Energy planning at the district level: an Implementation Plan as a first step towards smarter city development

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Abstract

Energy policies have recently been developed and funded, from the Nineties' initiatives right up to that of the actual EU Smart City and Communities confirm the interest focused on cities for strategic interventions in the energy sector. Nevertheless, many questions are still open about this: how to manage energy issues at the urban scale and by means of which kind of tool? In order to contribute to the debate around this topic, the author takes into account the methodology proposed by the FP7 project "TRANSFORM-TRANSFORMation Agenda for Low Carbon Cities" and its results, as one of the possible pathways to face the challenge. According to the TRANSFORM Project approach, the Implementation Plan (IP) is understood as a strategic document at the district scale which can be used to support the development of a strategy for an urban area (Smart Urban Lab, SUL).

From the collected case-studies within TRANSFORM's framework some general outputs can be underlined in order to draw concluding reflections from the methodological point of view. To verify the method proposed within the project frame, in particular the case study of Voltri district in Genoa (IT) and its implementation plan are discussed. After considering this example, the paper is, then, able to abstract some general remarks concerning energy planning at the district level and positive and negative aspects of the implementation of energy measures at this scale, resulting from the drawing up of IPs in TRANSFORM's devoted phase. Features of the district, energy potential and designed interventions are explained in order to observe light and shadow of the implementation of energy planning measures at the district level and its future perspectives.

1. Introduction

Global concern regarding climate change has brought about several different approaches to manage and reduce greenhouse gas emissions connected with energy generation and consumption, at both global and local scales (Wilbanks & Kates, 1999; ICLEI, 2009). In this trend, a leading role has certainly been played by the European Union which, since the early years of this century, has been implementing environmental policies to face climate change scenarios and favor low emission actions (Mertens, 2011, European Commission, 2013a). The Lisbon Treaty put Energy at the centre of the European initiative and gave it a legislative basis not yet comprehended in previous acts (Braun, 2011).

Nevertheless, turning general determination into operative policies is not easy; the transition from a statement of principles and objectives to implementation of actions may be complex. It is therefore crucial to involve the institutions closest to citizens and stakeholders, beginning with municipalities, the basic unit of public administration in much of the world (Satterwhite, 2008; Kennedy et al., 2009). Energy policies have recently been developed and funded, from the Nineties' initiatives right up to that of the actual EU Smart City and Communities confirm the interest focused on cities by the EU for strategic interventions in the energy sector.

Many questions are still open about this matter: how to manage energy issues at the urban scale and by means of which kind of tool? In order to contribute to the debate around this topic, the author takes into account the methodology proposed by the FP7 project "TRANSFORM-TRANSFORMation Agenda for Low Carbon Cities" and its results, as one of the possible pathways to face the challenge. The paper also investigates the characteristics of the urban planning tool suggested by TRANSFORM, the implementation plan (IP), an operative tool to be developed at the district scale. It compares the project's approach to the aspects related to the right scale of energy planning in the evolution of EU policies, focused so far on regional- and urban-scale applications. To verify the method proposed within the project frame, the case study of Voltri district in Genoa (IT) and its IP are discussed. After considering this example, the paper is then able to abstract some general remarks concerning energy planning at the district level and positive and negative aspects of the implementation of energy measures at this scale, resulting from the drawing up of IPs in TRANSFORM's devoted phase.

According to the steps mentioned, the paper is structured as follows:

- the following section shows a summary of the international debate around urban energy issues and their recent declination from the regional, urban, to the district scale;
- then, the third part is dedicated to the methodology proposed by TRANSFORM and, in particular, to choosing the district

area as the right urban dimension to tackle energy efficiency and smart development matters. The project activity carried out by each partner-city on drawing up the implementation plans for their own district is also seen in depth;
- the case study of Voltri, Genoa is the focus of the fourth section. Features of the district, energy potential and planned interventions are explained in order to observe light and shadow of the implementation of energy planning measures at the district level;
- starting from the reported case, conclusions of general interest are drawn, adding materials for further discussion.

2. Energy issues and smart initiatives in eu policies: the increasing role being played by municipalities and districts

Recent policy from the EU comes from the evidence that generic declarations of intent are not sufficient to produce an effective change in trends towards an increase of emissions. This fact was clearly demonstrated by the limited effects of the governance actions implemented during the early years of this millennium: the environmental policy to reduce CO2 emissions needs to be adjusted to the actual situation and customized to the specific territorial conditions.
Summing up briefly the steps of the engagement process by the EU in the energy sector, a particularly meaningful moment was when (after a European Heads of State meeting), in 2005, the need was explicitly expressed for a shared policy at the UE level around these topics. The first result of this alarm was the publication, in 2006, of the Green Paper on Energy "A European Strategy for Sustainable, Competitive and Secure Energy", which anticipated (and confirmed in 2007) the necessity of common planning on energy efficiency and RES (Renewable Energy Sources) exploitation.
In 2007 the Action Plan for Energy Efficiency was drawn up for the 5-year period 2007-2012, which contained the targets of a 20% reduction and also the definition of the fields of intervention to achieve the target of reducing energy demand. In 2007, the so-called SET (Strategic Energy Technology) plan was also promoted, a strategy dealing with the new technologies to be implemented in the energy sector. It aimed at accelerating the introduction of innovative devices (with high performance) in order to minimize fossil resource dependency, favoring renewable sources. In 2008 the engagement of the EU reached meaningful levels by means of a fundamental instrument: the 2nd Strategic Energy Review, which introduced the well-known "20-20-20" strategy.
More recently, the European Commission has presented the "Roadmap for moving to a low-carbon economy in 2050". This Roadmap aims at a reduction of greenhouse gas emissions in the EU 27 by at least 80% in 2050 vis-a-vis emissions in 1990. In a general spirit of solidarity among Member States, the EU policy around the energy sector intends to guarantee the safety of the energy supply chain of the Union and the regular course of the market; thus, promoting energy saving, efficiency and interconnection of energy networks, together with the development of renewable sources. This could be considered as the first answer to be implemented in order to tackle the worst environmental challenges such as the lasting carbon footprint and how to reduce greenhouse gases (GHG). This approach, consolidated as the years went by, was oriented to radically changing the way Europe produces and consumes energy, setting up the basis of a new "industrial revolution", able to build up a high-level, efficient and CO2-low-emission economy.
European choices, which have characterized the economic and industrial policies in the first decades of this century, are running straight along the Kyoto Protocol perspective (even though controversial) which, as well known, establishes that Industrialized and Transition Economy Countries must achieve different targets of atmospheric emission reduction (Hickman and Banister, 2007). The European Union wishes to pursue these objectives through innovation in energy technologies and the proposal of market-and-finance instruments controlled at the EU level, also thanks to the involvement of the world of research.
After the issuing of European Directives, the Member States have adopted the targets, drawing up National Action Plans for emission reduction, since the early years of the third millennium. But as a consequence of the adoption of the Renewable Energy and Climate Change Package in 2008, the European Commission reckoned to launch, at the local government scale, the initiative of the Covenant of Mayors (CoM), with the aim of sparking and supporting the efforts made by Municipal Administrations in the process of actualization of energy and climate change policies. The CoM initiative and the planning tool it promotes, the Sustainable Energy Action Plan-SEAP, is located within this framework. Adhesion to the CoM involves Municipalities in a voluntary long-term project with the purpose of reducing more than 20% of CO2 emissions before 2020. In this way, the decisive role of municipalities has been acknowledged, above all taking into account that 80% of energy consumption and production of CO2 is associated with urban activities.
In this way, the EU considers cities as producers of environmental externalities, but at the same time also as protagonists of the related policies. It assigns them a primary role in dealing with GHG effects and the problem of surplus of energy consumption, attributing a great commitment and responsibility to public administrators and citizens (Betsill and Bulkeley, 2006).

Municipalities, at the same time, directly suffer the effects of the increasing of energy demand and consequent pollution but, on the other hand, they may also play a relevant part as experimental places of innovative policies (Musco, 2012), focused on sustainability and resilience in a wider sense (Alberti and Marzluff, 2004; Derissen et al., 2011). In all OECD countries, national governments have increased the level of autonomy of cities so much that the local authorities are now facing difficult political decisions and are pushed by conflicting interests.

The increasing percentage of people living in cities, which is also occurring in some parts of Europe, raises urban policies to being a main priority, especially declined along the lines of the smart paradigm. Considering a holistic definition of the so-called "smart city", from the literature it is seen as a place where good governance, participation and education of inhabitants, easy logistics and transport, ICT applications, security/safety and efficient and sustainable energy are unavoidable pillars. As is well-known, the term "smart" is referred, on the one hand, to the principles established by the Smart Growth Network 1 and addressed to the development of sustainable communities and places that are attractive, convenient, safe, and healthy (ICMA, EPA, 2006; Inam, 2011). On the other hand, it is meant for cities where investment in human and social capital and in communications infrastructure actively promote the overall urban performances and, above all, the quality of life of citizens and the management of natural resources by optimizing energy and water, through an effective use of ICTs (Caragliu, Del Bo, Nijkamp, 2009; Papa, Gargiulo, Galderisi, 2013).

With the launch of the first call of the FP7 Cooperation Work Program on Energy Area, focused on Smart Cities and Communities, the shift to the urban scale of the energy issue became more and more evident. As part of the SET-Plan, the framework of Smart Cities and Communities' Initiatives encompassed a broad range of energy-related topics such as energy efficiency, energy networks and renewable energy production, as well as other urban area issues like electricity, heating and cooling, transport, waste and water management. One basic assumption comes out clearly from these recent documents: European cities are diverse in terms of size, economic morphology, organizational structure, climatic conditions, proximity to transport networks and progress towards sustainability achieved so far. So, the call was intended to promote replication of successful projects through clustering of cities with similar framework conditions or similar ambitions.

The intention of the FP7 (2011) of sponsoring a call on smart energy planning, addressed mainly to municipalities, was to start a new phase of the smart paradigm, not limited to the theoretical side but operative-oriented, in order to provide, for other "follower" cities Europe-wide, the first sample-cases concerning energy interventions. The arising need to light the phase of implementation and testing at the urban level of the above-mentioned energy policies (requested by the call) drove the first committed municipalities to start thinking about urban areas (within the city boundaries) where the expected transformation might be more feasible and governable. So, the districts, decided at the central level by cities, were selected as testers of smart energy planning measures. It is a new era for districts, which are not considered yet so crucial as a level in energy policies by the EU. As a further confirmation of the upcoming role of districts in energy policy evolution, the EU Lighthouse Project Call (launched in 2015, integrating Energy, Transport and ICT sectors) affirms, not even 5 years after the cited FP7 call, that the key challenges for Smart Cities and Communities are "to significantly increase the overall energy efficiency of cities and to exploit the local resources better, implementing and optimizing measures at the level of districts".

The Lighthouse Project call has just closed and the projects funded have not yet been published (as of September 2015). In order to go deeper with the open questions presented in the introduction, about the right scale of urban energy planning and its tools, the author pays attention to the results of the FP7 project TRANSFORM-TRANSFORMation Agenda for Low Carbon Cities, financed by the mentioned call, which ended in June 2015. Firstly, the overall project approach is analyzed in order to frame the initiative and its contents; then, the focus is concentrated on the activity referred to the partner-city districts and the planning tools adopted.

3. The TRANSFORM method to face the challenge

The FP7 project TRANSFORM-TRANSFORMation Agenda for Low Carbon Cities proposes a transversal survey on integrated energy planning Europe-wide, considering experiences from all partner cities: Amsterdam (beneficiary), Copenhagen, Lyon, Hamburg, Vienna and Genoa. TRANSFORM improves the integrated energy policy and decision making process of cities, both at a strategic and operational level, by providing the cities with a framework based on overall planning experiences, in-the-field projects and qualitative and quantitative analysis support models (Delponte, 2014).

The overall objective is to draw up a TRANSFORMation Agenda (TA) which may be useful to address, firstly the partners and secondly the other interested urban contexts, in the process of transition towards a smarter way of planning, designing and living in cities. The particular focus of the project concerns the energy sector as a qualifier of the smart paradigm, as the call requested. The project starts from a very deep analysis of the towns involved: this for two main reasons. On the one hand, because of the sharing of mutual knowledge and the building up of a computer science tool in support of the planning activity. On the other hand, the survey of data (by means of Key-Performance-Indicators) had the aim of selecting those indicators which can take a picture of city performance that is walking along an evolutionary scenario, from the "rough" level to a "smart" one.

The philosophy of the project sustains that to meet the 2020 and 2050 targets, a strategic TA is needed for the city as a whole. A TA should have the flexibility to look beyond the political borders of cities to the functional 'energy' borders, thus including the metropolitan hinterland of the core cities. Therefore, such an outlined TA addresses the main components influencing the chain of energy production and consumption at city level: main infrastructure and sources of energy (thermal energy, electricity, gas,...) and efficiency potentials. It also deals with the possible energy efficiency in flows of water, waste, ICT and mobility. It includes urban planning, regulation and the participation of end users. It is based on qualitative and quantitative insights and contains a strategic financial strategy. During the project, each city develops a TA, containing energy efficiency measures and actions that need to be taken by stakeholders, in order to make a city smart.

In other words, the project wants to answer to this question: is the district scale the right one to cope with the urban energy challenge and by means of which sort of tool?

According to the method, the TA is expected to be brought to the operational level in the form of an Implementation Plan (IP), which will be drawn up for specific city districts. These districts are selected for the project under the name of 'Smart Urban Lab' areas (SULs). The designed process concerns city regulators and decision makers, private companies, and other relevant stakeholders. In fact, part of the TRANSFORM method is to organize in each SUL a three-day wrap-up meeting (named ILS, Intensive Lab Session), where all the selected stakeholders are invited in order to identify and discuss the main goals to be achieved in the area.

Evidently, morphology, urban density, functional mix, demographic aspects, infrastructures and energy networks vary from district to district, but the activity of the project consists of developing a long-term integrated concept for an energy-optimized city district using appropriate technologies, products and solutions, that will be mostly tailor-made and site-specific. The districts where Smart Urban Labs are located are transformation areas undergoing redevelopment at the moment, in need of initiatives to be deployed by means of a comprehensive tool. Thus, each IP is supposed to be a product made locally (in a joint effort by all relevant city stakeholders) which includes, for example, renovation of the building stock, heating and cooling possibilities, domotics, improvements to both electric and thermal networks, the potentials of existing water systems, innovative (electrical) transportation possibilities and urban greenery. It includes quantitative aspects such as indicators, but also reports participative practices made for mapping and involving stakeholders. And lastly, in each IP there are references to feasibility, for example the insertion of preliminary achievable business plans, which take into account the costs, pay-back periods, regulatory issues and market conditions. In the picture the table of contents of the IP template is shown.

1. **BACKGROUND AND CONTEXT INFORMATION ON THE SUL AND THE CITY**
   - 1.1 Description of the area and its overall development
   - 1.2 Structure of population and businesses
2. **DEVELOPMENT PROCESS (SO FAR)**
   - 2.1 Insight in the ongoing development process
   - 2.2 Basis for decisions – available data and detailed knowledge
   - 2.3 Legal framework, tax incentives, aid schemes
   - 2.4 Achievements and experiences
3. **STATUS OF THE ENERGY SYSTEM AND RELATED THEMES AND ENABLING THEMES**
   - 3.1 Energy systems and networks
   - 3.2 Buildings, industry and services – energy demand and energy efficiency
   - 3.3 Local renewable energy sources
   - 3.4 Mobility
   - 3.5 Use of ICT and smart grids (enabling theme)
   - 3.6 Other important issues (optional, e.g. Water, Waste)
4. **OVERALL DEVELOPMENT VISIONS, OBJECTIVES AND TARGETS, FUTURE ORGANIZATION AND MANAGEMENT OF THE SUL FROM THE POLICY PERSPECTIVE**
   - 4.1 Objectives, targets and KPIs, development vision and end-state of urban development
   - 4.2 Development strategies and priorities of future development activities
   - 4.3 Future management and organization of the SUL
5. **IMPLEMENTATION MEASURES, KEY ACTORS FOR FUTURE REALIZATION**
   - 5.1 Energy systems and networks
   - 5.2 Buildings, industry and services – energy demand and energy efficiency
   - 5.3 Local renewable energy sources
   - 5.4 Mobility
   - 5.5 Use of ICT and smart grids
   - 5.6 Other important issues (optional, e.g. Water, Waste)
   - 5.7 Measures concerning the legal framework, tax incentives and aid schemes
6. **REFLECTION – PRELIMINARY ASSESSMENT**

Figure 1 – Table of contents of the TRANSFORM IP template.

The project tries to link the district scale with the city and metropolitan one, by means of the preparation of the IP: namely, the proposed approach tries to link local developments with strategic supra-territorial choices made on (energy) infrastructures implementing a planning process as far afield as at the district level.

The methodology of the drawing up of the IP needs to be addressed to a couple of crucial questions: how to lead a city's quarter to become a 'smart urban area'? How to find investors and projects contributing to the area's transformation, and how to link local development approaches to the wider city strategies? How and with whom to implement projects, that contribute directly to the main TRANSFORM Key-Performance-Indicators (CO2 reduction, energy demand reduction, increase of renewable energy production or energy efficiency)? Moreover, this drawing up of IPs involves the use of existing plans and ongoing planning processes and brings them to a comprehensive format.

Within the TRANSFORM project, the idea of selected Smart Urban Labs (SULs), as test beds of increasing energy efficiency, was created from several observations:

- new technologies are being applied first in individual experimental projects, where testing can take place and learning for future improvements is being sought;
- smart urban technologies, however, need to be bundled and rolled out in a minimum of scale and applications, in order to provide a realistic test for further spreading out: buildings, grids, energy production and energy storage facilities need to be developed and linked in a more coherent way;
- local networks and exchange of energy, renewable energy produced locally, the use of waste heat – all these relevant types of projects in a 'smart neighborhood' related to energy and CO2 reduction – need to be integrated in real urban uses, be they residential, services, offices or manufacturing;
- the 'real life' implementation in selected target areas, provided by TRANSFORM, is needed in order to develop realistic strategies for overall city-wide development. This is particularly relevant in terms of the impact legal and economic framework conditions form for local implementation, but also with respect to technological innovations, which may be of quite different relevance in various parts of a city.

In other words, the TRANSFORM approach proposes an energy planning process where smart future neighborhoods are considered as the basic tesseras. The TA is, then, the tool which fully contains the mosaic formed by the neighborhoods, gathered together by a unique Municipal vision.

It can be seen as working both ways, top down as an element in a city-wide transformation strategy or bottom-up, as an experimental way of learning and testing in order to develop the city-wide transformation strategy. Ideally, the aggregate contributions of the numerous urban districts should form the basis for the achievement of the goals set at city-level. Since urban areas are most differentiated in terms of uses, densities, building types etc., the general, city-wide transformation strategy needs quite substantial adaptations at the sub-city level. Therefore, performance targets will also have to be different between e.g. old urban quarters and newly built areas, where the latest technologies and know-how can be applied. The situation of partners at the kick-off is very diverse, and they have all different targets to achieve, according to the features of their SUL areas.

Specifically, the main "intention" regarding IPs by the partners ranges from:

- a visionary framework in a rather open, bottom-up process (Amsterdam),
- to a process-orientated strategy to organize (Lyon) or structure a platform of dialogue between the most important stakeholders in order to come to a comprehensive strategy for the area (Vienna, Liesing Groß Erlaa),
- and finally to a more content-related, comprehensive strategy development (Copenhagen), the sharpening, deepening and enhancing of an existing strategy (Vienna, aspern Seestadt, the second SUL selected by Vienna) or the speeding up of the implementation process in the next phase (Hamburg).

In the case of Genoa, due to the early stage of the SUL, the IP also aims to support the promotion and the actual decision for a realization. The understanding of the IP is closely connected to its embedding in the municipal landscape of programs and strategies, which are variously related to the smart city conception.

SUL type: G = Greenfield T = Transformation	Area	Population today (2013/14)	Projected population	Jobs today (2013/14)	Projected jobs	Year of projection
Amsterdam, Energiek Zuidoost T	300 ha	18,000	20,000	18,000	18,500	2025
Copenhagen, Nordhavn G	250 ha/ 350 ha	0	40,000	5,100	40,000	2040
Genoa, Mela Verde T	280ha	12,758	12,800	n/a	n/a	n/a
Hamburg, Wilhelmsburg T/G	3,500 ha	55,000	69,160	n/a	n/a	2050
Lyon, Part-Dieu T	135 ha	5,000	7,100	45,000	80,000	2030
Vienna, aspern Seestadt G	223 ha	0	26,000	1,200	23,000	2030

Figure 2 – Different characteristics of TRANSFORM SULs: Mela Verde is the name of the area of Voltri where the project's focus was located (Source: TRANSFORM Synthesis Report).

4. The case study: the Voltri district in Genoa (IT)

The experimentation district for Genoa is in the neighborhood of Voltri.

Voltri is located in the innermost point of the Gulf of Liguria and in the far western suburbs (Municipio VII Ponente) of Genoa, about 17 km away from the city centre. The Voltri area has strong historical and cultural identity and in the past it played a significant role in the local economy. In 1926, Voltri's autonomy was removed by incorporating it into the city of Genoa the economic structure axis rotated and the networks of relationships have focused mainly on the coastal axis resulting in an imbalance of the ancient links with the city center.

The SUL located in this area is represented by a few remaining residences as well as a building devoted to commercial activities and motorized mobility assistance, the local police force barracks, a hotel and car park, several sports facilities, a shipyard, several clubs and sports associations, bathing establishments and shops, and port activities.

The western area of Genoa has been affected in recent years, on the one hand, by the closing of industrial activities, and, on the other, by the transformation of the infrastructure system with the construction of the new commercial port of Voltri, the rail connection with the lines of the mountain pass and connection to the highway network. The road that connects Voltri to the city center separates the coastal strip from the historic area that lies behind, characterized by residential typology.

The new port has given a different connotation to the entire area by strengthening the economic structure and a consequent rebalancing of the economically active population. The territory of Voltri also presents different small and medium enterprise realities, sometimes limited by weak transport infrastructures. There are numerous cases of unused buildings the state of abandonment of which has brought about, in some cases, situations of deterioration and dilapidation of the associated buildings.

Here, some stakeholders' groups asked themselves about what is essential for a real urban regeneration. Their suggestions are renewable energy, improvement in public mobility services (a new metropolitan railway system will have an important node in Voltri) and safeguarding the Mediterranean characteristics of the building stock.

The SUL area addressed by this framework occupies a surface area equal to approximately 30 hectares, mostly public: RFI (Italian railway Network) areas and buildings, predominantly Port Authority land in concession to associations and operators, with private residential buildings located on the margins.

The two main stakeholders (RFI and Port Authority) are very large and powerful and are connected to the urban system in a vast number of issues so the decision on how to develop the SUL could be influenced by external factors, also including national economic and financial issues.

This means the local fact of Voltri is directly linked to supranational matters. So, the strategy to be performed for the

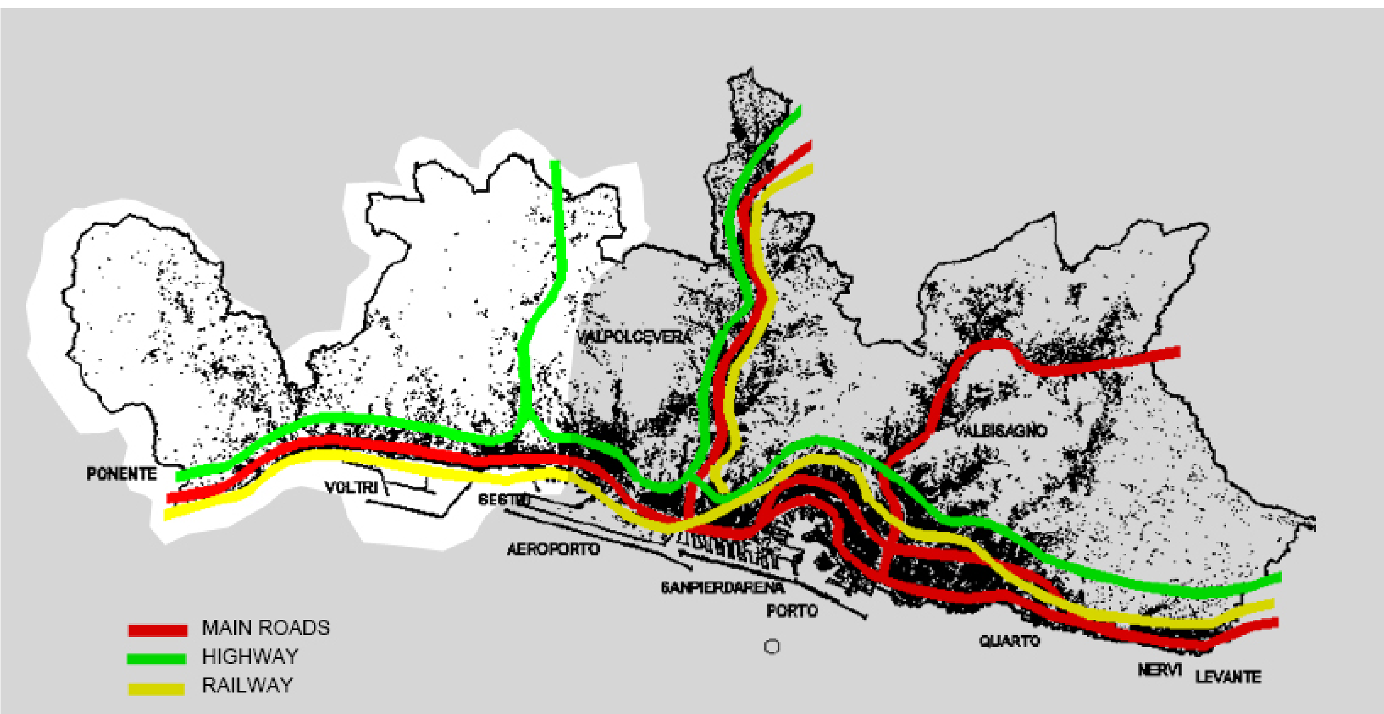

Figure 3 – Voltri district (in white): main road, highway and railway networks (Source: TRANSFORM Voltri Implementation Plan).

SUL foresaw the involvement of the two main public stakeholders in order to reach a shared vision to, then, build up a set of interventions on selected themes considered decisive to trigger the process.

It appears quite clear that economic recovery is related to infrastructure interventions to be started under a careful use of public resources, in dialogue with local power, first of foremost the District Council, where, with a large consensus, a very-well known resident of the area was twice elected President.

Within the Regulatory Masterplan (PUC in Italian) many development actions are focused on Voltri on different topics. In particular:

- concerning the socio-economic and infrastructure development:
  - the enhancement of connecting infrastructure north-south and east-west from the Municipality of Genoa foresees the realization of the metropolitan railway service Voltri-Nervi (the eastern part of the city);
  - the enhancement of intermodality and use of public transport push Voltri neighborhood towards the realization of interchange parks and the strengthening of public transport to hill areas;
  - the re-launching of housing policies sees in future years the conversion of some of the former buildings into health and social service centers;
- concerning the spatial organization of the city and qualification of the urban image:
  - promotion of the compact city and enhancement of public space through the creation of more pedestrian areas of quality;
  - architectural, landscape and environmental promotion of the city crossing axis and redevelopment of the image of the city with the requalification of Voltri's historical center;
  - strengthening of the link with the sea and promotion of interventions increasing the visibility of water, the accessibility and usability of the waterfront through reduction of built-up areas and visual barriers creating new public beaches, accessible by means of pedestrian and cycle paths and completing the eastern promenade.

During the participative phase promoted by the project and carried out by the Municipality, three key-issues were chosen as priority for the SUL development. They are energy, mobility and ICT and smart grids.

To assess the interventions thought for the Voltri SUL on the selected themes, CO2 reduction was considered as the Key Performance Indicator that would contribute to the general achievement of the overall city-goals.

ENERGY

The SUL is served by a gas network and by an electricity network. All buildings are heated by either natural gas or fuel oil. No district heating or energy storages are in place in the area nor significant renewable energy plants. No CHP (Combined Heat and Power) is present in the area and no waste heat is generated. As far as the area is concerned, the only smart grid technology currently in place is the Smart Meter System.

One of the two greatest challenges here is energy saving in buildings. Given the location of the area along the coastline, one of the most promising options being proposed and investigated by the TRANSFORM project team is to improve efficiency and to achieve significant energy (and probably also cost) savings for final consumers. It could be thought as feasible by replacing the currently adopted heating systems using fossil fuel boilers (mostly natural gas) by installing and adopting sea-water coupled heat-pump systems. This action will however need to involve citizens and local stakeholders as well as identifying possible financial solutions to promote investments.

The second important challenge is the retrofitting of public/social buildings throughout the area (a swimming pool, medical practices, a library, schools, etc.).

Specifically, the basic idea behind this proposal is to exploit the nearby sea as an enormous heat-source for space heating and any other low-temperature heating purpose (e.g. domestic hot water etc.) as well as for cooling in summer. Many variables still pending do not allow us to reach an estimation of the required investments. Splitting the intervention into 4 phases of implementation, the expected benefits will be the reduction of 5586 MWh/year in energy consumption and 1065 tons in terms of CO2/year.

Another action that was foreseen, related to the energy sector (not precisely calculated yet), is the replacement of conventional and low-efficient public lighting systems with LED technologies, which will enable energy savings along with the cost reduction related to the maintenance of the system.

MOBILITY

Genoa has about 600,000 inhabitants who live in 73.53 km^2, representing 31% of the municipal area. About 302,000 trips are recorded during the morning peak hours in the urban territory.

The national highway network, with its 7 toll gates located in Genoa, is very important in the distribution flows in the urban area: one toll gate "Genoa Voltri" is located to the east of the SUL and also connects the western entrance to the port.

The presence of 21 railway stations and ticket integration between buses and railway has brought about the growth of the use of rail to move within the urban area (along the coastline).

The most relevant infrastructural intervention in Voltri will regard the "metro" railway station which will connect the western outskirts of Genoa directly to the city-centre thanks to a frequent service of small trains, very similar to a metro

system. A node with public transport terminal bus will be built near the new railway station. Moreover the urban mobility plan foresees the creation of an interchange parking area (Park & Ride).
The contribution of the Metro Railway system in Voltri and the realization of the related intermodal hub will amount to about -772,2 MWh/year and -206,5 tons/year in terms of CO2 reduction.
ICT AND SMART GRIDS
The main Smart Grid measures that have been planned in the SUL are the following: Electricity Grid preparation and empowerment and Active Demand/Smart Info. Some interventions in the ICT sector were foreseen in previous plans and they are now ongoing or completed. Moreover, throughout the City of Genoa there are 17 Electric Vehicle recharging infrastructures that are managed and controlled by an ICT application called the Electric Mobility Management System (EMMS). The main functionalities of the EMMS are: data acquisition and transmission of every single charge procedure, remote monitoring and availability check, recharge process remote control, customer info through display (Localization of the EV recharge stations).
The reduction of energy consumption as a consequence of Enabling infrastructure interventions can be estimated as -2222 MWh/year and -555 tons CO2/year.

After looking firstly at Voltri, then, the project question about the suitability of the IP method can be posed: is this an useful format for each city?
What comes out of the Voltri IP is a photograph of different colors: on the one hand the work already done permits us to take into account the complexity of the case; on the other, such mindfulness makes the Municipality and the other actors involved aware of the limits and the gaps of the process so far. This is also due to the early stage of the Genoa SUL, in comparison with the others selected by partner-cities. Starting from the results, *further studies should be made* into technical aspects, such as development of sea-water coupled heat-pumps or implementation of smart grid connected tools, but especially into business models useful to trigger works in the current overall economic crisis hitting the Italian (and not only) economy, thus permitting a virtuous cycle leading to the district's transformation, job creation, energy efficiency and reduction of consumption.
A first reflection can be drawn directly from the results of the way of working (locally) on Voltri IP.
Designing projects at the Voltri district scale, the need for a database tool as a technical means to gather information with an adequate level of sophistication and functionalities, suitable for an energy dashboard (able to revise the current stage but also the drawn out forecasts) come up seriously. The use of local and detailed data, the possibility of bringing in end users for the generation of data, the opportunity to do practical applications, the report of analytics to search for better economies within scenario alternatives, are crucial points in a smart city planning process and for assessing feasibility aspects. The district's focus shows the lasting gap between, on the one hand, the designed and planned actions that could be theoretically realized and, on the other, the characteristics of the territory. A good result of the IP's preparation was the scientific preliminary assessment of local energy needs and the corresponding availability of local renewable resources. But, without an intermediate and more in depth step, able to verify the correspondence of the two sides, the potentials of the area risk not being exploited and the planning actions being programmed without a consistent background of information.

5. Concluding remarks

As shown in the paper, the project proposes a common method for implementation of energy planning measures, leaving cities free to adopt them locally by means of a tool, the Implementation Plan (IP). This, first of all, in order to shed light on the richness of diversity of urban approaches to planning, but also the criticalities experimented among partners in applying EU directives, the gap standing out between the institutional documents' urban strategies and the consequent implementation at the local level (Papa et al., 2014). The activities of the project confirm how the declination of the energy strategy in the local context, to evaluate successful aspects and lacking points, is crucial for the city government and the attention paid by the project to that issue matches the expectations of municipal administrations. In fact, a matter of scale for the correct declination of smart energy planning concerns is still pending.
To sum up: is the district scale the right one to manage the energy issue and by means of which kind of tool?
From the collected case-studies within TRANSFORM's framework (and in particular the one of Voltri), some general outputs can be underlined in order to draw concluding reflections from the methodological point of view.
TRANSFORM addressed the question of scale "by combining the district scale in smart urban labs with the level of the city as a whole – the strategic level where TRANSFORMation agenda's will be made".
Some good points can promote the district level as a starting point for smart energy thinking in an urban environment, considering that the EU promotion of the district level in energy planning is "in its infancy". In this perspective the Lighthouse Project's results will provide new and deeper an-

swers to the issue: it will finance neighborhood-level projects which demonstrate that they optimize and balance integrated measures, aiming to become a nearly zero or low energy district, integrating energy, transport and ICT sectors.
Considering a district as a portion of the city, its positive side in order to plan out energy solutions is the opportunity to have *homogeneous characteristics, derived directly from its location*. Usually, within a neighborhood solar exposure can easily be the same, the territorial altitude, the presence or not of a river or sea,… on to the features related to buildings, which often, in a proximity context, were built almost in the same years. Distinctive characteristics could allow a district to perform *certain energy strategies* that might not be supported by another, with a different layout, as seen for Voltri. For the heating and cooling system, the geographical proximity is an important input, too: for a preliminary survey, the district could be a suitable site to begin an energy exploitation feasibility study. The Genoa SUL was an adequate-sized area where it was possible to calculate the opportunities for exploitation of a water-sea-pump, considering the estimated consumptions and future needs of the limited cell of Voltri, although there are many unknown quantities derived from economic analysis. Therefore, the district, from the urban fabric point of view, can be considered as *a basic cell for thinking about interventions*. Even when, within the boundaries of the district, there are not common features, other operative sub-perimeters can be hypothesized on the basis of specific aspects that do not permit a complete homogeneity.
Also from the participation point of view, *the scale of the district accepts a direct involvement of citizens* that are sometimes still linked by ordinary and daily relationships. Moreover, in many cities, district councils are still operative and active and the leadership by the district President is admitted and acknowledged; the case of Voltri is one of those. At this scale, almost everybody knows who the key-local-stakeholders are and who the “opinion-leaders” are or the fundamental actors to get committed. The case of Voltri shows a very homogenous identity of local residents who are organized into associations where all inhabitants can recognize themselves*: for the central administration it is easy to achieve a precise map of actors*. It was a crucial aspect of the preparation of the IP, also thanks to a series of meetings held in Voltri in order to update and share strategies and local will (such as during the Intensive Lab Session, ILS).
In favor of district scale, several regeneration projects, funded by the EU, can also be mentioned. Generally speaking, for a renewal or a transformation initiative within the city, we refer quite automatically to the neighborhood level. Also from the governance point of view, the administration is used to managing interventions following the area’s needs (in dialogue with the District Councilors) and, consequently, according to their boundaries.
Nevertheless, there are many points lacking when thinking about the energy solution at the district scale: some of them, come out clearly from the case-study.
As in the case of Voltri*, the local solution does not work at all if the area and its future are not inserted in a more complex city-vision*. Starting from the TRANSFORM results, one of the most common points, observed transversally among partners, is that if the SUL interventions do not have a crucial position in the Transformation Agenda (the upper level of city strategy), the contents of the IP, even if well-designed have very few possibilities of being attained. Therefore*, a fundamental political support*, aware that the future of an existing city is made by its neighborhoods, is needed: each of them takes part in achievement of the city goals, even in the energy sector. The collaboration between technicians (able to show potentials and future scenarios) and politicians (who make consistent a general intention on local contexts) is the first suggestion which can be shared so as to put an active, programmatic city-district connection into practice.
Another *very critical point is the matter of data*, as just mentioned in the previous paragraph concerning Voltri. It is difficult to envisage a quantitative result of an energy hypothesis (for example regarding local renewable resource exploitation) at the neighborhood scale, lacking a tool where scenarios can be analyzed in a detailed territorial way (which considers geographical features, energy potentials, binding urban planning instruments and so on). *Some statistics are available at the city level but not at the district one*; and after an in-depth survey, not consolidated literature (mainly related to the design-side – Ratti and Steemers above all - rather than to the planning-one) treats this topic at the district level. For this reason, to many partners it seems to be worthwhile to develop and adopt a Decision Support Tool or an Energy Atlas or similar, in order to complete and make the tool kit, provided by the project for a correct energy planning task force, efficient.
Other remarks arose taking into account the tool proposed by TRANSFORM for district planning, its contents and its methodology.
One of the project’s objectives is transferability and dissemination towards new “environmentally virtuous” cities which want to follow the pathway led by the TRANSFORM frontrunners. The added value, replicable by followers, of a tool like the implementation plan, proposed as a unique way of implementing local designs, is questionable. The Smart Urban Labs selected by partners provided an excellent variety of urban development phases, including the transformation of brownfield sites, former harbor areas, as well as redevelopment of fully built up and living districts. In this way, a realistic sample from European cities, also covering a wide range of geographic situations and different policy making traditions,

is represented in this project. Therefore, the *template is quite general but at the same time adaptable*.

Thinking also about the case of Voltri IP, could this format be considered as a tool, or can each city foresee another more suitable to its own case?

Regarding Genoa SUL, it was quite clear that the IP template built this way is not useful to make the area advance in its process, because of the early stage of the ideas on Voltri. Some reflections on the Voltri IP are sometimes general and do not reach the real "core" of the problems that are not well deployed yet: therefore, the IP template is expected to be correctly used only when the implementation phase is really started up.

To conclude, the nature of the tool is very operative and the generic contents do not blend in with the structure of the document. *Suggesting it as a sort of "guideline" for collecting contents* (tailoring themes and technical aspects) could constitute a softer way to propose the tool to "buddy cities" not accustomed to these kinds of projects yet, without reducing the methodological elements of the IP's proposal (for instance, the suggestion to also insert obstacles and barriers concerning tax schemes and legislation that are sometimes the main reasons for inapplicability of innovative and experimental solutions).

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