section on the Island is assessed at about 70% in opposition to the national average (30/40% for residential and business sectors).

The annual emissions in relation to the Island's energy needs, is currently measured at 25.000 tons CO_2 (44 tons/inhabitant). Such results, integrated to the ones on transportation (necessary vehicle for tourism supply), bring the emissions on the Island in line with the national averages (8-12 tons CO_2/inhabitant).

- Mobility means

The connections among the Islands are done through the airport and the port. In this analysis the environmental impact of the transportation, to and from Lampedusa and Linosa, has been entirely included.

The decision to include such data is motivated by the type of economy that drives the Island. The large tourism flows that triple the population in the summer months, represent the primary source of income for the residents. Therefore, the emissions that are released into the atmosphere during the journey are the "responsibility" of the constantly growing touristic-economic process.

The ferries for transporting passengers are also used for transporting to Sicily the waste products that cannot be disposed of on the Island, causing many inconveniences for the tourists. The naval traffic also includes the tanker ships that transport the diesel oil necessary to supply the power station, and the water to satisfy the inhabitant's water system demand. The hydroplanes are only limited to the touristic summer season.

Fishing is the only economic activity not tied to tourism. In fact, it was established to evaluate the consumptions in relation to fishing with respect to the actual ones, in a 50 km/radius. ENAC (Italian Civil Aviation Authority) indicates that the passengers who arrived on the island are 194.915/year, with a yearly increase of 10%.

3.2.4 Action Plan for Sustainable Energy – SEAP

The objective, for the energy point of view, is to bring the Island by 2020 to the community objective, and by 2030 to a total energetic autonomy by making CO_2 emissions equal to zero.

In order to do that, we experimented to put the SEAP not as a ending tool of an energy plan but, in a strategic position able to ordinate the overall planning (Figure 1)

Figure 1 - The planning process logic scheme

The expected result of this energy based city planning are briefly exposed in Figure 2.

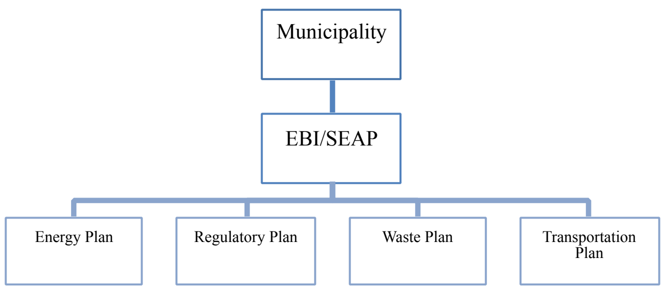
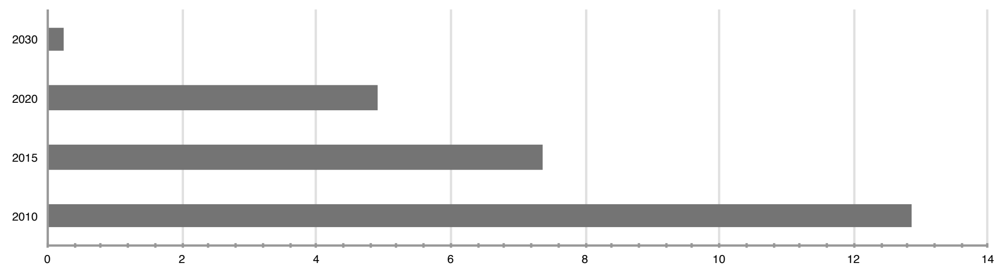
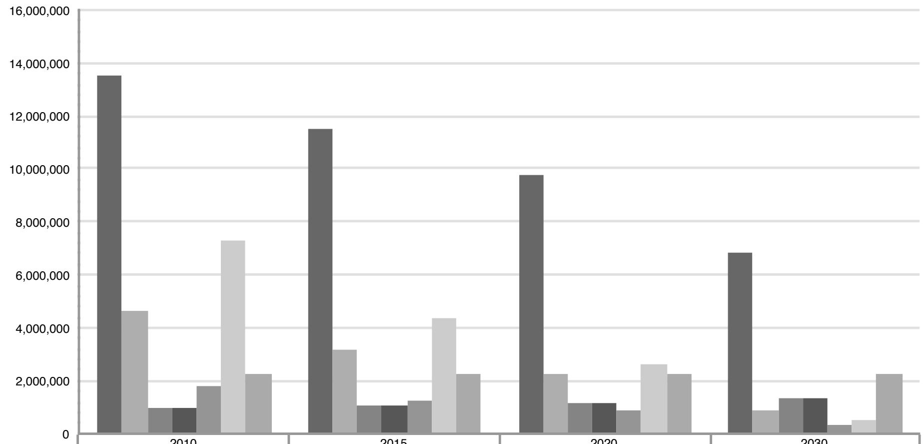


Figure 2 - The CO_2 goals



	2010	2015	2020	2030
Tons CO2/inha.	12.87	7.37	4.91	0.22

Figure 3 - Energy demand simulation

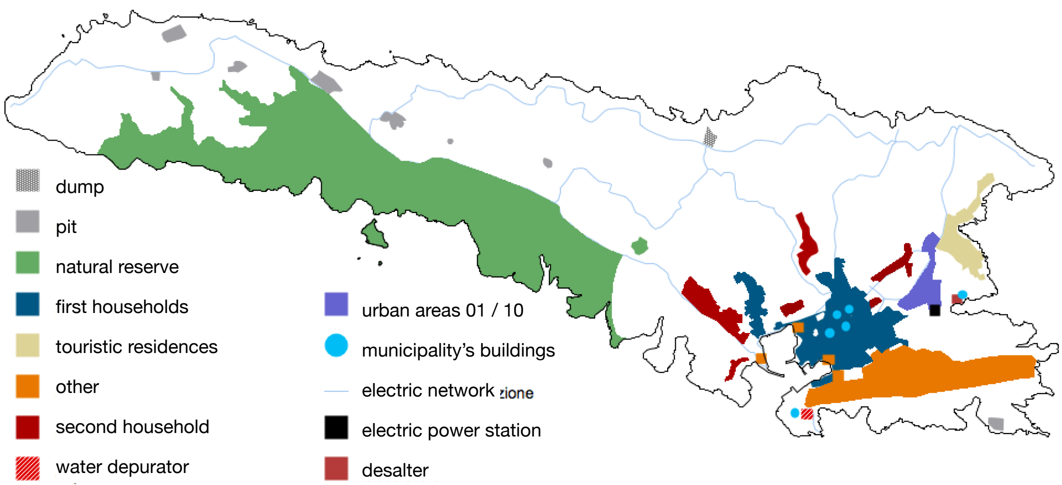


	2010	2015	2020	2030
first households (kWh/a)	13,560,000	11,526,000	9,797,100	6,857,970
second households (kWh/a)	4,599,000	3,219,300	2,253,510	901,404
touristic structures (kWh/a)	945,000	1,050,000	1,155,000	1,365,000
new urban areas (kWh/a)	945,000	1,050,000	1,155,000	1,365,000
municipality (kWh/a)	1,777,143	1,244,000	870,800	348,320
electricity distribution (kWh/a)	7,295,864	4,377,518	2,626,511	525,302
other (kWh/a)	2,246,513	2,245,390	2,244,267	2,242,023

The strategies to reach these goals are:

- reduce the existing needs;
- design the sustainable real estate and tourism development;
- substitute the diesel oil through the use of renewable resources;
- plant new woodlands.

Figure 4 - Lampedusa current use of soil



Actions for the Municipality of Lampedusa and Linosa

Preliminary phase:

The municipal administration will set the bases by creating a public-private energy agency (a E.S.Co with the current energy provider on the Island and an accredited energy certification institute such as CasaClima or others).

Design phase:

The Agency will take care of the first phase for co-drafting the APSE. This instrument will provide the guidelines for the PGR, for a detailed plan for the infrastructures on the Island and an integrated plan for waste management.

Executive Phase:

This phase will be dedicated to the requalification of the municipal building heritage, will draft an energy land registry and will manage the renewable energy structures distributed throughout the island.

Actions for energy

- Creating an underground electric grid will decrease energy loss for distribution.
- Creating an underground electric grid will allow the use of the pole for small wind powered generators.
- The photovoltaic structures will be distributed in the degraded areas, to reduce their visual impact.
- Hotels will receive incentives to adopt geothermic climate systems using the seawater.
- By analyzing the current state, it is deduced that 90% of the buildings have flat rooftops. To give incentives to adopt photovoltaic systems, the municipality could offer a volume increase in relations to the covered surface (light structure). The renovation and extension of the property must include a greater overall efficiency, and the new roof surface must be predisposed for a solar thermal and photovoltaic system. The provision aims to increase the square footage of the Island for the housing supply, sparing the territory.
- Every household will receive incentives, in any case, by equipping solar thermal systems for health and hygienic consumptions.

- The power plant will slowly be reconverted into a hydrogen stock station and reconversion through combustion cells.

Figure 5 - Distributed Alternative Energy solutions: photovoltaic parkings

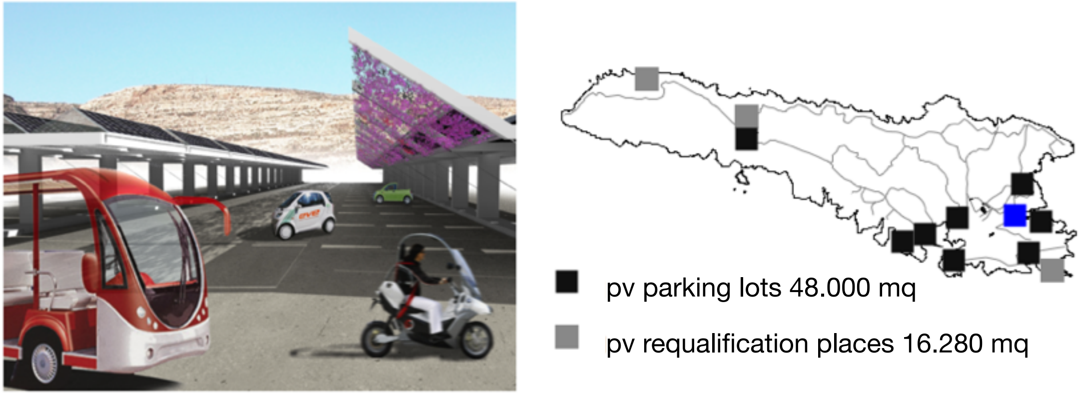


Figure 6 - Distributed Alternative Energy solutions: micro wind turbines

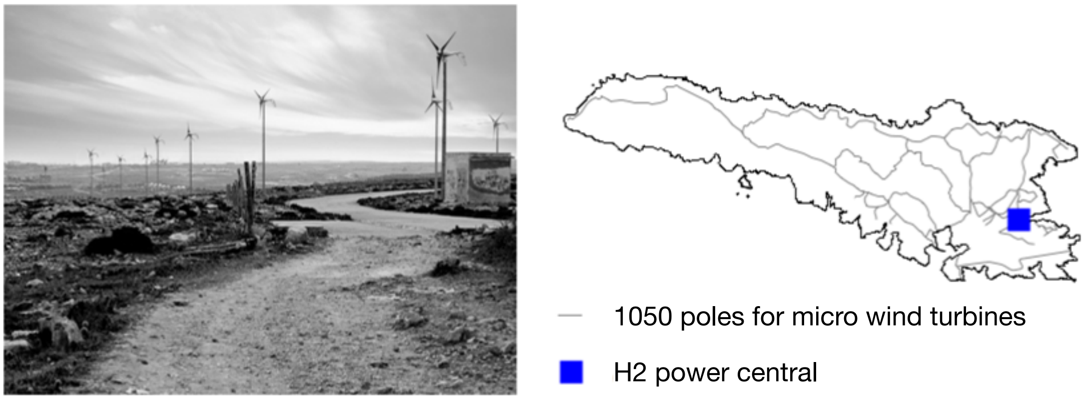
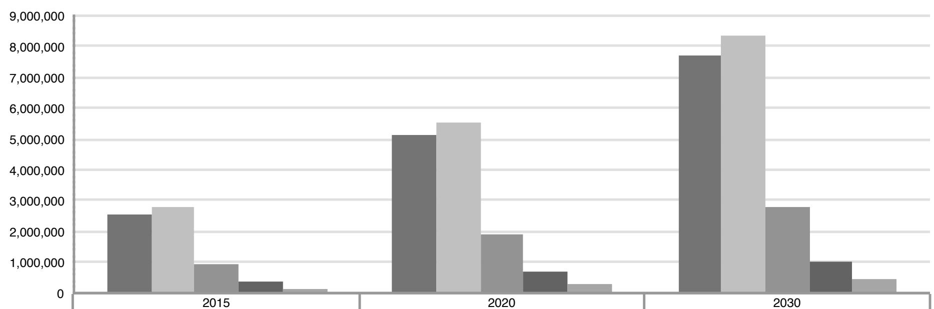


Figure 7 - Distributed Alternative Energy production



	2015	2020	2030
pv roofs (kWh/a)	2,566,181	5,132,363	7,706,250
pv parking lots (kWh/a)	2,783,121	5,566,241	8,357,719
pv requalification (kWh/a)	937,690	1,875,381	2,815,887
waste digester (kWh/a)	334,600	669,200	1,004,804
micro wind turbines (kWh/a)	159,440	318,881	478,800

Actions for waste management

A provision for all goods entering the Island will reduce the production of undifferentiated waste.

A fee for packaging will facilitate recycling PET, aluminum, steel, etc.

An integrated door to door waste pick up will allow for using the fraction of wet waste to power the waste digester (5.000 ton capacity) that will produce electric and thermal energy (usable to power absorption refrigerators for storing groceries or to depurate for domestic usage the sea water).

The organic waste can be used to fertilize vast areas of the territory (today of uncultivable Mediterranean garrigue).

The residents will be able to pay their waste management tax based on the effective quantity produced, through a magnetic ID card. On the other hand, tourist can charge a credit on a magnetic card attached to the travel ID. The credits can be spent on the island on tourism services.

Figure 8 - Waste digester

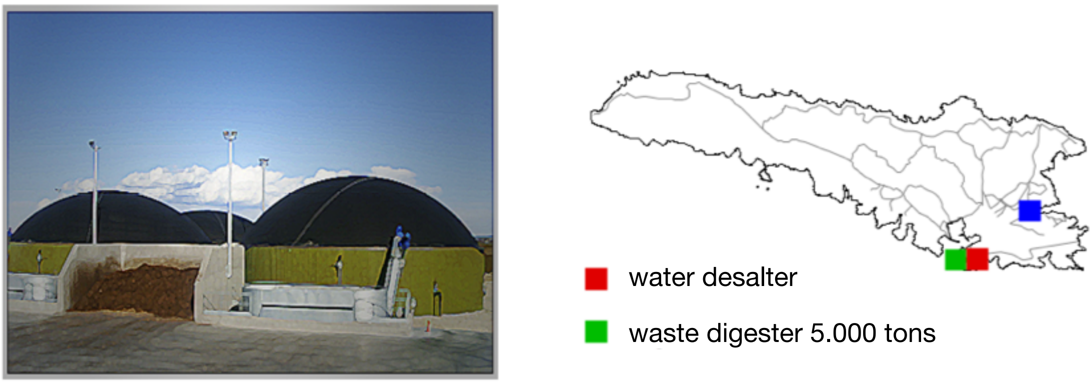
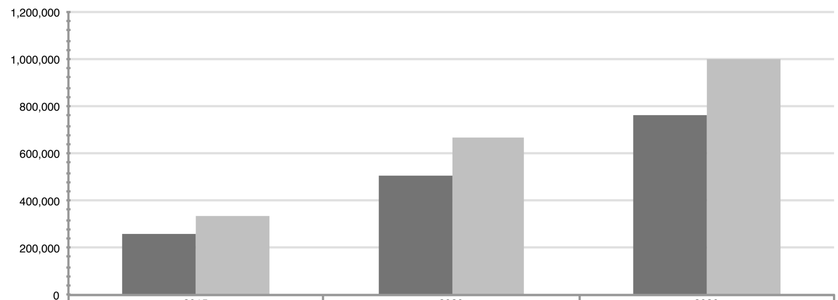


Figure 9 - Waste digester energy production



	2015	2020	2030
thermal energy (kWh/a)	254,260	508,520	763,544
electric energy (kWh/a)	334,600	669,200	1,004,804

Actions for territorial design

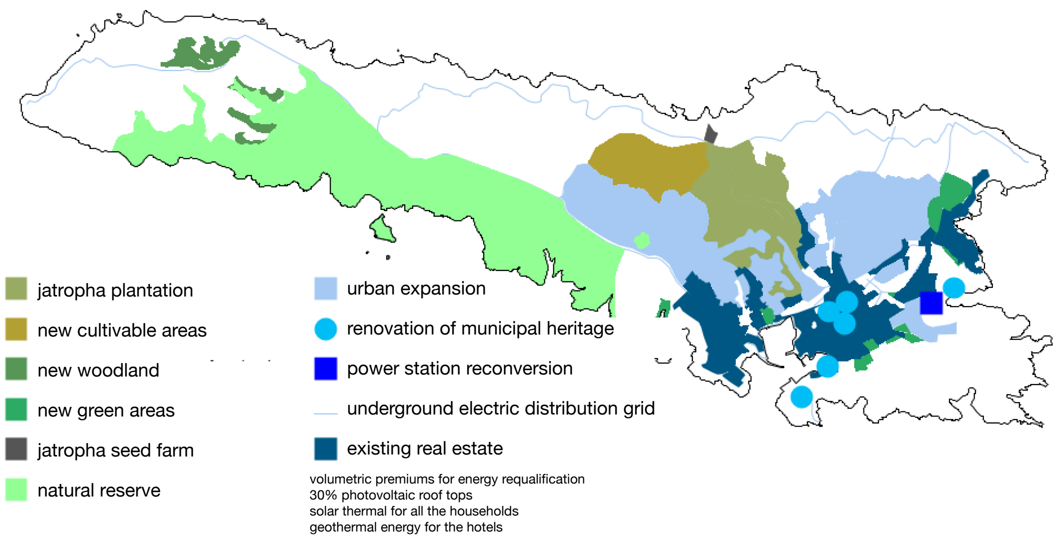
The expansion areas will be located upon completion of the current urban fabric.

The new green areas will act as a filter between the existing real estate and the future development.

The water network will be renovated to reduce its leakages (currently 35%).

The ordinary and extraordinary renovations will receive incentives by volume (real or virtual for the expansion areas), or by reduction of responsibilities for increasing efficiency and installing energy production structures (to be used or contracted to the Agency).

Figure 10 - Lampedusa indications for the Regulatory Plan and public-private development



The building limits set by Ministerial Decree 2/4/68 will be updated according to the Agency's indications, for the expansion areas.

For the first house the limit will be: ORO

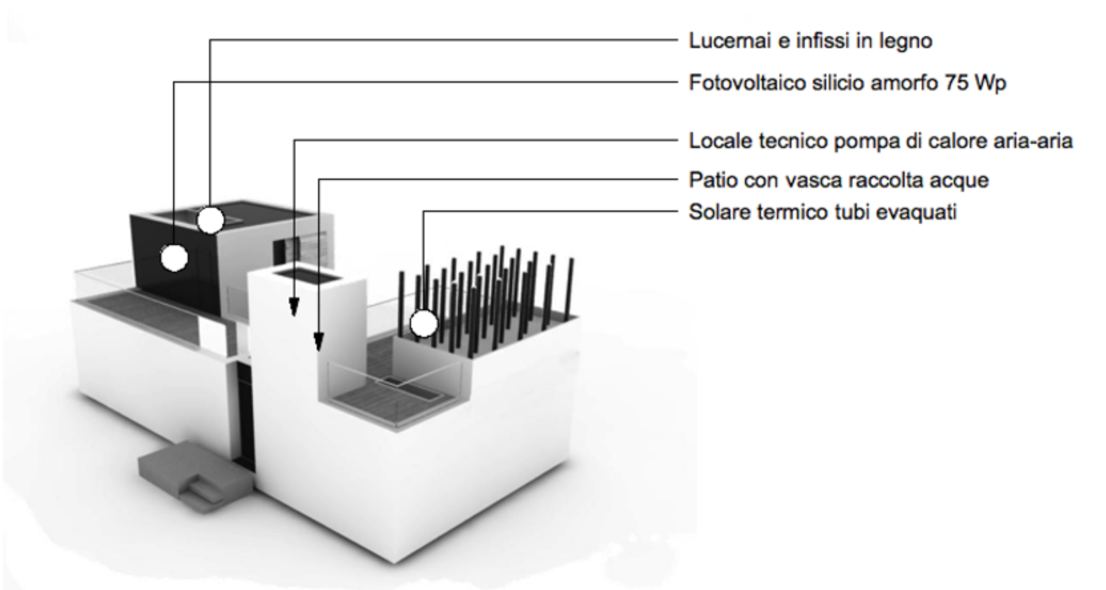
(EP<5 kWh/m^2/year);

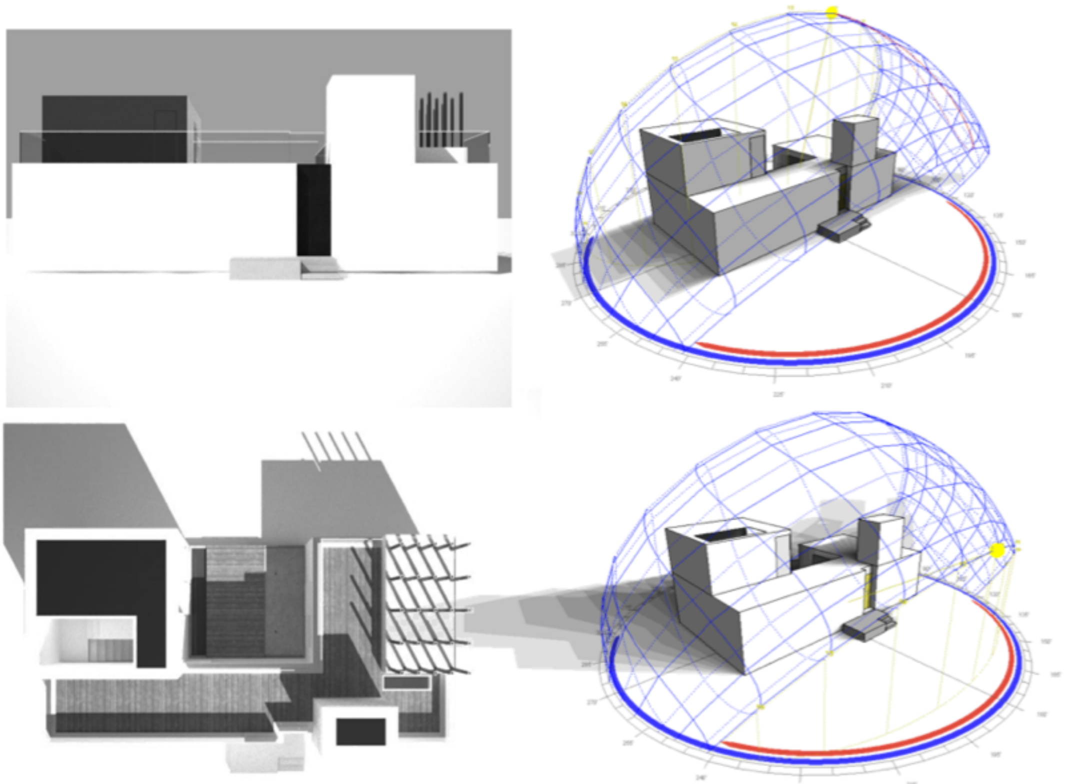
for the second: A

(EP<10 kWh/m^2/year).

The energy certification system will expect a dynamic calculation of the consumptions, using for the data reading, distributed times systems (Floweather).

Figure 11 - Typological villa study





Actions for transportation

The reduction in production of undifferentiated waste will decrease the transportation through the ferries.

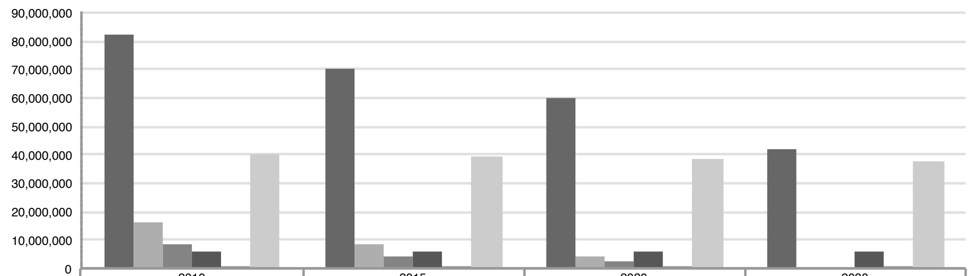
The reconversion of the power station will eliminate the trips of the fuel tankers.

A water saving policy and the reduction of leakages (today 35%) will eliminate external supply.

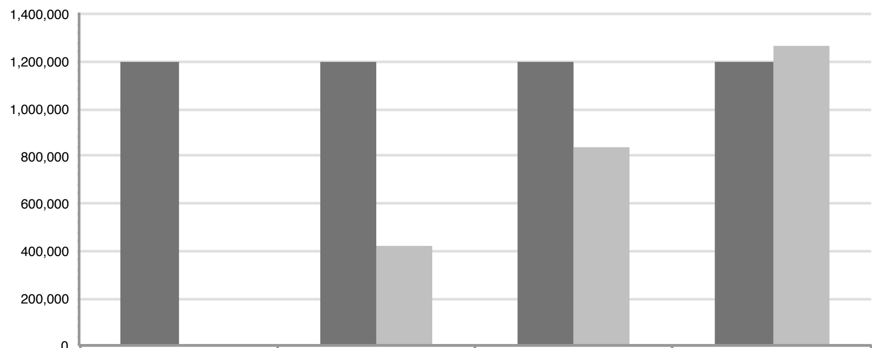
Incentives will be given for initiatives such as car pooling and car sharing (on electric and hydrogen fuelled cars and motorcycles).

Plantations of Jatropha curcas (perfect for this climate) will provide biodiesel for consumptions by motor fishing and recreational boating. The residual seed byproducts from the production will be used as fertilizer for the new green areas.

Figure 12 - Savings due to the efficiency policies on transportation (on top) and biodiesel production. balance.



	2010	2015	2020	2030
ferries (kWh/a)	82,500,000	70,125,000	59,606,250	41,724,375
water tanks (kWh/a)	16,244,444	8,122,222	4,061,111	0
oil tanks (kWh/a)	8,613,333	4,306,667	2,153,333	0
hydrofoils (kWh/a)	5,890,500	5,890,500	5,890,500	5,890,500
fishing boats (kWh/a)	1,194,444	1,194,444	1,194,444	1,194,444
airplanes (kWh/a)	40,000,000	39,600,000	38,720,000	37,268,000



	2010	2015	2020	2030
fishing boats (kWh/a)	1,194,444	1,194,444	1,194,444	1,194,444
biodiesel (kWh/a)	0	420,744	841,487	1,263,494

Actions for urban design

Technology carries along great potential for re-establishing the bond of citizens with the city; around the reconverted structure of the power station (via cala Pisana), for example, to mitigate the impact and give back this piece of Island to its citizens and tourists, an infrastructural ring is created for small-scale elements to be plugged-in and serve people's contemporary daily needs as expressed and modified in terms of locality and weather conditions. The mild Mediterranean climate expressed in a virtual nine-month summer instilled an innate gregariousness thereby affecting the character of their activities and the way they are spatially manifested. Kitchens, tables, lounge chairs, workstations, bathrooms, ponds, projectors, power sockets and Wi-Fi, water fountains, herb gardens, bike repairing stations, gyms create a habitable environment.

A phased construction approach allows the proposal's basic tenets to adapt to any concurrent social, economic and political changes without interrupting the fluidity of experiencing the urban reality.

Figure 13 - A render image of a possible solution around the H_2 central.

The expected appropriation will trigger people's creativity, stimulate small-scale productions and revive arts and crafts for an alternative lifestyle. It will create the premises for a new practice of democracy, one interwoven with everyday life.
The project of urban retrofit itself becomes the city's playground for the community's creativity in a 2.0 or a indian "jungaad" way.
So it becomes the dynamic city interface, built by the citizens on our adaptive outline, that provides quick and effective answers to the everyday city's issues. This kind of references literally shape the master plan and its social and economical impact with the city.
We can summarized this design policy in a main address: hacking the system. Minimizing the removals and gaining the most from the existing situation with the minimum effort (i.e: most of the existing pavements are maintained while, existing electric network poles are converted in micro wind turbines, and so on).
The proposed policies interventions will trigger bottom-up initiative and small scale intervention, likely to be implemented and transformed according to specific needs with minimum effort.
The implementation of the new sustainable energies facilities (the H_2 central, the Jatropha treatment center, the waste digester, the photovoltaic parking areas) are designed in order to give value to the territory also with their impact, sharing the benefits and optimizing the cost. By doing that we can derail some of assets toward a more effective impact in daily life.

Actions on community behaviour

The community of inhabitants and tourist of Lampedusa, in order to improve the energy performance based on their bahaviors, has to share the effort needed to do it, but how? How can we foster behaviours' changes toward new more sustainable citizens' lifestyles?
Rethinking communities by using social network tools becomes an opportunity to promote interaction between citizens and their environment.

Digital media is, nowadays, the best option for gathering individual demands and transform them into collective opportunities. Moreover, through digital media tools it is possible to create and stimulate awareness through gamification process. More and more used in product and service marketing, gamification proposes and brings the use of game mechanics and dynamics into contexts that are far away from the recreational field, trying to generate interest, focus and solve problems. But may we use points, levels and prizes for stimulating, feeding and making more sustainable the processes of civic participation and creation of public value in our cities?

Many cities are already working on this path, flipping the usual approach towards the cure of the "common goods": from giving prizes to the good practices, to stimulation and involvement of border line people, through the creation of a shared and focused community.

We propose to create a new way of urban sharing by underlining the importance of the role of the gaming processes in generating interest and participation of the citizenship.

For Lampedusa we have designed a mobile application so called "Lampedusa Social market", a multi-platform application, for interaction on four capital city community topics: Mobility, Education, Energy and Labour.

Figure 14 - The fourth domains Lampedusa Social Market.

On this platform users share with the community their choices and they are rewarded with credits depending on how sustainable their choose was. This credits become bonus that citizens can invest in the community context. For instance, savings in the domestic energy consumes can be transform in discounts for buying orchard vegetables or they can get free use of co-working space in common areas.

Citizens' active interaction is the key point.

On the one hand, they describe their needs and on the other hand they explain what they can offer to the. In oder to achieve this interaction, a collaborative game is developed, where any lavish contribution to the community becomes a virtual credit. This bonus are exchangeable in the community, and maybe use as discounts on local products, free use of services and facilities, or other users help or attentions.

In such a way, a complex system for transaction and participation is promoted. The project goal is that starting from a virtual experience, it will positively influence the urban environment.

On the Mobility topic, the app provides credits depending on the mobility means people use, the more sustainable it is, more credits they get.

On the Education topic, the system assigns scores based on the citizen role (teacher / student) in Lifelong Learning Program or in technical workshops (gardening, general maintenance, etc.).

On the Energy topic, the E.S.Co. will collect the data of citizens' energy consumption and connected to different virtuous actions, such as using energy at certain parts of the day or improving the energy demand, will give credits to the customers.

On the Labour topic, the efforts that a users display on the waste collection and fruit and vegetables production are considered at a first step. By using intelligent bins, the system measures the amount of waste that each inhabitant introduces and each user will get bonus depending on this amount. In a similar way, the amount of fruits or vegetables produced is measured and a score is assigned depending on each kind.

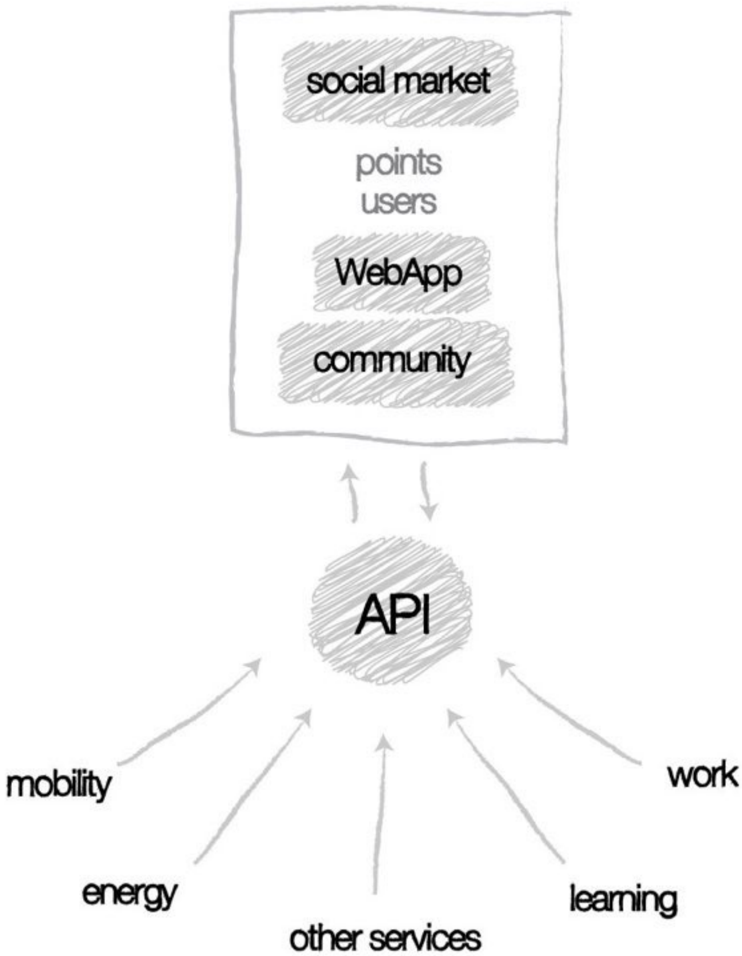
All bonus earned using the ways described above are used by inhabitants at the local groceries stores or in the local business network.

The key question is that each user contributes to create a personal bonus portfolio, which is the consequence of showing a kind behavior at different aspects of everyday life.

In short, this system is an powerful tool for pushing community spirit and the citizen are conscious of how they can transform their environment with their everyday life little actions.

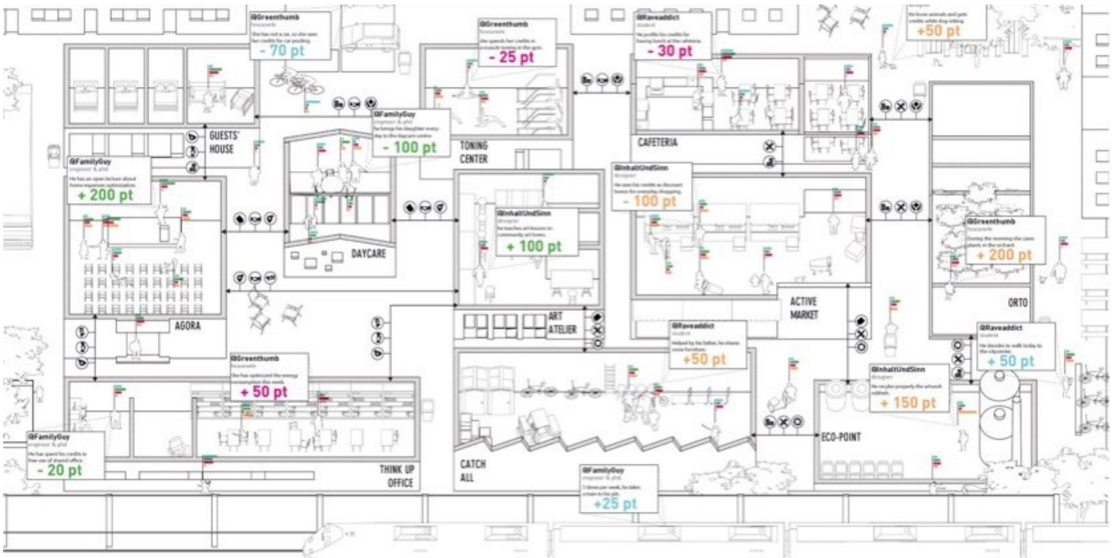
In the Lampedusa Social Market will be stored all the information regarding the smart citizens, their smart behaviors and the points they have earned. Those data will per accessible through a web app, that will take the role of a real net-square, from which all the community members will be able to track the smart behaviors of the others citizen in order to enhance their engagement within the platform. From a technological point of view, the role of this block will be the storage of the citizens profile and the aggregation of the information coming from the external services delegated to track the smart behaviors. Furthermore, the Social Market will be link between Local Business and citizens.

Figure 15 - Software architecture.



For the software development process, a very important component of the platform is the Application Programming Interface (API) block. In fact, this will take the role of a middleware through the Social Market and the services that tracks the citizens behaviors. This separation is needed by the fact that the citizens interacts with the cities in many different ways and through many different services.
Every service has got its very own metrics to evaluate the citizens behaviors and to compare those to smart pattern of interactions.

Figure 16 - User interaction simulation.



3.2.5 Economic sustainability

This project is economically "lean"; "...it provides a way to do more and more with less and less - less human effort, less equipment, less time, less space - while coming closer to providing citizens with exactly what they want" (J.P. Womack, The lean thinking).

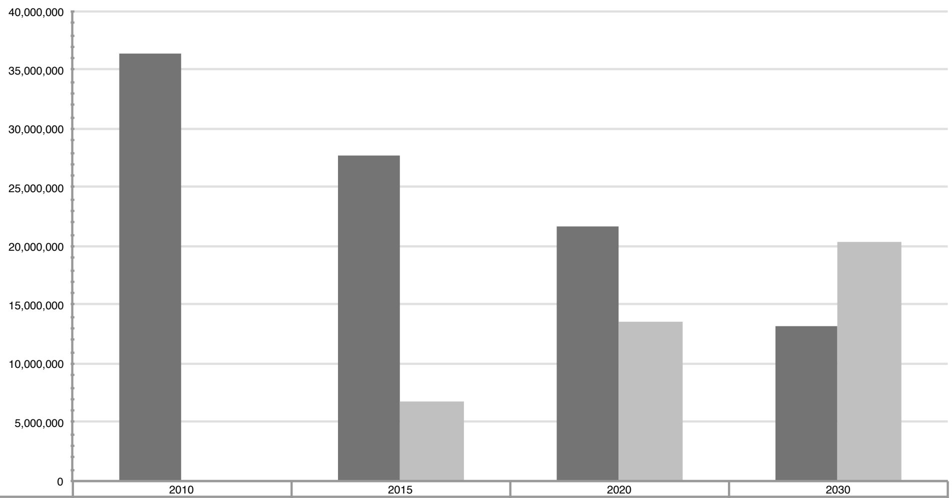
The overall design is driven by lean economical principles: zero waste, value to the value, value to the process that gives value to the citizens and it tries to solve the urban and the social problem completely.

So the very beginning of the conceptual design is this kind of socio-economic approach. An adaptive architecture that trough a resilient process let the city actually meet the citizens in a interactive, valuable, cost-effective way. The project is thought as a pamphlet: although being one coherent plan, it allows the consequent

implementation of singular interventions, making the economical plan flexible and deferrable trough a long time span (proposed implementation phases), and the lean approach let the municipality free to valuate the implementation of the living infrastructure step by step and day by day, let them know when, how and if intervene.
The interventions themselves are bound to the existing conditions and act to enhance the potentials found in place: rather than an overall redesign the project aims to reuse existing materials and situations.
The project aims for resilience, being the interventions very defined from a morphological point of view but able to host changing activities trough time.
Due to the simplicity and efficiency of technical construction, the intervention is expected to have extremely low maintenance costs. Furthermore most of the constructions are reversible, dismountable or recyclable.
As the proposal is basically a distribute energy infrastructure with the chance to foster new activities, also new economical operator are expected to enjoy its benefits: mostly small scale business, related to flourishing of a local, artisanal practices, will expand from Cala Pisana to wide surrounding area. Besides, the pleasant environmental conditions and the multiplicity of equipment ensure a constant presence of people all day long, not only passing-by but actually spending time on the street: this is expected to trigger local entrepreneurship, shops, bars etc…
Also the development of the "Lampedusa Social Market" app will create new digital jobs and opportunities for the Islands.

By integrating the above-mentioned actions into the current urban instruments, according to our forecasts, the objective of eliminating emissions per inhabitant will be achieved by 2030.
Furthermore, the Island will become energetically independent and active.
Through the combined actions of energy saving and production of renewable resources, in fact from 2030, the hyper production of "clean" electric energy, will allow the Agency to conserve it in the form of hydrogen produced through water hydrolysis. Therefore, the Island will have its own "natural" source of energy, which can be traded on the national and international markets.

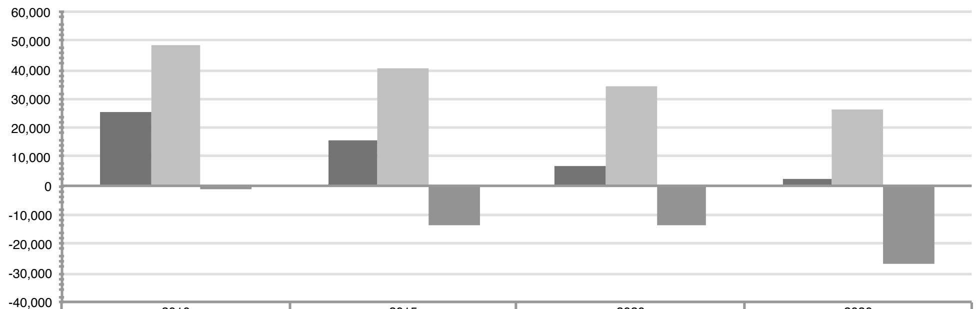
Figure 17 - Energy balance and CO_2 production simulation.



	2010	2015	2020	2030
Energy demand kWh/a	36,479,320	27,727,388	21,708,394	13,263,862
Renewable energies kWh/a	0	6,781,032	13,562,065	20,363,461

Tourism will be completely sustainable; in fact, the Island will guarantee a balance between the anthropic and natural systems with the rotation of the seasons.

Figure 18 - CO_2 production trend and overall emission balance.

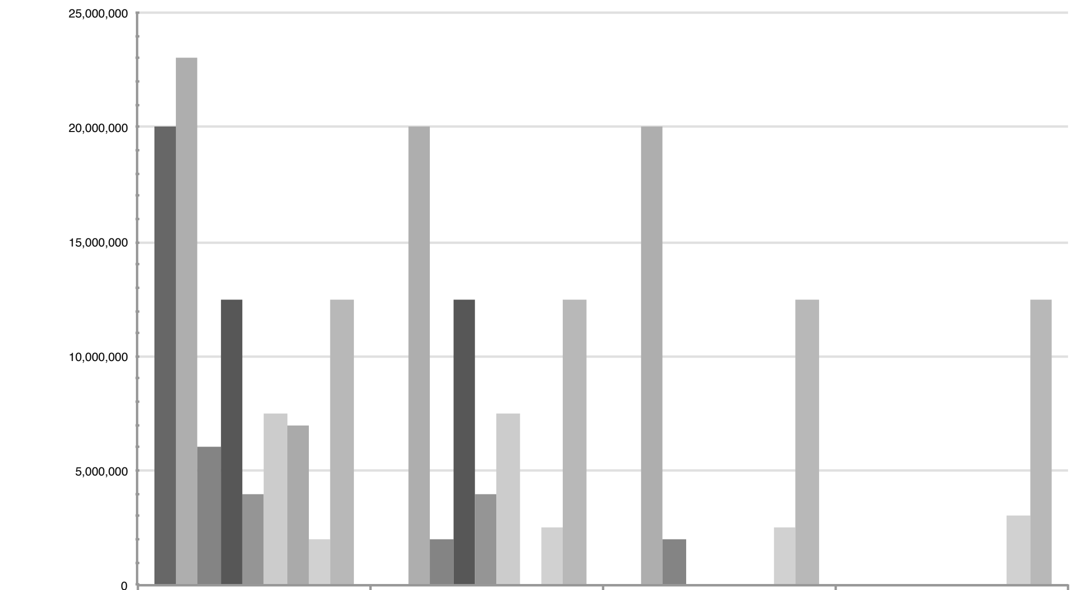


	2010	2015	2020	2030
Island CO2 tons	25,426	15,326	7,131	2,049
Transportation CO2 tons	48,771	40,326	34,490	26,202
New woodland CO2 tons	-544	-13,484	-13,484	-26,968

An extraordinary resource for the territory, which on one side will allow for a local programming and development on the track of environmental sustainability, and on the other side will allow the Island to be integrated within an economy on a Mediterranean level, based on hydrogen as an energy vector (as foreseen in the PEARS).

All of the proposed actions, and briefly outlined in this document, are conceived to be financed by the economic resources already existing on the Island.

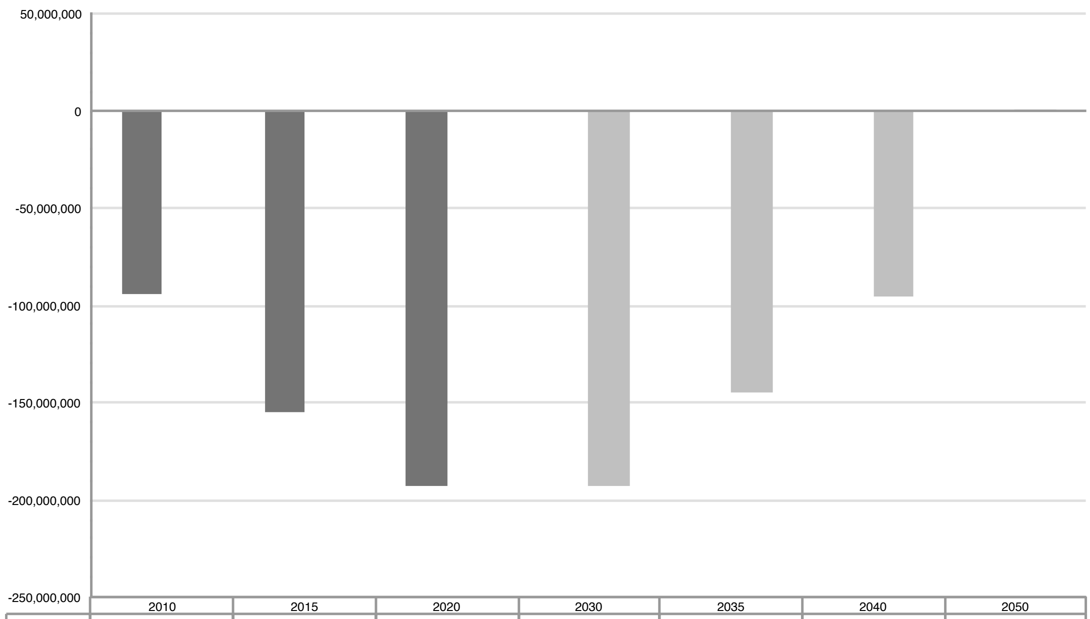
Figure 19 - Investments.



	2010	2015	2020	2030
electricity network	€ 20000000.0	€ .0	€ .0	€ .0
renewable energies	€ 23000000.0	€ 20000000.0	€ 20000000.0	€ .0
waste digester	€ 6000000.0	€ 2000000.0	€ 2000000.0	€ .0
central hydrogen	€ 12500000.0	€ 12500000.0	€ .0	€ .0
municipality retrofit	€ 4000000.0	€ 4000000.0	€ .0	€ .0
water supply network	€ 7500000.0	€ 7500000.0	€ .0	€ .0
new woodland	€ 7000000.0	€ .0	€ .0	€ .0
energy agency	€ 2000000.0	€ 2500000.0	€ 2500000.0	€ 3000000.0
incentives	€ 12500000.0	€ 12500000.0	€ 12500000.0	€ 12500000.0

The island will invest in itself, in other words the Municipality, the Agency for energy and every single citizen.

Figure 20 - Budget balance



	2010	2015	2020	2030	2035	2040	2050
Investment	-€ 94500000.0	-€ 155500000.0	-€ 192500000.0				
Payback				-€ 192550889.694	-€ 144253438.895	-€ 95955988.097	€ 638913.50

Furthermore, about one third of all of the proposed investments are functional for the renewal (electric and water grids, etc.) and improvement of the “standard” living conditions of the inhabitants.

The economic feasibility of the proposed investments was evaluated without considering the continuous price increase of diesel fuel; the profits, foreseen from 2040 on, could be seen before.

3.2.6 Conclusions

With this design experiment we have tried to prove that the integrated use of these new strategic design instruments (energetic-territorial) can offer the opportunity to trigger the deep processes of urban, social and economic renewal, necessary to guarantee development and growth in contexts that are often compromised and reviled by too many years of absent policies.

A SEAP, in fact, can reach in many different ways a territory and, despite its action-plan design shape, in the case of the municipality of Lampedusa and Linosa, it could be at the centre of a project of a complex urban renewal.

All the actions proposed to solve the energy issues of the Islands, have the multipurpose to heal deeply the “city body”. As the Gilles Deluze "Rhizoma" concept, indeed, "there are no authorities and hierarchies, and democracy is characterized not only by the principles of equity, consultation and equal representation, but over and above that by the proliferation of inter thinking strands of production, commerce and desire" (W. Artes, An alabaster skin).

It is not a simple intervention in the city's heart beat, it is more. With an integrated strategy it provides to the city a new complex system of relationship, pointing straight to the community values.

It is a project that builds urban communities, it triggers new social and urban dynamics. By mentioning Alice Amsden, we can say that the main aim of the project is its spillover effect on a "labor based development strategy".

By providing public amenities for everyone, with no social target group, the proposal aims for social integration. Spending more time on the street, citizens will create stronger social relations and affection to their citizenship.

Bringing together leisure and education, the project wants to turn each energy intervention into the centre of culture production in Lampedusa.

The project provides facilities and suggests uses, but on the other hand it allows any kind of unexpected activity to take place triggering peoples creativity.

The involvement of the citizens is not only expected in the use but also planned in the design: given the main top-down energetic and morphological design, the small scale set up will be agreed with the citizens following participative design workshops and using the mobile app.

As Adriano Olivetti said about communities: "Per dare vita ad un'autentica comunità occorrono delle generazioni. Il volto della città nuova non può essere affidato all'estro di un uomo, ma a un sistema, una civiltà di cultura decentrata" [To let born an authentic community it needs generations. The new city face does not belong to the creativity of just one man, but it belongs to a system, a decentralized and spread culture - A. Olivetti, La città dell'uomo]

For this reasons, we tried to design holistically a different system able to innovate and be meaningful.

"The view we take in the following pages is that culture arises in the form of play, that it is played from the very beginning... Social life is endued with supra-biological forms, in the shape of play, which enhances its value."

Joan Huizinga, *Homo Ludens*

3.3 TrafficO2 - social network for communities' sustainable mobility

The following action-research study started with the ambition of being a real effective bottom-up solution for the urban mobility issues.

Without touching neither a bus lane journey or digging the historic city's tissue for a metro lane, in fact, we thought possible to change urban traffic dynamics just by talking to the people, giving them the right motivations at the right time to do the "right thing" regarding their urban mobility behaviors.

This bottom-up proposal is far to be a formal Sustainable Urban Mobility Plan but, regarding the final results, it shares the same ambitions.

This "goal" makes the experimentation peculiar and interesting because it tries to raise the impact level to a bigger scale than what we usually have for these bottom-up projects. It, actually, belongs to the new frontier's research domain that investigates the connections between energy and behaviours (briefly described in the previous chapter) and firstly born as a possible solution of the Lampedusa island mobility project.

The following paragraphs are a short overview of the work that won the 2012 Italian Challenge funded by the Italian Ministry of University and Research "Smart Cities and Communities and Social Innovation" and we are conducting together with "Push - no profit" organization.

3.3.1 Introduction

As many thinkers have stated on cities and citizens' behaviors, from Kevin Lynch (The image of the city, Cambridge, 1960, MIT Press) to Peter Calthorpe (Urbanism in the age of climate change, Washington, 2011, Island Press), cities are communities made of people, and if we aim to effectively change the urban conditions, we have to change how people perceive cities, how they interact with them, how they act upon them. All over the world designers are dealing with studies that aim to define new tools to face urban traffic issues in the old and consolidated cities. Many believe that we need to change the citizens' views towards mobility systems, simply focusing and improving the "human transit".

Social sciences have already crossed into the urbanism field, but today new information technologies are making this communication faster and more productive. American private enterprises such as Nuride (http://nuride.com), Zimride (http://www.zimride.com/), LYFT (https://www.lyft.com/), or European like moovel (https://www.moovel.com/en/US/), Mo-bility (http://www.mo-bility.com/mo/home.html) and Covivo (http://www.covivoturage-dynamiq.eu/) are quickly moving the debate on changing cities by focusing their attention from the necessary modifications of the urban structure (the hardware) to the changes that can be induced by working on the citizens' behaviors and the urban communities' habits (the software).

All of these projects have the purpose to stimulate the community to change its bad habits, fostering more responsible behaviors through the use of smartphone apps.

Essentially the idea is to trigger a social and cultural change, with the "dialog" tool provided by the social media technology and, possibly, create a new service and, therefore, a new market. In fact, the majority of the above mentioned projects were all developed by start-ups. The area of computer science is called "Social Computing" and is behind the idea that good connections due to low cost devices, modular contents and shared computing resources can obtain a deep impact on our global economy and on our social organization.

Lately the Italian Ministry of University and Research has funded with 4 million euro three of these kind of projects that are being implemented in Palermo.

These applied research projects, still ongoing, aim to stimulate local communities to change their behaviors, to promote more responsible mobility behaviors through the aid of smartphone applications (Kamal et al, 2014).

The three teams of researchers that won the fellowship grant are multidisciplinary groups with a "social entrepreneur" approach – Muovity, CityFree and TrafficO_2 – that will provide services of carpooling logistics (most of which focusing on short distance commuters) and of inter modality logistics to promote the values of sustainable mobility. All of the funded projects will firstly be directed towards the large urban community of the University of Palermo. This choice was made based on the selected target to test their products: young and curious students are probably the best social community on which to experiment projects that, driven by new technologies and social media, aim to changing their mobility behaviors (Vinci and Di Dio, 2014).

3.3.2 The mobility system of Palermo

As previously mentioned, many researchers and designers are attempting to create "tailor made" solutions for behavior changing projects that are able to improve energy efficiency policies. Following this main research approach the city of Palermo was chosen because of the interesting situation the city has been facing for the past years.

Palermo is the fifth city in Italy for population (654,858 inhabitants in the urban area and 1.200.000 in the metropolitan area); its population density is 4.270 inhabitants / km^2 in an area of 159 km^2. Palermo, as many other cities in Italy, faces severe traffic problems on a daily basis. By consulting the data from the 2012 ISTAT (ISTAT, 2012a) regarding the average speed of vehicles and of the public transportation in the urban areas, it is evident that the city is one of the slowest among the entire Italian territory, as reported in Table 1.

Table 1 - Average speed of urban vehicles, density and average age.

	Rome	Milan	Naples	Turin	Palermo	Genova
Car average speed (km/h)	23	22	21	26	20	25
Public Transport average speed (km/h)	12	12	10	13	*12	15
Cars per 1000 inhabitants	565	529	597	565	590	461
Cars older than 8 years	49%	47%	48%	72%	60%	51%

*: data provided by AMAT (Palermo public transportation company)

The average vehicle density in Palermo is the second most in Italy after Naples, and, taking into consideration the fleet of vehicles present in Palermo, most of the vehicles are considerably old (see Table 1). This data is probably sufficient to make a first consideration regarding the complex scenario the city is facing.

The city's bus network extends for 341 km (Municipality of Palermo, 2013) and is served by one of the oldest bus fleets in Italy of which 50% belongs to the class Euro 0 (busses built in 1992) and class Euro 1 (busses built in 1995). The city has a good

distribution of bus stations (14,7 stations/ km^2 – 3,6 points higher than the average of the 15 largest Italian cities), but the supply (2400 seats per km per inhabitants) is widely below the Italian average (about 3500 seats). Nevertheless, in 2010 the number of passengers increased by +18% in comparison to the previous year, and according to the data collected by AMAT the fleet effectively in use is only 51% of the entire fleet (in 2010 only 287 busses were circulating among the 560 available ones).
Palermo does not currently have an underground transport system (the project is currently being developed). In the past years, the city has integrated an urban rail transport system (with a frequency of every 30 min – service provided by Ferrovie dello Stato) with three lines, 12 stations and able to cover 16 km in the urban area. Finally, a tram network (includes 3 lines) is currently being built and is destined to serve the suburban districts of the city.
Palermo has also been experimenting for the past 5 years a car sharing system, which includes 43 car parking spaces, 31 parking areas and 900 users. Unfortunately the efficiency of the system is limited due to the fact that people are forced to return the cars at the same station they were picked up.
Other policies to improve sustainable mobility systems have never been concretely pushed by the city's administration. The ISTAT data shows, for example, that the length of the bike lanes is apparently coherent with the national average (13,3 km per 100 km^2 compared to 15,4 km per 100 km^2), however most of the lanes are on the pedestrian sidewalks, interrupted by decoys, trees and garage accesses.
Until 2007 the city was last among the 15 metropolitan cities in Italy per territorial density for areas with limited traffic. Recent data show a rapid increase in square meters for the areas with limited traffic, however the limitations are actually few (for example in commercial streets there are no restrictions).
The civic administrators seem to use policies on the prices of parking as the only instrument to face mobility problems. The number of "pay and display" parking has increased with a vertical growth (the variation from 2000 to 2007 was grater than %1500), with a clear dual objective: ease the use of cars and to bring money into the city funds. Nevertheless, this strategy does not seem to work well, the pay for parking areas are all mainly within the already heavily congested city center, and the interchange based parking lots are few and too poorly connected to the city center to

be effective. This situation, obviously, does not foster people to use alternative public transportation services, as shown clearly in Table 2.

Table 2 - Modal split (source: authors elaboration on 2009 ISTAT data).

	Rome	Milan	Naples	Turin	Palermo	Genova
Cars	28%	17%	19%	27%	37%	21%
Urban bus/tram/filobus	14%	16%	14%	16%	9%	19%
Metro	13%	16%	15%	7%	*-	5%
Extraurban bus	2%	3%	6%	3%	2%	3%
Motorbikes/scooter	8%	6%	10%	3%	12%	12%
Bicycles	2%	8%	3%	7%	3%	2%
Taxi	2%	2%	3%	3%	2%	1%
Train	4%	3%	5%	3%	4%	6%
Walking	27%	27%	25%	31%	31%	33%

*Palermo has not a metro transport system yet, a train lane is now working as a metro service provided by Ferrovie dello Stato.

This data explains one of the elements of proof of the urban conditions in Palermo. Years of "non-policies" for local transport have pushed the city into a worrying paradox: even if the typical distances traveled are brief (22 km per day – 3 km less than the average of the six major cities in Italy) horrible traffic jams are a daily routine, but the citizens still prefer to travel by car and unbelievably dream of a future with more parking lots and less public transportation (Cittalia, 2009). This means that urban traffic, besides being an infrastructure problem, is, more than ever, a great social and cultural problem.

These general characteristics of the city's transport system can be traced back to the fact that Palermo was the only city, among the three major Italian metropolitan areas, without an Urban Plan for Mobility for many years. This gap has only been overcome in March 2013, when the Municipality adopted a new General Urban Plan for traffic management that will focus on the following specific mobility themes:

- Plan for improving pedestrian mobility (which foresees the definition of squares, streets, itineraries, pedestrian areas and limited traffic areas).
- Plan for improving local urban and suburban public transportation (defining specific lanes, interchange hubs, the existing lines and the frequency reorganization).

- Plan for reorganizing urban and suburban private transport circulation (which will focus on a general traffic scheme, issues due to city crossing and street priority types).
- Plan for rationalization of the parking areas (which will indicate the parking streets that also define the fee system).

3.3.3 A new instrument Palermo's sustainable mobility: TrafficO_2

The TrafficO_2 mobile app, is a mobility information Decision Support System (DSS), which aims towards a more sustainable mobility, giving concrete incentives for each responsible choice made by the user.

The idea is to combine the interests of the two complementary actors involved in the urban traffic scene: the community of workers and the local retail businesses that subscribe to the platform (Porta et al, 2008). Therefore, all of the local businesses that subscribe to the platform (as sponsors) become the stations of a new type of transport system that fosters travel by walking, biking, public transportation, vehicle pooling and car sharing. The final objective is to reduce traffic and pollution simply through an educational game (Filsecker and Hickey, 2014) by proposing an equal deal for everyone: prizes in exchange for a respectful behavior towards the environment.

Similar to a decisional support system (Kwai Fun and Wagner, 2008), for each user of the mobile app the first information, following a survey and subsequent access to the service, two personal improvement scenarios are described and generated according to the user's daily mobility routine and his/ her preferences regarding mobility transport choices. This means that the commuter will immediately be able to see the total improvement towards a more sustainable mobility, and therefore can be more motivated to change.

The following section of the paper will discuss how the model that describes two possible improvement scenarios is built.

The User Experience (UX) brings the user to choose among the closest "Local Business Station" (LBS) or "Star Sponsor Station" (SSS) as a starting or arrival point, afterwards the route will be displayed according the different types of journey: walking, biking, public transportation or with a shared vehicle. Each choice will give a list based on the time, environmental costs, economic costs and spent calories (see Figure 21).

Figure 21 - User interface

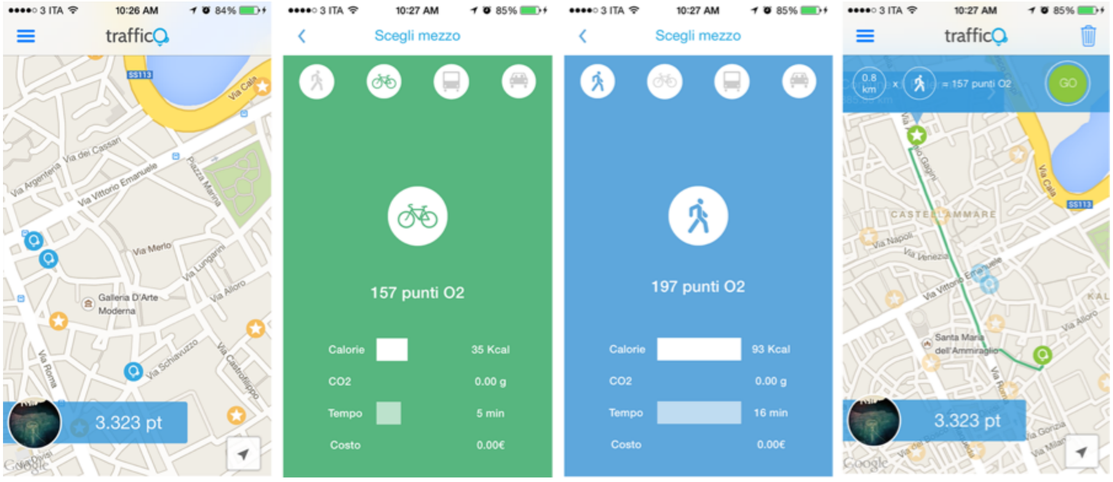


Figure 1 description: from left to right: the overview of the city map with local businesses (blue icons) and sponsors (gold icons); information about the selected trip (by biking and walking); the last image represents a selected trip that, if it will be completed, will gave to the user 157 O_2 points.

Furthermore, each choice will be worth a certain amount of so called O_2 points (a virtual currency), which the users will earn and use towards prizes, transforming TrafficO_2 from DSS sustainable and environmentally friendly trips into a game citizens play. The possibility to earn O_2 points is also influenced by a weather factor. This option is created with the attempt to promote more sustainable systems (walking, biking and moving by the public transport network) on the cloudy and rainy days.

Obviously more sustainable trips will award more points, as reported in Table 3, and also users will be able to increase their O_2 points by challenging, through the website or via mobile app, their friends and playing with the engagement contents made available by the sponsors.

Table 3 - O_2 points divided per mobility system.

	O2 points per kilometer	Cloudy weather factor	Rainy weather factor
Walking	5	1,5	3
Biking	4	2	4
Public Transport	3,5	1,5	2
Car-pooling 2 sits	0,5	1	1
Car-pooling 3 sits	1,0	1	1
Car-pooling 4 sits	1,5	1	1
Car-pooling 5 sits	2,0	1	1
Moto-pooling	0,5	1	1
Car-sharing	1,5	1	1

The system rewards walking trips the most compared to biking, due to the business model behind the app. Travelling by walking, in fact, gives the opportunity to engage with more local businesses, therefore it contributes to providing more advertising information and higher revenues for the network of sponsors. The points awarded for the other mobility systems, as mentioned before, are proportional to the emissions and environmental impact of the system on urban mobility.

Fundamentally, TrafficO_2 is a platform based on value exchange: for each responsible choice there is an existing tangible market value, and each choice will advertise and communicate information regarding the sponsors.

In fact, there are several reasons to encourage people to change their habits: “extrinsic reasons” such as rewards and challenges, and “intrinsic reasons” such as the given improvement scenarios, calorie information, the cost in euro of the selected route, the carbon footprint (Pierce et al, 2003), etc…

TrafficO_2 aims to provide commercial motivations and an emotional input to push people towards change, by combining information on mobility, advertising and a game.

The system is designed to create value for the citizen, the city and the network of businesses and sponsors that actively participate to the project. In fact:

- Communities that currently need a mobility manager will face traffic issues through a DSS for sustainable mobility.
- Local businesses that want to invest in innovative advertising and seek geo-marketing analysis will receive visibility by becoming stations in the system, which will allow them to obtain detailed information on their customers and on their products.
- Sponsors that want to provide clients with positive values and contextually receive the analysis of their target, will be recognized for their social efforts by financing the prizes, and will receive detailed feedback on the products and on the users that interact with them.

The smartphone technology, besides the software interface, provides motion recognition for the trips (Dernbach, 2012), differentiated with a high level of accuracy if the user is walking, biking or travelling by car. This is possible due to the sensors within the devices and the microprocessors that, through a specific algorithm, overlap the GPS position information and accelerometer, and detects the motion system (Manzoni et al, 2011). The recognition of the transport system and validation is the most interesting innovation, and represents for the users and sponsors a fundamental guarantee for the rules of the game.

During the testing phase, TrafficO_2 does not foresee any financial efforts by the business partners. This is a non-profit business model with the final objective to able to guarantee an entirely free service to the citizens, covering the administrative costs through the economic contribution of the partners. As of today, the communities involved in the project are asked to use internal resources to make the users aware of the functions of the system, and the initial Local Stations and Sponsor Stations are only asked to provide discounts and prizes for the users.

TrafficO_2 was recently selected by the EU campaign “Do the right mix” (http://www.dotherightmix.eu/) as a remarkable action for mobility and the future of the cities.

3.3.4 Building up the model

In December 2013, 30 students were selected through a workshop (three different University of Palermo departments: Computer Science, Design and Marketing Communication), and the first test of the assumption was performed. The objective of this first test was to verify the user experience project and the questionnaire structure necessary to build the modal split for each individual involved. During the month of April 2014, the test sample was increased, involving 77 students from other departments as well. Naturally, the sample is not yet representative of the entire population in Palermo, neither of the entire student body (about sixty thousand), however it is quite significant in terms of a behavioral approach for research purposes. Through the information collected from the survey, it was possible to determine the length of the routes travelled daily (one way) for each user to reach the given university department, and consequently the total impact of the sample on these distances.

The sample was subdivided in five different categories based on the distance covered to reach the university departments (Table 4). These distances were obtained through an analysis provided by the ©Google maps tool.

In our discussion, in order to simplify the calculations, for the moment the data on the frequency of the routes was excluded, therefore working with the total one-way length (Ltrip) obtained by adding every movement modality according to the modal split. That is:

$$L_{i,trip} = D_{0i,w} + D_{0i,b} + D_{0i,t} + D_{0i,c} + D_{0i,m} + D_{0i,cp} + D_{0i,mp} + D_{0i,cs} = (M_{0i,w}\, L_{i,trip}) + (M_{0i,b}\, L_{i,trip}) + (M_{0i,t}\, L_{i,trip}) + (M_{0i,c}\, L_{i,trip}) + (M_{0i,m}\, L_{i,trip}) + (M_{0i,cp}\, L_{i,trip}) + (M_{0i,mp}\, L_{i,trip}) + (M_{0i,cs}\, L_{i,trip}) \quad (1)$$

Where D_{0i} is the daily distance (km) to reach the university by the different types of transportation w, b, t, c, m, cp, mp, cs and respectively indicate: walking, biking, public transport, auto, motorcycle, car-pooling, moto-pooling, car sharing; and M_{0i} are the percentages of usage of the different mobility transportation systems in the survey.

Table 4 - Distribution of the five University commuter classes.

SCENARIO 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Σ Ltrip (km)	34,7	75,8	156,1	89,7	164,7	521
% Sample	30%	26%	27%	9%	8%	

Table 5 contains the available mobility systems based on the survey results. The questionnaire also allowed for evaluating the modal split of the sample (Table 6), which represents Scenario 0.

Table 5 - Available mobility systems for the five university commuter classes.

SCENARIO 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Motor disabilities	0%	0%	0%	0%	0%	0%
Bicycle owner	22%	65%	38%	14%	50%	39%
Bicycle available	4%	15%	24%	14%	0%	13%
Car owners	9%	15%	43%	14%	50%	23%
Car available	52%	60%	57%	71%	50%	57%
Moto owners	13%	30%	14%	29%	17%	19%
Moto available	9%	15%	19%	0%	0%	12%

Table 6 - Scenario 0: modal split of the five university commuter classes.

SCENARIO 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
M0,w - Walking	62%	32%	0%	0%	0%	9%
M0,b - Biking	12%	20%	4%	0%	0%	5%
M0,t - Public transport	10%	13%	25%	19%	34%	22%
M0,c - Car	5%	9%	34%	35%	35%	27%
M0,m - Moto	0%	14%	12%	9%	3%	8%
M0,cp - Car-pooling	6%	9%	17%	26%	25%	23%
M0,mp - Moto-pooling	5%	4%	8%	12%	3%	6%
M0,cs - Car-sharing	0%	0%	0%	0%	0%	0%

It is interesting to note how almost 50% of the testers are bike owners or have bikes available to them, but only 5% of them use this mobility system to commute to the University. Furthermore, it is relevant that almost 50% of the sample could easily use the local public transport system (based on the distances of their houses to the bus stops), nevertheless only 22% uses it frequently.

The care ownership rate (Table 5) increases almost in line for distances from 3 to 10 km. The low rate of car owners (14%) for distances between 10 and 20 km is justified by the fact that suburban area residents belong to the blue-collar working class with generally mid to low salaries. On the other hand, the notion that car owners with vehicles belonging to class E (50%) is also justified by the distance itself that entails the need to use private transportation, also given by the general public transport situation in Sicily. This system is the most used (50% adding who uses only cars and who travels by carpooling), even if the average is constant at 35% for distances above five kilometers.

As far as the environmental performances for Scenario 0, the total carbon emissions (E) for each daily one way trip (L_{trip}) was calculated with the following equation:

$$E_0 = E_{0,t} + E_{0,c} + E_{0,m} + E_{0,cp} + E_{0,mp} + E_{0,cs} \quad (2)$$

Where

$$E_{0,t} = \sum_{i=1}^{n} D_{0i,t}\,\alpha_t \quad (3)$$
$$E_{0,c} = \sum_{i=1}^{n} D_{0i,c}\,\alpha_c \quad (4)$$
$$E_{0,m} = \sum_{i=1}^{n} D_{0i,m}\,\alpha_m \quad (5)$$
$$E_{0,cp} = \sum_{i=1}^{n} D_{0i,cp}\,\alpha_{cp} \quad (6)$$
$$E_{0,mp} = \sum_{i=1}^{n} D_{0i,mp}\,\alpha_{mp} \quad (7)$$
$$E_{0,cs} = \sum_{i=1}^{n} D_{0i,cs}\,\alpha_{cs} \quad (8)$$

Where, for the i^{th} commuter, n is the total number of the individuals in the sample, and α (g/km) are the CO_2 emission factors for each type of transportation.

The α emission factors (Table 7) were calculated using the © COPERT 4.10 software (Kioutsiouski I., 2010): the bus data were scaled for the average number of passengers in a vehicle (80), the result on carpooling was defined starting from the result on cars and divided by 2,5 average passengers, the result on moto-pooling was defined starting from the result on motorcycles and divided by the 2 possible passengers.

Table 7 - Copert 4.10 results (source: elaboration by the authors based on the Copert 2014 data).

α emission factors	αc - Car	αt - Bus Transport	αm - Motorcycle	αcp - Carpooling	αmp - Motopooling	αcs - Car sharing
CO2 g/km	238,97	22,54	80,89	95,59	40,44	238,97

The output data for the Copert software is described in Table 8, where the authors define car, motorcycle, bus type and average speeds, based on the average results of the tester sample and AMAT data.

Table 8 - Copert output data (source: elaboration by the authors based on the Copert 2014 data).

Sector	Technology	Class standard	Number of vehicles	Average distance (km/y)	Average speed (km/h)
Car	Gasoline 0,8 - 1,4 l	PC Euro 4 - 98/69/EC Stage2005	77	132.052	20,0
Bus	Coaches Standard <=18 t	HD Euro II - 91/542/EEC Stage II	250	41.508	12,0
Motorcycle	4-stroke < 250 cm³	Mot - Euro III	77	132.052	20,0

All of the performances of Scenario 0 are described in Table 9.

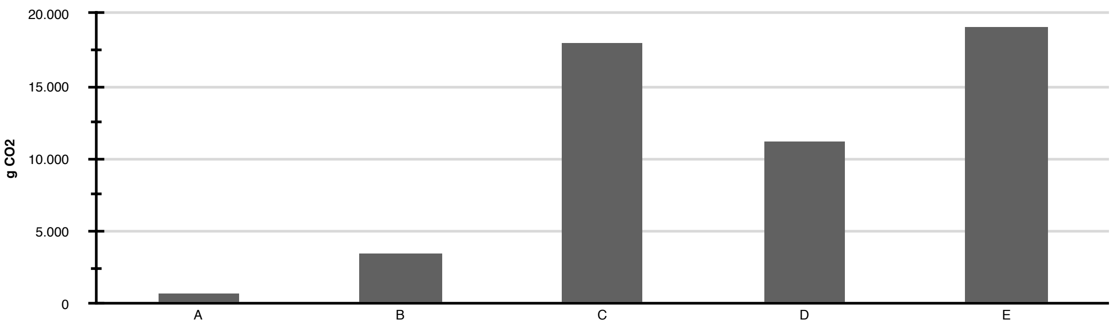
Table 9 - Scenario 0 emissions: cumulated values of the five University commuter classes.

SCENARIO 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Σ E0 (g CO2)	760,9	3.514,30	17.996,60	11.092,20	19.052,80	52.416,70
E0/km (g/km)	21,9	46,4	115,3	123,7	115,7	100,6
% E0	1,50%	6,70%	34,30%	21,20%	36,30%	100%

It is easy to notice (Figure 22) that the behaviors with the greatest impacts refer to the last three categories (C, D, E), with an average impact of E_0/km 120g/km.

Furthermore, despite the fact that less than 44% of the sample population lives in these areas, their impact implies more than 91,8% of the global emissions, indicating the generally bad environmental behaviors of these groups.

Figure 22 - Scenario 0: overview of the environmental impact of the five university commuter classes, as far as CO_2 emissions.



It is worth noting that the emissions of each class are coherent with the values reported in Table 5.

In order to improve the performances of Scenario 0, two possible assumptions were suggested for environmental improvement, by designing two additional scenarios.

- Scenario 1 – a simple improvement of the modal split that does not exclude completely trips by car of motorcycle (as in Scenario 2), but encourages commuting by walking, biking, public transport and vehicle-sharing. For this reason the scenario was called “Do your right mix”.
- Scenario 2 – a noticeable behavioral change that excludes completely trips by car and motorcycle, with occupancy coefficient equal to one (passenger/vehicle) and, based on the distances of the group, even other mobility systems. In this scenario, for the subjects in group A, who live closest to their university department, their commute must be only by walking or biking; subjects from groups B and C must commute by walking, biking or public transport; lastly, the subjects from groups D and E will be allowed to commute also by vehicle-pooling and car sharing. For this reason this scenario was called “Do your best mix”.

Scenario 1 - Do your right mix!

Starting from equation 1, the assumptions behind this scenario are summarized by equation 9:

$$I_{1,i} = M_{i,c} + M_{i,m} = 1 - (M_{i,w} + M_{i,b} + M_{i,t} + M_{i,cp} + M_{i,mp} + M_{i,cs}) \quad (9)$$

Where I1i, are the target percentages for improvement that the users Ith must reach by using more sustainable mobility systems. In other words, this percentage of improvement is given by the sum of percentages relative to the means of mobility that should be reduced, and for this reason for Scenario 1 they are cars and motorcycles.

In Table 10 the total improvement percentages are reported for each category of the sample population. It is interesting to note that the possible improvement percentage increases up to 10 km commutes (class C); for greater distances the possible improvement percentage tends to decrease slightly, proving that classes D and E have similar mobility habits.

Table 10 - Possible improvements for Scenario 1.

SCENARIO 1	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km
Improvement 1	30%	60%	81%	71%	67%

As far as the performances of each modal split, Table 11 indicates the benchmark performances, defined as the best performance (in percentage) for each category with the given transportation means: for example, referring to the biking category, the best recorded behavior among the users of class C (distance between 5 and 10 km) is 38% for commuting by bike.

In conclusion, the mission of the discussed Scenario 1 is to promote environmentally friendly mobility choices through an assumption principle based on emulation: "your peers do it, why don't you?"

Table 11 - Best benchmark performances for Scenario 1: the percentages refer to the percentage of each entire trip covered by using one type of transportation.

SCENARIO 0 Benchmarks	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km
B,w - Best walking behave	100%	80%	-%	-%	-%
B,b - Best biking behave	67%	80%	38%	-%	-%
B,t - Best public transport behave	50%	67%	67%	50%	50%
B,cp - Best carpooling behave	20%	27%	50%	60%	50%
B,mp - Best motopooling behave	17%	14%	33%	25%	13%
B,cs - Best car-sharing behave	0%	0%	0%	0%	0%

In the following section the Algorithm 1 for Scenario 1 is reported.

In the equation M_1 is the new percentage of the modal split, I_{1i} represents the improvement potential for each mobility system, K_i is a Boolean variable, extrapolated from Table 5 and Table 6, which indicates the availability (1) or less (0) of the mobility systems and, I_{1i} is the highest available improvement percentage for each transportation type in function of the benchmark parameters B.

In fact, the algorithm if-then-else (Annex 1) explores in order of hierarchy the different possibilities to reach the goal for improvement (I_{1i}) by saturating, from time to time, the single improvements for the modal split. The order of improvements included in the equation is: walking, biking, public transport, carpooling (with 5 seats occupied the CO_2 emissions are similar to the moto-pooling emissions), moto-pooling and car sharing.

Through this model it is possible to obtain the new modal split for Scenario 1 (Table 12). If the cycle does not achieve the objective of target improvement, it suggests that there is still the possibility to foresee trips with occupancy index equal to 1 (passengers per vehicles) in cars and motorcycles.

Table 12 - Scenario 1: modal split for the five university commuter classes.

SCENARIO 1	“A” less than 3 km	3 km < “B” < 5 km	5 km < “C” < 10 km	10 km < “D” < 20 km	“E” > 20 km	TOT
M1,w - Walking	67%	55%	0%	0%	0%	14%
M1,b - Biking	12%	20%	17%	0%	0%	9%
M1,t - Public transport	10%	13%	32%	22%	48%	30%
M1,c - Car	0%	0%	6%	21%	13%	9%
M1,m - Moto	0%	0%	0%	2%	0%	0%
M1,cp - Car-pooling	6%	9%	36%	42%	37%	31%
M1,mp - Moto-pooling	5%	4%	9%	12%	3%	7%
M1,cs - Car-sharing	0%	0%	0%	0%	0%	0%

These results, compared to the ones obtained in Scenario 0 (Table 6), show a general improvement of the performances, because the less sustainable means of transportation (car and motorcycle) show a reduction: for example, regarding the subsample of class E the use of cars is reduced from 35% to 13% according to the prediction of this scenario. The environmental impact of this first scenario due to the behavioral changes of the sample is reported in Table 13.

Table 13 - Emissions Scenario 1: cumulated values for the five university commuter classes.

SCENARIO 1	“A” less than 3 km	3 km < “B” < 5 km	5 km < “C” < 10 km	10 km < “D” < 20 km	“E” > 20 km	TOT
Σ E1 (g CO2)	357,6	969,2	9.321,60	9.145,10	13.190,40	32.984,00
E1/km (g/km)	10,3	12,8	59,7	102	80,1	63,3
% E1	1,10%	2,90%	28,30%	27,70%	40,00%	

As show, the current scenario allows for a CO_2 emission reduction from 100,2 to 63,3 g CO_2/km

Table 14 compare Scenarios 0 and 1, in terms of percentages of modal split and indicates, for each mobility system analyzed, the improvement percentages foreseen by Scenario 1 compared to the baseline (Scenario 0).

Table 14 - Modal split (%): Scenario 1 vs. Scenario 0

	Scenario 0 – M0%	Scenario 1 - M1%	Improvement - I1%
Walking	9	14	56
Biking	5	9	80
Public transport	22	30	36
Car	27	9	-67
Moto	8	0	-100
Car-pooling	23	31	35
Moto-pooling	6	7	17
Car-sharing	0	0	0

It is worth noting that for the assumptions "Do your right mix" distributing the usage habits of cars (27%) and motorcycle (8%) among the other mobility systems, there is a general improvement of the entire system's performance. Meanwhile, the analysis of the components of the modal split indicates that bike (5%) and car (9%) mobility systems are influenced by higher improvements (respectively 80% and 56%), followed by public transportation and carpool (respectively an improvement by 36% and 35%). Car and motorcycle experience a drastic drop, respectively reaching a 67% and 100% decrease. Figure 23 graphically represents these results, at the same time comparing each modal split for the two scenarios.

Figure 23. Improvements in the modal split for the comparison between Scenario 0 and Scenario 1.

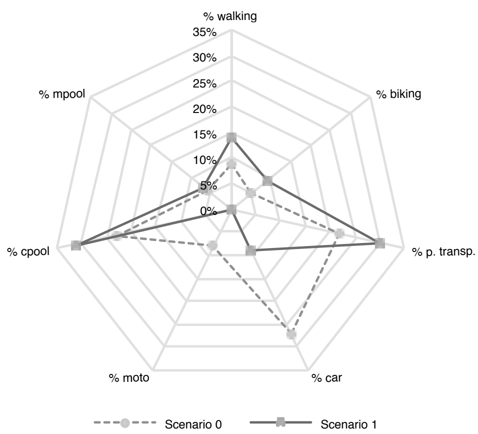


Table 15 - Comparison of the CO2 emission improvements between Scenario 0 and Scenario 1.

SCENARIO 0 - 1	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Σ E0 (g CO2)	761	3.514	17.997	11.092	19.053	52.417
Σ E1 (g CO2)	358	969	9.322	9.145	13.190	32.984
△1 = Σ E1 - Σ E0	403	2.545	8.675	1.947	5.862	19.433
E0/Km (g/km)	22	46	115	124	116	101
E1/Km (g/km)	10	13	60	102	80	63
△1/Km (g/km)	12	33	55	22	36	38

In terms of comparing CO_2 emissions, Table 15 shows that the decrease in emissions for subsample C cuts by 50% the total impact of the entire sample. It is also interesting to note that the reductions are referred to the intensive values of the emissions (g CO_2/km) for all of the categories of distance, even if each one of them presents a different improvement in Scenario 1 compared to Scenario 0.

Scenario 2 - Do your best mix!

Starting from Equation 1, the assumptions that support this scenario are briefly expressed by equations 10, 11 and 12, where I_{2A} is the target improvement for the users belonging to the distance class A, I_{2BC}, is the improvement objective for classes B and C, I_{2DE} is the desired improvement that classes D and E must reach using the more sustainable mobility systems.

$$I_{2A,i} = M_{Ai,c} + M_{Ai,m} + M_{Ai,t} + M_{Ai,cp} + M_{Ai,mp} + M_{Ai,cs} = 1 - (M_{Ai,w} + M_{Ai,b}) \quad (10)$$

$$I_{2BC,i} = M_{BCi,c} + M_{BCi,m} + M_{BCi,cp} + M_{BCi,mp} + M_{BCi,cs} = 1 - (M_{BCi,w} + M_{BCi,b} + M_{BCi,t}) \quad (11)$$

$$I_{2DE,i} = M_{DEi,c} + M_{DEi,m} = 1 - (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs}) \quad (12)$$

In Table 16 the possible improvements are described using these assumptions.

Table 16 - Possible improvements for Scenario 2.

SCENARIO 2	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km
Improvement 2	65%	75%	100%	71%	67%

With these limits 100% of the users from class C can improve their mobility habits. The class A users could improve their sustainable mobility performances more than double compared to Scenario 1, and even the number of users belonging to class B distance increase proportionally (from 60% in Scenario 1 to 75%). For classes D and E the assumption is the same as Scenario 1, these assumptions, in fact, try to foster more users who can easily keep their cars parked in their garages, therefore classes A, B and C.

The algorithm that defines the conditions to calculate Scenario 2 is in Annex 2.

Table 17 demonstrates the modal split for Scenario 2 in which it is evident that commuting by car and motorcycle has been eliminated from the assumptions.

Table 17 - Scenario 2: modal split for the five university commuter classes.

SCENARIO 2	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
M2,w - Walking	86%	53%	0%	0%	0%	15%
M2,b - Biking	14%	27%	14%	0%	0%	9%
M2,t - Public transport	0%	20%	86%	34%	58%	51%
M2,c - Car	0%	0%	0%	0%	0%	0%
M2,m - Moto	0%	0%	0%	0%	0%	0%
M2,cp - Car-pooling	0%	0%	0%	47%	38%	20%
M2,mp - Moto-pooling	0%	0%	0%	20%	4%	5%
M2,cs - Car-sharing	0%	0%	0%	0%	0%	0%

These results, compared to the one obtained in Scenario 0 (Table 6), highlight a consistent improvement for the more sustainable transport systems, eliminating completely the individual use of cars and motorcycles. For example, with regards to the university commuters from class C, the use of the public transport system increases from 20% to 86% in the current scenario.

By applying for the third time Equation 2, it was possible to elaborate the finial emission scenario E_2, as reported in Table 18.

Table 18 - Scenario 2: five University commuters classes Carbon Dioxide Equivalent production.

SCENARIO 2	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Σ E2 (g CO2)	0,0	316,7	2.889,8	5.397,4	9.614,2	18.218,1
E2/km (g/km)	0,0	4,2	18,5	60,2	58,4	35,0
% E2	0,0%	1,7%	15,9%	29,6%	52,8%	

In table 18, the assumptions for this scenario allow for a reduction of emission from 100,2 to 35,0 g/km of CO_2 and design a total environmental impact, referred to each class, finally proportional to the travelled distances.

The comparison of this scenario with Scenario 0 is reported in Table 19. Since individual trips by car and motorcycle have been excluded from the assumptions for this scenario, it is interesting to note how the model splits the new system of behaviors spreading 35% of the routes normally travelled by car (27%) and by motorcycle (8%) mainly to the public transportation (this system earns almost 130%)

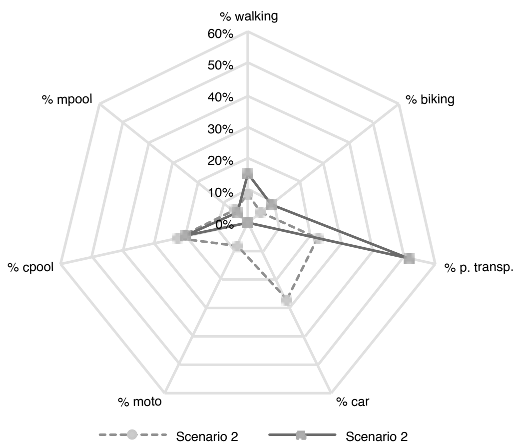
and, instead of increasing the percentage of carpooling and moto-pooling, they are reduced respectively by 13% and 17%.

Table 19 - Modal split (%): Scenario 2 vs. Scenario 0

	Scenario 0 – M0%	Scenario 2 - M1%	Improvement – I2%
Walking	9	15	67
Biking	5	9	80
Public transport	22	51	132
Car	27	0	-100
Moto	8	0	-100
Car-pooling	23	20	-13
Moto-pooling	6	5	-17
Car-sharing	0	0	0

From Figure 24 it is evident how the modal split for Scenario 2 completely modifies the initial diagram, maintaining only some parameters stable.

Figure 24. Modal split improvements Scenario 0 vs. Scenario 2.



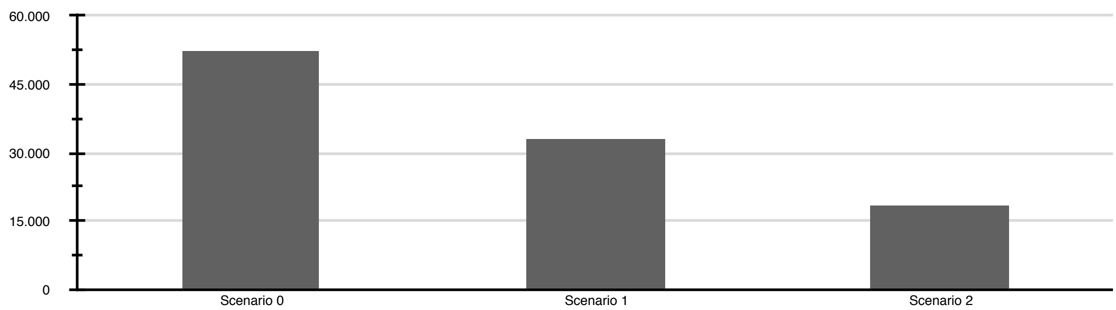
In Table 20 it is interesting to underline how the percentage of CO_2 emissions, in conclusion, increases as the distances increase as well: for distances superior to 10 km the coefficient of emissions per km E_2/km is constant with the average of 60g/km CO_2.

Table 20 - Improvement of CO2 emissions comparing Scenario 0 and Scenario 2.

SCENARIO 0 - 2	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km	TOT
Σ E0 (g CO2)	761	3.514	17.997	11.092	19.053	52.417
Σ E2 (g CO2)	0	317	2.890	5.397	9.614	18.218
∆2 = Σ E1 - Σ E0	761	3.197	15.107	5.765	9.439	34.199
E0/Km (g/km)	22	46	115	124	116	101
E2/Km (g/km)	0	4	19	60	58	35
∆2/Km (g/km)	22	42	96	64	58	66

The comparison among the two scenarios shows how the CO_2 emissions decrease from Scenario 0 to Scenario 1 by 37%, while from Scenario 0 to Scenario 2 by 65%. Furthermore, comparing the partial improvement of Scenarios 1 and 2 it is possible to see a reduction by 45% of emissions. With these conditions and referring to the current sample, the emission reduction among the different scenarios seems to follow a linear reduction law with an index of 40% (Figure 25).

Figure 25. Environmental impact of the three Scenarios.



Scenario 2 certainly ensures the best environmental performances compared to Scenario 1 and, Scenario 1 presents itself already as an important improvement compared to Scenario 0. It is worth noting that Scenario 1 is based on the principle of emulation of good behaviors, and could already be easily implemented in a community through a local policy. However, Scenario 2 absolutely needs more radical behavioral changes. These two improvement scenarios are not alternatives to each other, however the objectives of Scenario 1 can be adopted as transitory goals towards more ambitious results defined by Scenario 2.

It is also interesting to underline how this analysis allows highlighting different behaviors among the different classes and distances. Users belonging to class C, for example, compared to the entire sample, register an unusual waste of resources, which probably reflects a different cultural and socio-economic condition of the people that belong to such areas. This information provides a clear indication regarding the possible marketing strategy for the mobile application "TrafficO_2" in Palermo.

3.3.5 Results

In order to test this model and these assumptions, from the 28th of May to the 28th of June 2014 we performed the first test (with limited features) of the mobile app TrafficO_2.

For this experimentation testers could earn O_2 points (and win several prizes) just by walking or biking. The 77 testers were invited to download and install the trafficO_2 mobile app in order to start the "Sustainable Urban Values" Challenge (http://www.trafficо2.com/suv).

Almost half of the sample downloaded the app and than about the 50% of them actively used the application. Active users are those students whom used the application with frequencies (F_T) superior to the ones declared through the survey (F_0).

In Table 21 there is a description of the distribution of the sample according to the five University commuter distances and the redemption of use.

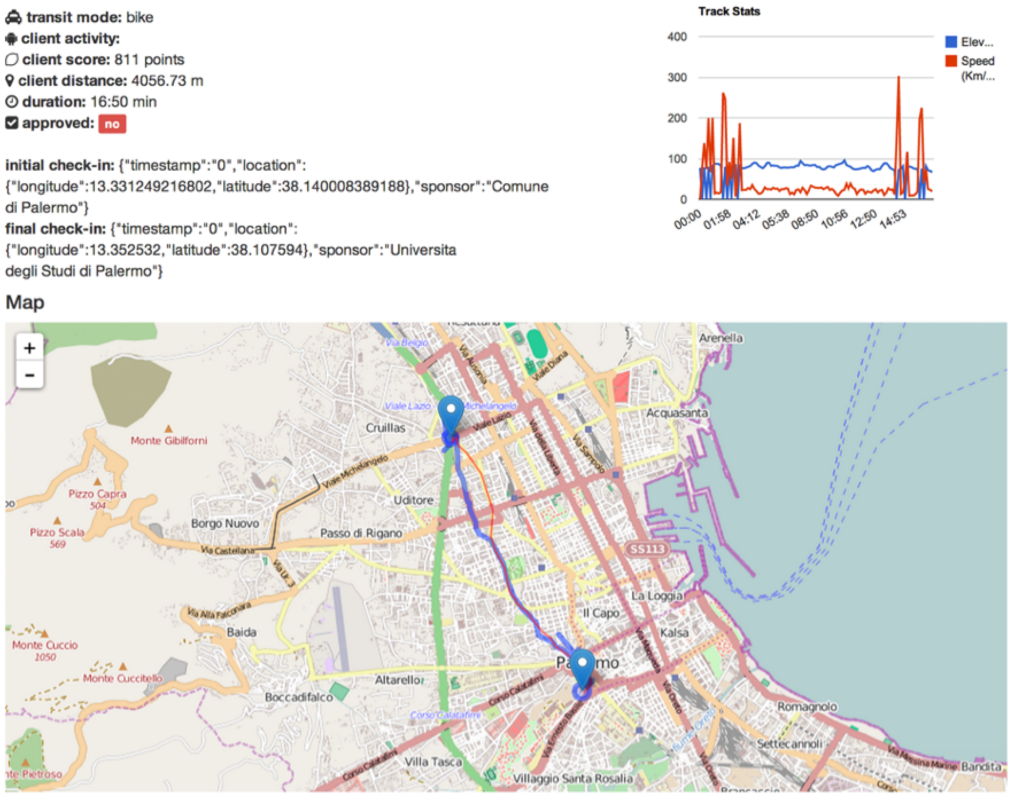
Table 21 - TrafficO_2 testers' redemption

SUV Test	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	10 km < "D" < 20 km	"E" > 20 km
Sample	30%	26%	27%	9%	8%
Users	16%	12%	14%	4%	4%
Active users	8%	9%	5%	1%	1%

Analyzing the data on Table 21 we should notice that probably the lack of the other mobility systems (public transport and vehicle pooling mainly) discouraged the D and E users. These two categories because of the long distances, in fact, had more difficulties to collect points just by walking and biking.

In Figure 26 a snapshot of the server frontend interface shows what data were collected through the mobile application.

Figure 26. Server data screenshot.



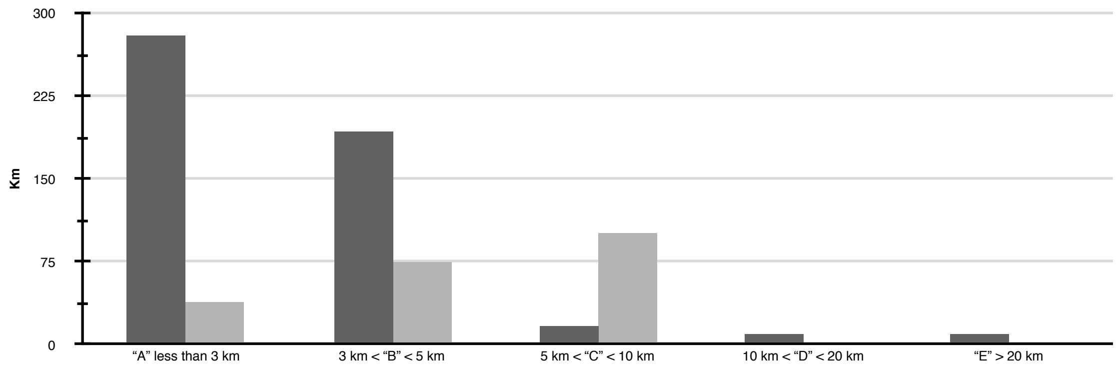
As shown in Table 22, by analyzing the gathered data, we succeeded in dividing trips according to each tester home-university department trip.

Table 22 - Number of trips recorded by the server during the Test and divided by destination and mobility system.

	Walking	Biking	Total	%
Home-Department (and vice versa) trips	59	40	99	33%
Other trips	124	83	207	67%

It is interesting to see how only one third of the total trips were “from” or “to” the University. This is probably due to the University examination period when part of the SUV challenge was done. During this period, in fact, students don’t have to go everyday to their departments. In Figure 8 is described the distribution of the distances traveled (km) by the active users.

Figure 27. Five University daily commuter classes kilometers distribution divided by destinations.



Analyzing Figure 27 it is possible to interpret how the active testers have used the mobile application. In fact it is possible to point out how people living far from the departments (C class students) mostly use it for other daily routinely trips (home-department and vice versa) and how this behavior changes and drastically inverts the proportion going towards the nearest area. A and B class users seem to play more with the app using it often during the day, C students use it mainly to come and go form the University.

In order to estimate the performance of the sample, it was necessary simulate how many kilometers active users travelled (home-department and vice versa) in that period according to the answers given to the survey.

In Equation 11 F_0 represents the monthly frequency of home-department (and vice versa) trips. With this data it was possible to calculate the total distances ith user will travel testing the game.

$$L_{i,TOT} = F_{0i} L_{i,trip} \quad (13)$$

Moreover, it was be possible to calculate each mobility system frequency. The following Equations explain the definition of the walking and biking frequency ($F_{0i,w}$ and $F_{0i,b}$) in (Equations 14 and 15) and how, with the walking and biking home-department (and vice versa) distances recorded ($D_{Ti,w}$ and $D_{Ti,b}$), the rate percentages of use of each mobility means ($M_{Ti,w}$ and $M_{Ti,b}$) were elaborated (Equations 16 and 17).

An if-than-else algorithm explores a comparison between the declared frequencies and the recorded ones (respectively $F_{Ti,w}$ and $F_{Ti,b}$) and so the different conditions each user has caused in terms of CO_2 emissions (Annex 3).

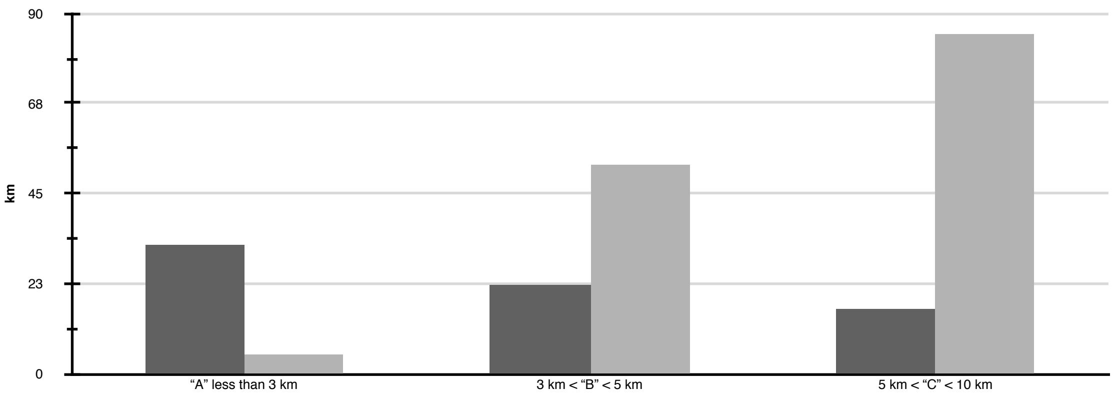
In Table 23 are presented the results of the elaborations on the distances.

Table 23 - SUV test active users' total distances estimated and recorded.

SUV Test	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
ΣL_{TOT} (km)	48,06	95,83	534,32	678,21
$\Sigma D_{Tw} + \Sigma D_{Tb}$ (km)	37,34	71,01	97,78	206,13
% ($\Sigma D_{Tw} + \Sigma D_{Tb}$)	77,7%	74,1%	18,3%	30,39%

Looking to the next Figure 28 it is evident how for longer distances TrafficO_2 fosters mostly the modal split toward bicycles and for shorter distances people prefer go walking.

Figure 28. Active users' sustainable distances (home-departments and vice versa) covered during the SUV Test divided by mobility system.



Looking to Figure 28, moreover, it is interesting to notice how the most impacting results are equally balanced between the two systems offered and, despite the total absence of bike lanes "to", "from" and even "inside" the Palermo University Campus, TrafficO_2 succeeds in fostering people to use bicycles.

Table 24 reports the simulated CO_2 emission due to Algorithm 3. The simulation is done basically comparing Scenario 0 modal split with the one that is possible to elaborate with the data recorded during the SUV Challenge. This allows estimating the emission (E_T) done by active users during the SUV challenge test for the home-department (and vice versa) routes.

Table 24 - SUV Challenge Test: five University commuter classes Carbon Dioxide Equivalent production.

SUV Test	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
Σ ET (g CO2)	499,82	1.236,21	30.456,07	32.192,10
ET/km (g/km)	10,4	12,9	57,0	47,47
% ET	1,55%	3,84%	94,61%	

It is interesting to notice how the emission rate of C class users is higher than the whole sample, accounting for almost 95% of the global CO_2 emissions due to the active users daily mobility routine.

Table 25 shows the active users' kilometers calculated by the Scenario 0 data (trip lengths per declared frequencies) in comparison on what they actually recorded using the mobile app.

Table 25 - Walking and biking active users' performance: SUV Challenge Test vs. Scenario 0

SUV Test vs Scenario 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
$\Sigma D_{0w} + \Sigma D_{0b}$ (km)	35,50	49,87	26,77	112,14
$\Sigma D_{Tw} + \Sigma D_{Tb}$ (km)	37,34	71,01	97,78	206,13
Δ_{T0} (km)	1,84	21,14	71,01	94,00
Δ_{T0} %	5%	42%	265%	84%

The comparison between the past habits and the data recorded by the app, for the active users, shows positive results for each class category and particularly for C class active users (71 km more than the previously declared). Comparing all of the performances, the sustainable kilometers increased by 84%.

In Table 26 the comparison between the SUV Challenge data and the simulated Scenario 1 "Do your best mix" according the data provided by the active users is presented.

Table 26 - Walking and biking active users' performance: SUV Challenge Test vs. Scenario 1

SUV Test vs Scenario 1	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
$\Sigma D_{1w} + \Sigma D_{1b}$ (km)	37,84	72,18	95,64	205,66
$\Sigma D_{Tw} + \Sigma D_{Tb}$ (km)	37,34	71,01	97,78	206,13
Δ_{T1} (km)	-0,50	-1,17	2,14	0,50
Δ_{T1} %	-1%	-2%	+2%	0,23%

It is interesting to notice how the comparison shows an almost perfect match between the test data gathered by the app and the data elaborated for Scenario 1 that was based on the emulation principle.

Table 27 shows the final comparison with the "Do your best mix" Scenario.

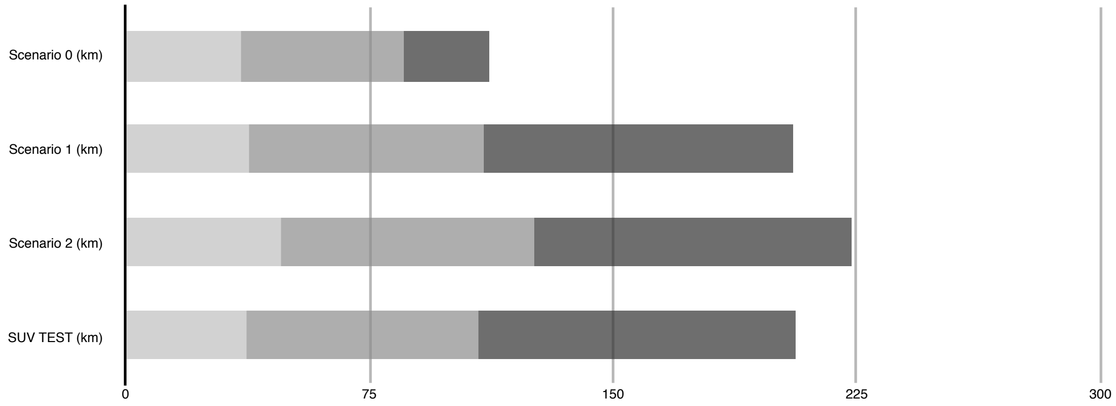
Table 27 - Walking and biking active users' performance: SUV Challenge Test vs. Scenario 2.

SUV Test vs Scenario 0	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
$\Sigma D_{2w} + \Sigma D_{2b}$ (km)	48,06	78,07	97,25	223,37
$\Sigma D_{Tw} + \Sigma D_{Tb}$ (km)	37,34	71,01	97,78	206,13
Δ_{T2} (km)	-10,72	-7,06	0,53	-17,24
Δ_{T2} %	-22%	-9%	1%	-7,72%

It is worth noticing how this comparison shows a reflection for the A and B class active users performance (respectively the -22% and the 9% of sustainable distances travelled estimated) but it still confirms a good performance for the C class active users' new mobility behavior.

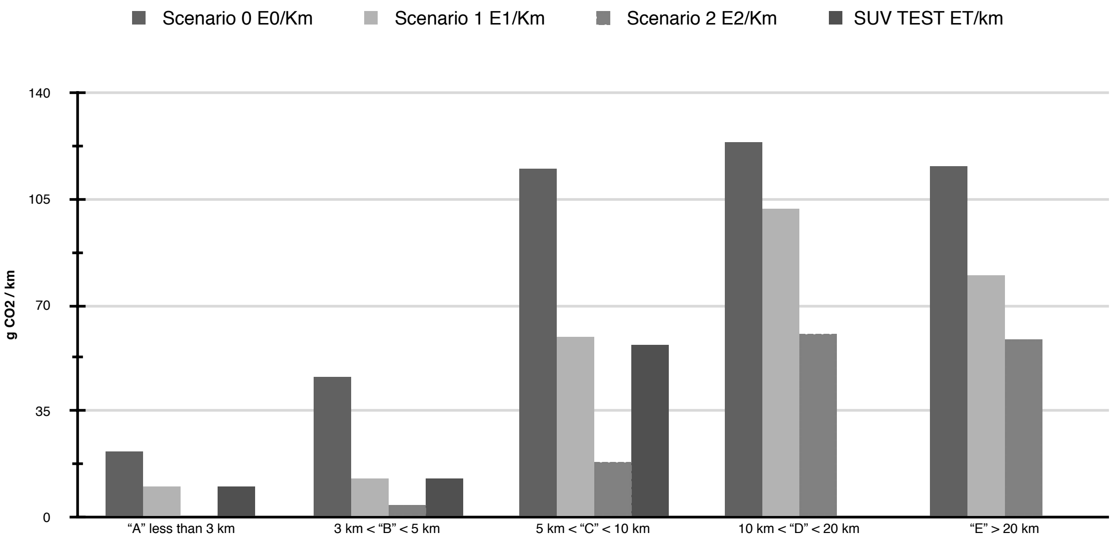
In Figure 29 shows graphically the comparison among all the analyzed mobility habits of the active users.

Figure 29. Active users' sustainable distances (Home-Departments and vice versa) comparison between Scenario 0, 1, 2 and those effectively travelled during the SUV Test.



A comparison among the three previously elaborated Scenarios (whole sample) and the data gathered through the SUV Challenge test (active users) regarding the emissions per kilometer is elaborated in Figure 30.

Figure 30. Simulated scenarios of the environmental impact comparison among the five urban areas regarding the average CO_2 emissions per kilometer (g CO2/Km).



It is interesting to notice how, according to the data gathered, the actual performance of the active users matches with the estimated performance of Scenario 1 emissions per kilometer.

Moreover, for the farther classes D and E, we have to underline how the final emissions per kilometers of Scenario 2 tend to merge near to the 60 g/km. This suggest to usefully modify our first assumptions simplifying classes in only three University community distances areas: from 0 to 3, from 3 to 10 and more than 10 kilometers

Table 28 shows the carbon dioxide equivalent emissions comparison between the Scenario 0 situation and the SUV Challenge data.

Table 28 - CO_2 emission improvement comparing active users' Scenario 0 simulation and SUV Challenge Test data.

SCENARIO 0 - T	"A" less than 3 km	3 km < "B" < 5 km	5 km < "C" < 10 km	TOT
Σ E0 (g CO2)	1030	5442	23.532	30.005
Σ ET (g CO2)	488	1.500	12.013	14.001
∆2 = Σ E0 - Σ ET	1.381	3.857	11.539	16.777
Improvement I_T	73,90%	72,00%	48,99%	54,51%

According to the Algorithm 3 calculations, it is possible to argue that the active users of the SUV Challenge Test effectively enhanced their behaviors regarding sustainable mobility choices saving almost half carbon dioxide equivalent emissions in comparison on their previous habits.

Obviously we have to notice how this first data is still partial and possibly the good performances recorded have to be related with the small sample of the first test. Moreover, we have started to analyze the first three distance categories that, excluding the C class students, have the least impact on the environment and the traffic conditions.

3.3.6 Conclusion

In this research we analyzed Palermo's transport system, and how TrafficO_2, as a social innovation project, aims to reduce vehicle traffic flows and pollution without making any modifications on the urban structures and without applying substantial modifications to the mobility policies. The strategy is to encourage, through specific information and small rewards, the workers who commute daily from home to work. Therefore, we studied the behaviors of a selected sample (student community from the University of Palermo) and simulated the CO_2 emissions for each trip. To motivate each individual to modify his/ her behavior, we developed feasible objectives and "tailor made" for each commuter by defining two possible improvement scenarios:

“Do your right mix!” (Scenario 1) and “Do your best mix!” (Scenario 2). The models were developed by taking into account the different distances commuters travel to reach their university departments, the availability of transportation and their habits (Scenario 0). Afterwards, we tested the TrafficO_2 application with reduced functions (SUV challenge) and we were able to collect the first results for the effects of using the instrument. The results, although partial, show how the behavior of the active users was successfully modified, hence reaching the objectives set by Scenario 1, where the participants aim to emulating the best behavior among the registered users of the community with homogenous characteristics.

The attempt to improve the city’s livability and the citizens’ health seems to be achievable more easily and effectively by seeking the change in bad habits through a direct dialogue with the individual citizens, allowed by the use of communication technologies and social networks. Many examples, in fact, come from different fields, from domestic energy consumption (Chen Lillemo, 2014; Shimokawa and Tezuka, 2014) (Lee et all), to waste management, which are giving the first encouraging results.

In these times of almost “zero resources”, it seems possible to improve the city’s livability without implementing actions on the current infrastructures but, through information technologies, by simply inducing people to change their current bad behaviors (Ceder et al, 2013). This type of approach to urban policies on mobility, furthermore, does not foresee the classic top-down dynamics such as road pricing or the optimization of the public transportation network, neither the creation of limited traffic zones.

For instance, this year City of Milan published compelling results in terms of traffic reduction (City Climate Leadership Awards, 2014) due to the Limited Traffic Zone (LTZ) of 8.2 km^2 (called “Area C”). This value (49% less of CO_2 emissions), despite the compliance to another scale of impact, it is actually lower then the result we have gathered during the first small test of the TrafficO_2 mobile app, but the cost of this policy is of course higher in terms of funds and also in terms of urban impact of the necessary infrastructures needed to apply the LTZ.

The presented model takes into account only the already available resources without modifying any aspects of them, but trying to highlight the real value they could provide citizen.

A fundamental characteristic of the present model is that it is designed to improve the user experience through dialogue and not changing the characteristics of the context. Furthermore, this aspect, along with the fact that smartphones are cheaper and Internet connections are rapidly improving (Pick and Nishida, 2014), should guarantee a rapid scalability for the approach to different contexts (Allcott and Mullainathan, 2010; Bajardi, 2013).

Obviously the results that we confirmed in the first application of the present model, in other words the data we collected during the first test of the mobile app TrafficO_2 with the SUV challenge, depend strongly on the characteristics of the city taken into analysis, form its mobility system, by its vehicular fleet and obviously by the sample under investigation. It is necessary to verify the effectiveness of the TrafficO_2 model by observing a larger sample of users, other communities and different urban contexts.

The TrafficO_2 project is in its development phase and new functions are being designed with the goal of gathering more data from the users. Detailed technical descriptions of the users' vehicles, for example, are essential to estimate the traffic CO2 emissions, so it is easier to find precisely the reduction objectives (improvement Scenarios 1 and 2), and then further evaluate the results.

Through a detailed analysis of the available data it will also be useful for better understanding what drives people in making their habits more sustainable (Dickinson et al, 2013). Thanks to the game's features and to the variety of relationships that the user can develop with the network of partners and sponsors (Bartolo, 2014), it is already possible to deduce what drives each individual user, or category, in modifying or not their personal mobility habits (Gatautis and Vitkauskaite, 2014).

Furthermore, through the collected data, it will be possible to study the urban flows of the active users on the entire urban network, and therefore compare the results to the urban mobility system (Holleczek et al, 2014; Hoteit et al, 2014; Iqbal et al, 2014; Kung et al, 2014).

The lesson, in our opinion, can be taken by the present analysis and experimentation regarding urban mobility is that through communication actions, able to establish a direct and virtuous dialogue with the citizens, important results can be achieved that are comparable to the ones obtained through the implementations of coercive urban policies or expensive modifications to the urban transportation system.

Annex 1

In the equation M_1 is the new percentage of the modal split, I_{1i} represents the improvement potential for each mobility system, K_i is a Boolean variable, extrapolated from Table 5 and Table 6, which indicates the availability (1) or less (0) of the mobility systems and, I_{1i} is the highest available improvement percentage for each transportation type in function of the benchmark parameters B.
In fact, the algorithm if-then-else explores in order of hierarchy the different possibilities to reach the goal for improvement (I_{1i}) by saturating, from time to time, the single improvements for the modal split. The order of improvements included in the equation is: walking, biking, public transport, carpooling (with 5 seats occupied the CO_2 emissions are similar to the moto-pooling emissions), moto-pooling and car sharing.

$M_{1i,w} = M_{0i,w} + I_{1i,w}$ $\qquad$ $I'_{1i,w} = (B_w - M_{0i,w}) K_{i,w}$

$M_{1i,b} = M_{0i,b} + I_{1i,b}$ $\qquad$ $I'_{1i,b} = (B_b - M_{0i,b}) K_{i,b}$

$M_{1i,t} = M_{0i,t} + I_{1i,t}$ $\qquad$ $I'_{1i,t} = (B_t - M_{0i,t}) K_{i,t}$

$M_{1i,cp} = M_{0i,cp} + I_{1i,cp}$ $\qquad$ $I'_{1i,cp} = (B_{cp} - M_{0i,cp}) K_{i,cp}$

$M_{1i,mp} = M_{0i,mp} + I_{1i,mp}$ $\qquad$ $I'_{1i,mp} = (B_{mp} - M_{0i,mp}) K_{i,mp}$

$M_{1i,cs} = M_{0i,cs} + I_{1i,cs}$ $\qquad$ $I'_{1i,cs} = (B_{cs} - M_{0i,cs}) K_{i,cs}$

$$M_{1i,c} = (I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp} - I_{1i,cs}) [M_{1i,c} /(M_{1i,c} + M_{1i,m})]$$

$$M_{1i,m} = (I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp} - I_{1i,cs}) [M_{1i,m} /(M_{1i,c} + M_{1i,m})]$$

where:

if $I_{1i} > I'_{1i,w}$ { then $I_{1i,w} = I_{1i} - I'_{1i,w}$

if $I_{1i} - I_{1i,w} > I'_{1i,b}$ { then $I_{1i,b} = I_{1i} - I_{1i,w} - I'_{1i,b}$

if $I_{1i} - I_{1i,w} - I_{1i,b} > I'_{1i,t}$ { then $I_{1i,t} = I_{1i} - I_{1i,w} - I_{1i,b} - I'_{1i,t}$

if $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} > I'_{1i,cp}$ { then $I_{1i,cp} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I'_{1i,cp}$

if $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} > I'_{1i,mp}$ { then $I_{1i,mp} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I'_{1i,mp}$

if $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp} > I'_{1i,cs}$ {

then $I_{1i,cs} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp} - I'_{1i,cs}$ }

else $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp} < I'_{1i,cs}$

then $I_{1i,cs} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} - I_{1i,mp}$ }

else $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp} < I'_{1i,mp}$ then $I_{1i,mp} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} - I_{1i,cp}$ }

else $I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t} < I'_{1i,cp}$ then $I_{1i,cp} = I_{1i} - I_{1i,w} - I_{1i,b} - I_{1i,t}$ }

else $I_{1i} - I_{1i,w} - I_{1i,b} < I'_{1i,t}$ then $I_{1i,t} = I_{1i} - I_{1i,w} - I_{1i,b}$ }

else $I_{1i} - I_{1i,w} < I'_{1i,b}$ then $I_{1i,b} = I_{1i} - I_{1i,w}$}

else $I_{1i} < I'_{1i,w}$ then $I_{1i,w} = I_{1i}$

Annex 2

In the following formulas M_{2i} is the new modal split rate percentage, I_{2i} represents the potential improvement of each mobility system, $I'_{2DEi,cp}$ is the minimum improvement percentage for car pooling modality if the user overuses (more than 50%) his/her car, and $I'_{2DEi,mp}$ is the minimum improvement percentage for moto-pooling modality if the user overuses (more than 50%) his/her motorcycle.

The new modal split table is due to the three different following assumptions:

Regarding the A class subsample:

$M_{2Ai,w} = M_{Ai,w} + I_{2Ai,w}$

$M_{2Ai,b} = M_{Ai,b} + I_{2Ai,b}$

$M_{2Ai,c} = 0; M_{2Ai,cp} = 0$

$M_{2Ai,m} = 0; M_{2Ai,mp} = 0$

$M_{2Ai,t} = 0; M_{2Ai,cs} = 0$

$I_{2Ai} - (I_{2Ai,w} + I_{2Ai,b}) = 0$

where:

$I_{2Ai,w} = I_{2Ai} [M_{Ai,w} / (M_{Ai,w} + M_{Ai,b})]$ and

$I_{2Ai,b} = I_{2Ai} [M_{Ai,b} / (M_{Ai,w} + M_{Ai,b})]$

for the B and C class users:

$M_{2BCi,w} = M_{BCi,w} + I_{2BCi,w}$

$M_{2BCi,b} = M_{BCi,b} + I_{2BCi,b}$

$M_{2BCi,t} = M_{BCi,t} + I_{2BCi,t}$

$M_{2BCi,c} = 0; M_{2BCi,cp} = 0$

$M_{2BCi,m} = 0; M_{2BCi,mp} = 0$

$M_{2BCi,cs} = 0$

where:

$I_{2BCi,w} = I_{2BCi} [M_{BCi,w} / (M_{BCi,w} + M_{BCi,b} + M_{BCi,t})]$

and $I_{2BCi,b} = I_{2BCi} [M_{BCi,b} / (M_{BCi,w} + M_{BCi,b} + M_{BCi,t})]$

and $I_{2BCi,t} = I_{2BCi} [M_{BCi,w} / (M_{BCi,w} + M_{BCi,b} + M_{BCi,t})]$

$I_{2BCi} - (I_{2BCi,w} + I_{2BCi,b} + I_{2BCi,t}) = 0$

and for the farther D and E people:

$M_{2DEi,w} = M_{DEi,w} + I_{2DEi,w}$

$M_{2DEi,b} = M_{DEi,b} + I_{2DEi,b}$

$M_{2DEi,t} = M_{DEi,t} + I_{2DEi,t}$

$M_{2DEi,cp} = M_{DEi,cp} + I_{2DEi,cp}$

$M_{2DEi,mp} = M_{DEi,mp} + I_{2DEi,mp}$

$M_{2DEi,cs} = M_{DEi,cs} + I_{2DEi,cs}$

$M_{2DEi,c} = 0; M_{2DEi,m} = 0$

$I'_{2DEi,cp} = M_{2DEi,c} - 50\%$

$I'_{2DEi,mp} = M_{2DEi,m} - 50\%$

where:

if $M_{2DEi,c} > 50\%$ { then $I_{2DEi} = (I_{2DEi,w} + I_{2DEi,b} + I_{2DEi,t} + I_{2DEi,cp} + I_{2DEi,mp} + I_{2DEi,cs}) - I'_{2DEi,cp}$

and $I_{2DEi,w} = I_{2DEi} [M_{DEi,w} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,b} = I_{2DEi} [M_{DEi,b} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,t} = I_{2DEi} [M_{DEi,t} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,cp} = I_{2DEi} [M_{DEi,cp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})] + I'_{2DEi,cp}$

and $I_{2DEi,mp} = I_{2DEi} [M_{DEi,mp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,cs} = I_{2DEi} [M_{DEi,cs} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$}

else if $M_{2DEi,m} > 50\%$ { then $I_{2DEi} = (I_{2DEi,w} + I_{2DEi,b} + I_{2DEi,t} + I_{2DEi,cp} + I_{2DEi,mp} + I_{2DEi,cs}) - I'_{2DEi,mp}$

and $I_{2DEi,w} = I_{2DEi} [M_{DEi,w} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,b} = I_{2DEi} [M_{DEi,b} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,t} = I_{2DEi} [M_{DEi,t} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,cp} = I_{2DEi} [M_{DEi,cp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,mp} = I_{2DEi} [M_{DEi,mp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})] + I'_{2DEi,mp}$

and $I_{2DEi,cs} = I_{2DEi} [M_{DEi,cs} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$}

else { $I_{2DEi} = (I_{2DEi,w} + I_{2DEi,b} + I_{2DEi,t} + I_{2DEi,cp} + I_{2DEi,mp} + I_{2DEi,cs})$

and $I_{2DEi,w} = I_{2DEi} [M_{DEi,w} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,b} = I_{2DEi} [M_{DEi,b} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,t} = I_{2DEi} [M_{DEi,t} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,cp} = I_{2DEi} [M_{DEi,cp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,mp} = I_{2DEi} [M_{DEi,mp} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$

and $I_{2DEi,cs} = I_{2DEi} [M_{DEi,cs} / (M_{DEi,w} + M_{DEi,b} + M_{DEi,t} + M_{DEi,cp} + M_{DEi,mp} + M_{DEi,cs})]$}

Annex 3

The following Equations explain the definition of the walking and biking frequency ($F_{0i,w}$ and $F_{0i,b}$) in (Equations 14 and 15) and how, with the walking and biking home-department (and vice versa) distances recorded ($D_{Ti,w}$ and $D_{Ti,b}$), the rate percentages of use of each mobility means ($M_{Ti,w}$ and $M_{Ti,b}$) were elaborated (Equations 16 and 17).
An if-than-else algorithm explores a comparison between the declared frequencies and the recorded ones (respectively $F_{Ti,w}$ and $F_{Ti,b}$) and so the different conditions each user has caused in terms of CO_2 emissions.

$$F_{0i,w} = F_{0i}\, M_{0i,w} \tag{14}$$
$$F_{0i,b} = F_{0i}\, M_{0i,b} \tag{15}$$
$$M_{Ti,w} = D_{Ti,w} / L_{i,TOT} \tag{16}$$
$$M_{Ti,b} = D_{Ti,b} / L_{i,TOT} \tag{17}$$

IF $F_{Ti,w} > F_{0i,w}$ *and* $F_{Ti,b} > F_{0i,b}$ *{then* $E_T = M_{0i,c}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_c + M_{0i,m}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_m + M_{0i,t}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_t + M_{0i,cp}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_{cp} + M_{0i,mp}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_{mp} + M_{0i,cs}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{Ti,b})]\, \alpha_{cs}$

IF $F_{Ti,w} > F_{0i,w}$ *{then* $E_T = M_{0i,c}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_c + M_{0i,m}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_m + M_{0i,t}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_t + M_{0i,cp}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_{cp} + M_{0i,mp}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_{mp} + M_{0i,cs}\, L_{i,TOT}\, [1 - (M_{Ti,w} + M_{0i,b})]\, \alpha_{cs}$

IF $F_{Ti,b} > F_{0i,b}$ *{then* $E_T = M_{0i,c}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_c + M_{0i,m}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_m + M_{0i,t}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_t + M_{0i,cp}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_{cp} + M_{0i,mp}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_{mp} + M_{0i,cs}\, L_{i,TOT}\, [1 - (M_{0i,w} + M_{Ti,b})]\, \alpha_{cs}$

else $E_T = E_0$ *}}}*

"Maximise the value. Minimise the waste."

Tahichi Ohno, *Toyota spirit*

4. Discussion: the Lean way to urban policies' design

As we have seen, the two proposal we have treated in the last chapter have very different dynamics but, *ex post*, seem to have something in common.

They share, in fact, a general philosophy that we are trying to identify in a already existing model called Lean Thinking.

The objective of this discussion is to associate the domain of urban planning to the properties and the method of "lean thinking" that belongs to the economic domain. The essential connection found between the conceptual frame, tied to the new development models, and the "lean approach" fundamentally tied to urgency, effectiveness and quality: a way to create value and avoid waste.

Lean thinking pivots on these areas, being applied to extremely complex contest, such as the manufacturing industry (lean manufacturing), companies (lean management) and technological innovation (lean information).

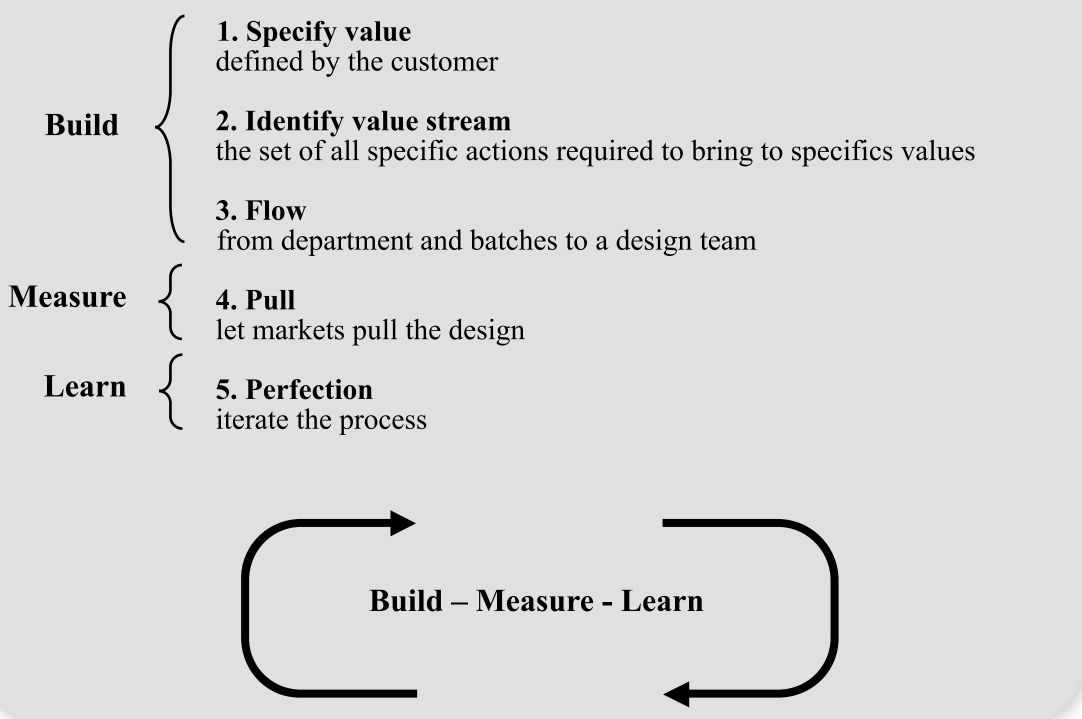
There are already different attempts to apply Lean Thinking concepts and guidelines to the urban planning domain, starting from the aspect merely of addressing urban scale design policies (Paolo Soleri - Lean Linear City), to the more complex one linked to the urban process dynamics (Andres Duany - Lean Urbanism) and to finally reach the most condensed applications of the concepts more similar to urban performances than urban strategies (Tactical Urbanism).

Following we firstly present the general theory of Lean Thinking, its possible applications and lastly the assumptions we have got by doing our action-research projects.

4.1 Lean thinking

The term was first coined by John Krafcik in his 1988 article, "Triumph of the Lean Production System," based on his master's thesis at the MIT Sloan School of Management. The concept of 'lean' became worldwide known because of the work of Womack, Jones and Roos (The Machine That Changed the World, 1990) where they describe the working philosophy and practices of the Japanese vehicle manufacturers and in particular the Toyota Production System (TPS). More specifically, it was observed that the overall philosophy provided a focused approach for continuous process improvement and the targeting of a variety of tools and methods to bring about such improvements. Effectively, the philosophy involves eliminating waste and unnecessary actions and linking all the steps that create value.

Figure 1 - Lean thinking approach



4.1.1 Five key principles

In 1996 the initial concept of lean was more extensively defined and described by five key principles (Womack & Jones, 1996):

1. Specify value – Define value precisely from the perspective of the end customer in terms of the specific product with specific capabilities offered at a specific time.

2. Identify value streams – Identify the entire value stream for each product or product family and eliminate waste.
3. Make value flow – Make the remaining value creating steps flow.
4. Let the customer pull value – Design and provide what the customer wants only when the customer wants it.
5. Pursue perfection – Strive for perfection by continually removing successive layers of waste as they are uncovered.

In order to introduce lean thinking within manufacturing environments the philosophy relies on the identification and elimination of waste and it is this fundamental aspect, which must first be understood, in order to effectively target and apply the various lean tools. In general lean transformations employ techniques such as Kaizen (Imai, 1986), SMED (Shingo, 1985), Six Sigma (Pyzdek, 2003), value stream mapping (Hines & Rich, 1997) and the five 'S's (Warwood & Knowles, 2004) in order to remove waste and deliver improvements in specific areas. However, it is the fundamental understanding of waste that is critical to successful lean transformation.

4.1.2 Seven wastes

Within the context of manufacturing systems there exist seven types of waste. These were first identified by Ohno (1988) of Toyota and reported by Womack and Jones (1996). The seven wastes include:

1. Overproduction – Occurs when operations continue after they should have ceased. This results in an excess of products, products being made too early and increased inventory.
2. Waiting – Sometimes referred to as queuing and occurs when there are periods of inactivity in a downstream process because an upstream activity has not delivered on time. Sometimes idle downstream processes are used for activities that either do not add value or result in overproduction.
3. Transport – Unnecessary motion or movement of materials, such as work in progress (WIP) being transported from one operation to another. In general transport should be minimised as it adds time to the process during which no value is added and handling damage can occur.

4. Extra processing – Extra operations such as rework, reprocessing, handling or storage that occur because of defects, overproduction or excess inventory.
5. Inventory – All inventory that is not directly required to fulfil current customer orders. Inventory includes raw materials, work-in-progress and finished goods. Inventory all requires additional handling and space. Its presence can also significantly increase extra processing.
6. Motion – Refers to the extra steps taken by employees and equipment to accommodate inefficient layout, defects, reprocessing, overproduction or excess inventory. Motion takes time and adds no value to the product or service.
7. Defects – Finished goods or services that do not conform to the specification or customer's expectation, thus causing customer dissatisfaction.
In addition to these seven deadly wastes, Womack and Jones (1996) identified an eighth category. This relates to the underutilisation of people and in particular their ideas and creative input for improving the processes and practices.

4.1.3 The application of lean thinking

Over the last decade the principles of lean have been extensively applied to manufacturing operations and production environments in not only the automotive (Kochan, 1998) and aerospace industries (Crute, Ward, Brown & Graves, 2003) but increasingly many small to medium-sized manufacturing organisations (Achanga, Shehab, Roy & Nelder, 2006) and the construction industry (Pheng & Fang, 2005). The relative success and commercial benefits of lean thinking include a focused enterprise-wide approach to continuous improvement, increased productivity, improved quality and improved management. As a consequence, both academia and industry are beginning to investigate the application of the lean philosophy beyond the primary manufacturing system. This includes what can be thought of as secondary and supportive processes for manufacturing, production processes beyond the traditional manufacturing and physical products, and also other aspects of the business, such as administrative processes (Innovations, 2005). For example, Dasari (2005) describes the application of lean to the software development process in order to improve quality and build in a continuous improvement cycle. The study defines waste, the principal contributors to value, the process for allowing customers to pull demand and product optimisation. Eric Ries (2011) investigate the application of lean to the product introduction process and propose the key activities, tools and techniques that constitute the lean startup processes.

4.1.4 The Minimum Viable Product

During the last years another concept was added to the Lean Thinking theory. It is called MVP and means Minimum Viable Product.

It has just those core features that allow the product to be deployed, and no more. The product is typically deployed to a subset of possible customers, such as early adopters that are thought to be more forgiving, more likely to give feedback, and able to grasp a product vision from an early prototype or marketing information. It is a strategy targeted at avoiding building products that customers do not want, that seeks to maximize the information learned about the customer per dollar spent. "The minimum viable product is that version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort. The definition's use of the words maximum and minimum means it is decidedly not formulaic. It requires judgment to figure out, for any given context, what MVP makes sense. An MVP is not a minimal product, it is a strategy and process directed toward making and selling a product to customers. It is an iterative process of idea generation, prototyping, presentation, data collection, analysis and learning. One seeks to minimize the total time spent on an iteration. The process is iterated until a desirable product/market fit is obtained, or until the product is deemed to be non-viable. The purposes to build a MVP is:

- Be able to test a product hypothesis with minimal resources
- Accelerate learning
- Reduce wasted engineering hours
- Get the product to early customers as soon as possible

Steve Blank, a silicon valley serial entrepreneur and consulting associate professor of entrepreneurship at Stanford, typically refers to minimum viable product as minimum feature set. He said: "You’re selling the vision and delivering the minimum feature set to visionaries, not everyone.”

4.1.5 The Lean Startup

Lean startup is a method for developing businesses and products first proposed in 2011 by Eric Ries. Based on his previous experience working in several U.S. startups, Ries claims that startups can shorten their product development cycles by adopting a combination of business-hypothesis-driven experimentation, iterative product releases, and what he calls “validated learning”. Originally developed with high-tech companies in mind, the lean startup philosophy has since been expanded to apply to any individual, team, or company looking to introduce new products or services into the market. Similar to the precepts of lean management, Ries' lean startup philosophy seeks to eliminate wasteful practices and increase value producing practices during the product development phase so that startups can have a better chance of success without requiring large amounts of outside funding, elaborate business plans, or the perfect product. Ries believes that customer feedback during product development is integral to the lean startup process, and ensures that the producer does not invest time designing features or services that consumers do not want. This is done primarily through two processes, using key performance indicators and a continuous deployment process. Because startups typically cannot afford to have their entire investment depend upon the success of one single product launch, Ries maintains that by releasing a minimum viable product that is not yet finalized, the company can then make use of customer feedback to help further tailor their product to the specific needs of its customers. The lean startup philosophy pushes web based or tech related startups away from the ideology of their dot-com era predecessors in order to achieve cost-effective production by building a minimal product and gauging customer feedback. Build-Measure-Learn is the core part of the lean startup methodology that explains what we should do between the phases of Idea (Build), Code (Measure), and Data (Learn). In other words, it is a loop process of turning ideas into products, measuring customers reaction and behavior against built products, and then learn whether to persevere or pivot the idea; this process repeats over and over again.

”You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.”

Buckminster Fuller, *Synergetics: Explorations in the Geometry of Thinking*

4.2 Lean thinking and planning management.

The idea that a Product Management Theory could be adapted to the Urban Policies domain, hides the assumption that citizens are cities' customers or, more exactly, cities' “pro-sumers”.

The term “prosumer” came from the internet domain and stands for “producers and customers" at the same time. The term is referred to the interactions and the contributes each single citizen can give to enrich the “city's language” (Barthes, 1970) and what he/she wants receive from the city mainly as different services.

Giving more value to the “end users” and saving more resources as possible is the key to design in a sustainable and successful way.

In more general terms it is arguable that the principles of Lean Thinking and, in particular, the removal of waste and pursuit of perfection can be applied to any system where product flows to meet the demand of the customer, user or consumer (another system).

These elements are certainly true if we look to the citizens as cities customers and the planning flows and work is undertaken to add value to the citizens's services.

In principle, the concept of lean can be applied to any design processing activity and its limitations are only constrained by the ability to identify waste and define value, which are arguably less visible and more subjective.

This is in considerable contrast to the manufacturing sector where there exists a culture of performance measurement and identifying and characterising aspects of waste is relatively straightforward. This is due to the physical and visible nature of the system considered.

For example overproduction is very visible and its effect tangible. In contrast to this, design systems are considered the various dimensions of waste do not occupy an equivalent space, the effects are less tangible and the value, or lack of, is far less clear and arguably highly subjective.

This is particularly the case where activities such as background information and research activities are dealt with. It follows that whilst lean has the potential to support improvements in information management systems a fundamental barrier to its application or introduction is a lack of understanding of waste and also the concept of value.

4.2.1 Lean urban planning in the U.S.

Lately the application of Lean Strategies to the city planning domain has been theorised in the U.S..

After a first attempt made by the Italian architect Paolo Soleri (Lean Linear City, 2005) New Urbanism planners, particularly, are trying to describe it from two different perspectives: the Lean Urbanism (mainly regarding the planning regulations in disadvantages cities areas as top-down policies) and the Tactical Urbanism (focused on ready-to-go practical actions as bottom-up dynamics).

"Lean cities", according to these theories, are the opposite of the full of wastes western countries' "Lardy cities".

Lean Linear City

The first attempts to bring together Lean Thinking and Urban Design were made in the U.S., in Arizona specifically. In his last year Italian architect Paolo Soleri, in fact, defined a comprehensive approach to defining and controlling growth patterns of existing and future cities to produce more sustainable, equitable, and robust urban forms.

As he was used to do, to describe the values of his idea he designed his utopia as a new urban shape. In his last book "Lean Linear city" he graphically illustrates how Lean Linear logistics are designed to cohere, enhancing the urban experience, minimizing waste, taking advantage of passive energy opportunities, and defining smart boundaries in relation to surrounding agricultural and natural lands. As urban planners face the key issues of the twenty-first century ever expanding populations,

rapid urbanization, limited global resources, increased demand for food production, and protection of a fragile environment Soleri proposes that logistically defined arterial cities may prove to be a viable option for sustainable urban development.
Specifically Lean Linear City proposes a continuous urban ribbon of twenty or more stories high, extending for many kilometers. Two main, parallel structures are built in modules measuring 200 meters in length. Each module accommodates about 3,000 residents and spaces for commercial, industrial, educational, cultural, recreational, and health maintenance activities.
Lean Linear City suggests a possibility of sustainable urban development within its structure and the environment beyond. While carbon neutrality is within its reach through innovations in building technology and energy conservation, the most important contribution of Lean Linear City is, perhaps, its logistical approach to define and control the growth pattern of the existing and future cities.

Lean Urbanism

Andres Duany is the director of the Center for Applied Transect Studies and the founder of the Congress for the New Urbanism, an organization that promotes communities that are compact, walkable, transit-oriented and mixed-use.
With the support of Knight Foundation, he elaborated during the last three years (from 2011 to 2014), the Lean Urbanism planning theory.
According to Duany, Lean Urbanism is a means of reducing the time, cost and morass of regulations that can make development and starting a business unnecessarily difficult.
Lean Urbanism will devise tools so that community building takes less time. It seeks to reduce the resources required for compliance, and to circumvent the financial, bureaucratic and regulatory processes that frustrate well-meaning entrepreneurs with common-sense workarounds.
Lean Urbanism "is not a reform movement. It is smaller than that. It is actually a series of tools that would work around impediments at certain scales and in certain places" he said during the last Council of New Urbanism Conference (2014).

Experienced professionals—and their attorneys—understand how to negotiate these workarounds. But that takes time, money and know-how. Lean Urbanism is an attempt to collect and "daylight" the workarounds so that everyone can use them.
"We need to level the playing field".
The Project for Lean Urbanism is structured on Seven Platforms:

1. Lean Building
2. Lean Development
3. Lean Business
4. Lean Green
5. Lean Regulation
6. Lean Infrastructure
7. Lean Learning

Duany and his fellows "hackers of regulation" from across the U.S. and Great Britain are working quickly on step 1 of the work - preparing a set of white papers to illuminate various workarounds and even laws being used today that simplify the making of our communities.

Tactical Urbanism

The theory of Tactical Urbanism starts from a brief analysis of what large scale transformations usually need to be effective.
These processes, generally, require a substantial investment of time, as well as a deep reserve of political, social, and fiscal capital. Moreover, the long-term economic or social benefit cannot be guaranteed. In the pursuit of equitable progress, citizens are typically invited to engage in a process that is fundamentally broken: rather than being asked to contribute to incremental change at the neighborhood or block level, residents are asked to react to proposals they often don't understand, and at a scale for which they have little control. For better or worse, this often results in NIMBYism of the worst kind. Surmounting the challenges inherent to these "public" processes continues to prove difficult.
While larger scale efforts do have their place, incremental, small-scale improvements are increasingly seen as a way to stage more substantial investments. This approach allows a host of local actors to test new concepts before making substantial political and financial commitments. Sometimes sanctioned, sometimes not, these actions are

commonly referred to as "guerilla urbanism," "pop-up urbanism," "city repair," or "Do It Yourself Urbanism."

While exhibiting several overlapping characterstics, "tactical urbanism," is a deliberate approach to city-making that features the following five characteristics:

• A deliberate, phased approach to instigating change.

• An offering of local ideas for local planning challenges.

• Short-term commitment and realistic expectations.

• Low-risks, with a possibly a high reward.

• The development of social capital between citizens, and the building of organizational capacity between public/private institutions, non-profit/NGOs, and their constituents.

Fig. 1 - The Tactical Urbanism continuum table

Source: https://www.cnu.org/sites/www.cnu.org/files/tacticalurbanismvol2final.pdf

4.2.2 Urban design ways to be Lean: U.S. experiments and our action-research

According to our experience, i.e. analyzing our action-research studies, we have found many similarities between U.S. experiences and our specific context.

Some solutions we have planned in our proposal to face our specific context, in fact, do not share the same final intentions but a similar method of the American ones.

Case studies from across North America reveal the benefit of taking an incremental approach to the process of city building—long-term change often starts with trying something small. Upon implementation, results may be observed and measured in real time. In this way, paraphrasing professor Nabeel Hamdi, the integration of bottom-up project allow for the making of plans without the preponderance of planning.

When such experiments are done inexpensively, and with flexibility, adjustments may be made before moving forward with large capital expenditures.

If the project does not work as planned, the entire budget is not exhausted and future designs may be calibrated to absorb the lessons learned from what is surely a particular and dynamic context. If done well, such small-scale changes may be conceived as the first step in realizing lasting change.

If included as part of a public planning process, bottom-up proposals as tactical urbanism may more quickly build trust amongst disparate interest groups and community leaders. Indeed, if the public is able to physically participate in the improvement of the city, no matter how small the effort, there is an increased likelihood of gaining increased public support for more permanent change later. Involving the public in the physical testing of ideas may also yield unique insights into the expectations of future users and the types of design features for which they yearn; truly participatory planning must go beyond drawing on flip charts and maps.

Finally, using bottom-up actions to activate those top-down plans already sitting on the shelf may recover the momentum gained during the actual planning process and move some of the most realistic or exciting ideas closer to fruition.

Trying to clarify the link we would like to build between Urban Policies Design and Lean Thinking, we have declined it according to the two different directions that design processes can follow to improve cities' conditions:

- Top-down processes.

The analogy between Urban Design and Lean (Manufacture) methodology is due to the similar challenge they face: operate on complex and expensive processes full of inefficiencies with a lack of vision about how to give more value to their customers/ citizen.

- Bottom-up processes.

Here the analogy with the Lean (Startup) method is mainly due to the attempts to test innovative (disruptive) solutions in a very short time with very little resources in a very hard context.

Following we will try to clarify this concept by translating the essential steps of the Lean Thinking to the urban policies field.

4.2.3 Lean planning according to a top-down view - Lampedusa Revolution

Approaching the challenge to build a stream of actions in order to improve the Island environmental conditions was faced by looking to the Island as it were a factory.

This is was easier considering the main condition of being an island: a complex living system but finite, with evident limits.

We have immediately pointed out the value to give to the Island users (citizens and tourists), i.e. the energetic self-sufficiency without compromising the comfort conditions. After that we have analysed every single activity the Island has where electric energy is involved, and every flow that brings value to the end-user.

At this point we have tried to define new processes and practical (economical sustainable) actions in order to let the Island change in a incremental modality and we also tried, through new information technologies, to trigger a cultural constant improvement loop that keeps it working as long as possible.

So, the model from where we started, i.e. the SEAP one, have been integrated with an approach that looks like the lean thinking one.

Cities and factories, of course, have not the same scale or dynamics but, as already said, if we focused on the “resources” they have (energy, heritage, people), there are many analogies between these two complex systems from a top-down point of view.

Here we summarised, after the Lampedusa Revolution analysis, what are, according to the 8 Lean Manufacturing wastes, the urban ones.

1. Overproduction

It is referred to the built environment and the energy needed to run the city's activities. This waste belongs to the idea that "development" equal new constructions, new buildings and new consumes instead of use what we really need. For Lampedusa we have considered the natural growth of the urban areas, of the population and the number of tourists (and their footprint due to the transport) but we have limited the energy consumptions trying to use it as less as possible.

2. Waiting

It refers to the city's logistic of goods and energy. Having resources in the right moment and at the right place is the necessary to develop human activities.

For the Island we have identified few places where bring together energy production and consumption (waste digester with depurator, photovoltaic parking with electric vehicles for rent, etc).

3. Transportation

An accessible urban network is the first condition to let cities being liveable and places of equal opportunities. Recent theories of transport oriented development and compact city, centred the attention on this incredibly important kind of city waste.

For the Island the most impacting part was mainly linked to the tourism and the carry of fundamental resources as Oil and Water. Our attempt was to minimise the waste due to the resources.

4. Extra processing

Often there are several departments that elaborate and re-elaborate the same process at the same time without adding any value to the citizens. This waste is mainly referred to the administrative organization of the town and it causes a waste of public money and citizens' time.

For Lampedusa we have planned basically two design teams: the first one inside the local government to plan the general strategy with the common planning tools, the second one inside the E.S.Co to concretely realise (motivated by the economic profit goal) the policies of energetic efficiency.

5. Inventory

This waste is referred to the tons of paper policy designers use for codes and regulations. As we saw, this kind of waste is the focus treated by Andres Duany.

This aspect for Lampedusa was faced using the SEAP tool as a general strategy platform, doing that we kept it very simple and understandable.

6. Motion

There are many costs, in terms of time and resources, due to extra processing, inefficient bourocracy or waiting conditions.

For the Island the Energy Agency has to keep all the process well interconnected and efficient, with the chance of acting in time to prevent other possible wastes.

7. Defeats

This wasting theme regards mainly the transformations or the urban improvement attempts that don't reach their goal. When errors occur in a costly urban action, more time and more resources are needed to fix problems and guarantee the right value to the citizens.

The "Lampedusa Revolution" proposal, by using an incremental method and a series of easy Tactical Urbanism actions, tests every single action by starting from a small scale. Defeats emerge quickly and readily they can be eliminated.

8. Underutilisation

Cities often have a cultural and human heritage (young people organizations, schools, Universities, retired mangers organization, union trades, etc) that could give a fundamental push to the changing dynamics.

For the Island we have tried to use any single aspect to generate more values for the citizens themselves. Even the "Social Market" mobile app has this objective, it tries to find resources where is very difficult to dig: the citizens behaviours.

Even if some of the above association seem to be forced, it is interesting to see how

4.2.4 Lean planning according to a bottom-up view - TrafficO$_2$

As what we did for Lampedusa also for the Palermo urban mobility we initially tried to focus clearly the value the citizens need: why people move? We roughly synthesised the answer by saying: people move to get money (go to work) and then spend money (go shopping).

This means that if we want to foster people to more sustainable habits, we have to get in this process and so, what are the values that should move citizens to change?

So we identified to main value stream, the first one that we called "intrinsic motivations" and the second one called "extrinsic motivations". The value of the Intrinsic is about the information citizens should have about the different costs of their mobility means choice and so the indicators of time, money, emissions and calories. Talking about daily routine trips, in fact, the prediction of the total costs for one year warming days can be effective to make citizens reflect on the opportunity of change.

The value of the Extrinsic motivations regards the shopping opportunities due to special offers or gift. In the sale periods, for example, people really sacrifice their comfort status being, in such case, in line for hours and hours.

After this analysis we tried to design two different flows for this two values propositions and after that we founded a common ground for them.

The common ground was actually the game dynamics and, to make many people as possible play, it should be on the internet and smartphone driven.

Finally, to develop it, we tried to get it pulled by the users, organising workshops and testing continuously every flow and dynamic.

Its first results, as we have seen in the last chapter, obviously are still experimental, but can long for more than bottom-up usual targets.

4.2.5 The principles of Lean Urban Policies Design

From the above description of the processes we had to reach the design of these two proposals, a general method comes out and we think it has lot in common with Lean Thinking theory.

In order to better explain our assumptions we will use the same shape Womack and Jones used in 1990 specifying, step by step, the meaning for our theory.

1. Specify value

The starting point is to recognise that only a small fraction of the total time and effort in urban policies design actually adds value for the citizen. By clearly defining Value for a specific product or service from the citizen's perspective, all the non value activities - or waste - can be targeted for removal.

Of course "values" changes from place to place and they depend on what objectives politicians want to address to their territory.

This first point is at the center of the research of many urban thinkers (as what we reported about the Lean Linear City values by Paolo Soleri) but, by the way, the definition of the value is a strategic choice.

2. Identify value stream

The Value Stream is the entire set of activities across all parts of the urban policies design team involved in jointly delivering the product or service. This represents the end-to-end process that delivers the value to the citizens: how we are delivering (or not) that to them. This step needs a special effort because it asks to rethink the tools we are generally using to accomplish the planning goal.

3. Flow

Typically after the Value Stream is mapped it takes out that only 5% of activities add value, this can rise to 45% in a service environment. Eliminating this waste ensures that the product or service "flows" to the customer without any interruption, detour or waiting. Typically most of the waste is eliminated after a deep rethinking of the internal processes, transforming the urban design structure from department and batches to a design team.

This is, actually, the point where the research of Andres Duany defined new possible strategy to make "change and development in our cities" happen in a sustainable and viable way.

4. Pull

This is about understanding the citizen demand and then creating a process to respond to this. Usually it is hard to rapidly develop effective answers to the citizens needs.

In the market domain the MVP (Minimum Viable Product) comes for help. Its very lean structure, in fact, guarantees a small investment and a immediate feedback from the target.

Tactical Urbanism strategies represent a very effective way to "test" the cities' dynamics and understand if the city really need those services or urban transformations. Empirically, it would be a right way to face the city's issue if the city "pulls" the design.

5. Perfection

Build-Measure-Learn is the core part of the Lean Urban Design methodology that explains what we should do between the phases of Idea (Build), Test (Measure), and Data (Learn). In other words, it is a loop process of turning ideas into urban policies proposals, measuring citizens reactions and behaviors, and then learn whether to persevere or pivot the idea; this process repeats over and over again. The Build-Measure-Learn loop emphasizes speed as a critical ingredient to urban development.

This is a key point for our domain: each urban design project is a never ending process that planners have to follow and improve constantly.

“The only way to win is to learn faster than anyone else.”

Eric Ries, *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*

5. Conclusion: Lean urban policies’ design research

If we want to clearly define our assumption in a simple phrase: the Lean Urban Policies’ Design is a resources-centered way to design urban issues solutions, minimizing the resources needed to improve the citizens livability.

As we saw, to do it, it is not only a question of top-down policies (Singapore Land Transport Authority 2008), but it is also about bottom-up dynamics guided by the citizens’ lifestyles, daily habits and ways they perceive the city itself (Gatersleben et al, 2013).
Following the ‘Urban Metabolism’ metaphor (Pincetl et al., 2012), in order to improve the “body’s” performance, we should operate also upon the “nervous system”, therefore, on the people that actually ‘use’ too often the city improperly (Wamsler and Brink, 2014).
Mens sana in corpore sano and urban design’ policies will be more effective.

According to our studies, in order to apply more sustainable policies in such contexts as marginal or even disadvantage areas, it results necessary to operate on every single urban process where energy and resources are involved, minimising the wastes and maximising the values to the citizens.
Today, in fact, because of new ICT technologies, to improve the energy performance of our cities we should use a social and communication approach in order to foster people to more sustainable habits.
In order to build up effective proposals to face the urban issues, in fact, we planners should be ready to design urban solutions according to top down and bottom-up approaches.

These two way of acting and transforming the city are apparently different but, as we tried to demonstrate, complementary to whole task of the planner (Ratti and Claudel, 2014).
In such complex domain each intervention, on each resources-values process, in fact, could trigger virtuous dynamics able to improve the whole strategic vision of the city future.
This planning path define a “circular” way of thinking, a never ending process to test, learn and than improve the urban conditions.
This sort of “quality process” to improve a complex system is the reason way we believe that Lean Thinking methodology could be a useful tool able to face urban issues, at different scale and in different contexts, by creating tailored made effective and sustainable solutions.
Looking the city with this model in mind should make planning solutions more able to change the future of our cities toward a more sustainable one.

Future research will explore other action-research projects in order to investigate on processes that with experimental data tries to test urban policies’ design solutions directly in the city complexity.

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“We must pass through the threat of that chaos where thought becomes impossible”.

Gregory Bateson, *Steps to an Ecology of Mind*