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Monitoring of Sustainable Energy Action Plan in the city of Genoa

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Abstract: After the adoption of the Climate-Energy Package on 29 January 2008, the European Commission launched the Covenant of Mayors, an initiative adressed to European cities voluntary participation in implementing sustainable energy policies, aimed to improve energy efficiency, to increase RES and to reduce GHG emissions by 2020.

The City of Genoa joined the initiative in February 2009 and in 2010 submitted the Sustainable Energy Action Plan (SEAP) drawn up in cooperation with UNIGE and the Energy Regional Agency of Liguria, a key document defining the energy policies the Municipality intends to adopt in different action fields in order to pursue the Covenant of Mayors objectives.

Since it is a dynamic tool, the SEAP requires continuous monitoring for the evaluation of the actions progress, enabling a proper management and a consequent ongoing interventions adjustment in order to encourage an optimal SEAP governance from the point of view of energy and environment.

This paper illustrates the approach for monitoring the SEAP of Genoa and the definition the criteria used to assess the degree of interventions implementation, to highlight the presence of critical issues affecting the actions performance and to understand the critical situations nature and then identify possible corrections. The estimate of the results obtained by SEAP in relation to the targets set is, in fact, a key element for the success of the Covenant of Mayors and, more generally, for the success of UE environmental policies for the reduction of greenhouse gas emissions.

Keywords: EU Environmental Policy, CO2 Reduction, Sustainable Energy, Monitoring, Covenant of Mayors, Urban Planning,

1. Introduction

Global concern regarding climate change has brought several different approaches to manage and reduce greenhouse gas emissions connected with energy generation and consumption, at both global and local scales [1, 2]. In this trend, a leading role has been certainly played by the European Union, which from the first years of this century has been implementing environmental policies to face climate change scenarios and favorite low emission actions [3, 4].

Summing up briefly the steps of the engagement process by EU in the energy sector, a particularly meaningful moment was when, in 2005, was explicitly expressed the need of a shared policy at the UE level around these topics. The first result was the publication, in 2006, of the Green Paper Energy "A European Strategy for Sustainable, Competitive and Secure Energy", anticipating the exigent of a common planning on energy efficiency and RES exploitation.

In 2007 the Action Plan for Energy Efficiency for the 5-years period 2007-2012 was drawn up, containing the targets of 20% of reducing and the definition of the fields of intervention for achieving the score of reducing energy demand. In the same year, the so-called SET plan (Strategic Energy Technology plan) was promoted, a strategy dealing with the energy field new technologies to be implemented. With the 2008, the engagement of EU achieved meaningful pillars by means of fundamental instruments, such as the first was the Climate Action, which promotes strategies for all the involved stakeholders at long and short terms. Afterwards we have the 2nd Strategic Energy Review, which introduces the well-known "20-20-20" strategy.

More recently, the European Commission presented the "Roadmap for moving to a low-carbon economy in 2050" [5]. This Roadmap aims at a reduction of GHG emissions in the EU 27 by at least 80% in 2050 vis-a-vis emissions in 1990.

European choices which characterized the economic and industrial policies in these first decades of this century are running straight along the Kyoto Protocol perspective which establishes that Industrialized and Transition Economy Countries must achieve different targets of atmospheric emissions' reducing. European Union wishes to pursue these objectives through the 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 European Directives, the Member States adopted the targets, drawing up national Action Plans for the emissions reducing, since the first Two-Thousands. But in consequence of the adoption of the Renewable Energy and Climate Change Package in 2008, the European Commission reckoned to launch, at local entities scale, the initiative of the Covenant of Mayors (CoM), with the aim of sparking and support the efforts by Municipal Administrations, as the basic unit of the public administration and citizens, in the process of actualization of energy and climate change policies [6, 7]. In this way, the decisive role of municipalities in the mitigation of the main causes (and consequent effects) of climate change was acknowledged, above all taking into account that the 80% of the energy consumptions and production of CO_2 is associated to urban activities.

The CoM initiative, launched on 29th January 2008 by the European Commission, and the planning tool it promotes, the Sustainable Energy Action Plan-SEAP, is located within this framework and aimed to promote the implementation of EU commitments on the Kyoto Protocol, by means of an unilateral and voluntary participation of European cities. The Municipality of Genoa joined the initiative on February 2009 and its Sustainable Energy of Action Plan (SEAP), with the aim of a 23.7% CO_2 reduction by 2020, has been the first to be officially published by the EU Commission [8].

The SEAP is based on the results of the "Baseline Emission Inventory" (BEI), which quantifies the energy consumption of the territory for the adopted reference year, and identifies several long and short term actions in different priority areas, in order to get the expected GHG reduction. Drawing up, implementation and monitoring are the three integrated phases by which the goals of the SEAP can be achieved, through a coordinate initiative at Municipal level involving public institutions, private stakeholders and simple citizens. In this way, the SEAP turns out to be a key document for the authorities that defines the municipal energy policies and, at the same time, a dynamic tool to be upgraded and optimized on the obtained results and the benefit/cost ratio of every action in view of the compliance of the EU objectives. This can be achieved only through accurate monitoring activities allowing tracking the progress of SEAP intervention implementation. In 2014 the Covenant of Mayors Office (CoMO), in collaboration with the Joint Research Centre (JRC) of the European Commission, released the "Reporting Guidelines on Sustainable Energy action Plan and monitoring" document [9], a tool aimed to control and check the progress of SEAP intervention.

In this paper, the implementation of the JRC Monitoring guidelines and the activities concerning the SEAP monitoring actions at the University of Genoa by an interdisciplinary working group have been described.

2. Monitoring the Sustainable Energy Action Plans

Monitoring is a key component of the cyclical process of continuous improvement and refinement characterizing the SEAPs [10], conceived as dynamic and evolving tools (Figure 1).

A Sustainable Energy Action Plan in fact, after the first draft, for its implementation have to take into account changing and updating needs, the knowledge scenario and initiatives within the related Administration but, at the same time, the territory feedbacks as well as the economic and regulatory framework. In this sense, the monitoring activities are an opportunity to control processes and to recalibrate the objectives and instruments of the carried out measures.

Therefore, the SEAP implementation and monitoring result a cyclic path, in which, through subsequent stages, the local territory tends to increase its quality through a process of continuous improvement. In this way, the assessment phase deriving from the results monitoring allows to refine the strategy in the light of the occurred needs and difficulties and the development of optimum tools for the implementation of actions.

Figure 1. Cyclical monitoring process of SEAPs.

In this sense, although based on the precise and set methods from JCR guidelines, the approach to monitoring activities is suitably built for the specific needs of local administrations and, on the other hand, municipality tools are optimized and suitable for implementation of the Plan.

As stated in SEAP Guidelines [11], CoM signatories are committed to submit two documents from the SEAP submission. The first one is an implementation report containing qualitative and quantitative information on interventions in order to evaluate, monitor and verify the status of their Action Plan and its effect to be submitted every two years; the second one is an update of the CO_2 emission inventory, named Monitoring Emission Inventory (MEI), to be compared with the Baseline Emission Inventory (BEI) to monitor the progress in term of emission reductions every four years.

The CoMO provides a monitoring template for the SEAP Implementation Status, in which every measure presents new fields, compared with the SEAP submission, to be filled in such as staff capacity allocation, overall budget spent so far and monitoring process where it is possible to identify the main barriers encountered during SEAP implementation.

3. Monitoring Genoa's SEAP

3.1. Methodology and approach

In order to monitor the SEAP actions progress the updating activity of each measure has been divided into the following phases:

1. Referents revision of the Action Plan interventions within the organizational municipal structure through formal requests.
2. Referents contacts, in order to agree on timing and procedures for meetings and the request of the information needed to monitor the SEAP.
3. Technical meetings and information request.
4. Qualitative and quantitative assessment of the progress of the actions.

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The involvement of citizens was implemented as general strategy by the Genoa Municipality, based on three steps: the participation through workshop with citizens and their associations, events within the Smart strategy and, above all, the establishment of Genoa Smart City Association. During 2010, the city of Genoa, aware of the crisis and the new social challenges, began a process of transformation to the new concept of Smart City, thus contributing to improving the quality of life through the development of the concept of economic sustainability based on innovation and research, all driven by the local government in an integrated planning process.

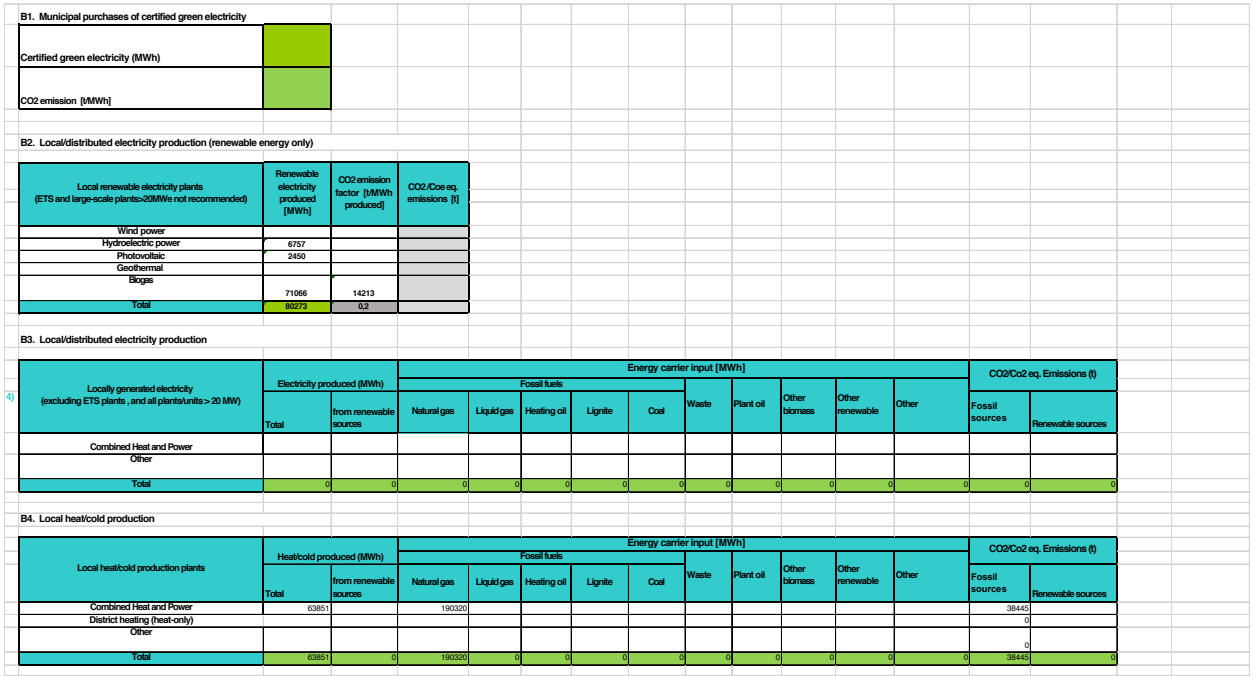
Under the Municipality leadership a fertile network of collaboration was created, involving public agencies, businesses, academics and citizenship, working together in a strategy of promotion of new theories and concepts trying to apply them in the context of a Smart City where people can lead a better life.

3.1. The Monitoring Emission Inventory

In order to monitor SEAP implementation, a "Full Reporting" document and the Monitoring Emission Inventory (MEI) (Figure 2) have to be submitted every four years in order to evaluate the energy situation of the municipality and the trend of CO_2 emissions. Just as happened with the BEI, also the MEI compilation is complex because of the difficulty in collecting consistent and coherent data. In many cases, in fact, the availability of complete data sources with the same level of aggregation (or sector) is quite impossible, thus making it necessary statistical processing or based on other indicators.

In the drafting of the Monitoring Emission Inventory, Genoa Municipality used data collection and processing tools according to a logic of governance and coordination with local organizations and individuals and seizing opportunities resulting from initiatives of local, regional and international level. As happening I several Italian Municipalities adopting different tools in support to local authorities within energy decision making [12], Genoa, trough its Energy database, intends to adopt a system of internal recognition and data systematization, strongly related with the Project Smart City "Transform" prototype software ("Decision Support Tool"), allowing a functional mapping of energy consumption of the territory and the simulation of scenarios of intervention for different sector policies programming. On the other hand, in order to optimize external resources and tools, in drawing up their inventories, Genoa used also information from the regional database, part of a wider Regional Environmental Information System (SIRA).

Figure 2. Monitoring Emission Inventory (2011)



B1. Municipal purchases of certified green electricity

Certified green electricity (MWh)	
CO2 emission [t/MWh]	

B2. Local/distributed electricity production (renewable energy only)

Local renewable electricity plants (ETS and large-scale plants>20MWe not recommended)	Renewable electricity produced [MWh]	CO2 emission factor [t/MWh produced]	CO2 /Coe eq. emissions [t]
Wind power			
Hydroelectric power	6757		
Photovoltaic	2450		
Geothermal			
Biogas	71066	14213	
Total	80273	0,2	

B3. Local/distributed electricity production

Locally generated electricity (excluding ETS plants , and all plants/units > 20 MW)	Electricity produced (MWh)		Energy carrier input [MWh]										CO2/Co2 eq. Emissions (t)	
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other		
	Total	from renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power														
Other														
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0

B4. Local heat/cold production

Local heat/cold production plants	Heat/cold produced (MWh)		Energy carrier input [MWh]										CO2/Co2 eq. Emissions (t)	
			Fossil fuels					Waste	Plant oil	Other biomass	Other renewable	Other		
	Total	from renewable sources	Natural gas	Liquid gas	Heating oil	Lignite	Coal						Fossil sources	Renewable sources
Combined Heat and Power	63851		190320										38445	
District heating (heat-only)													0	
Other													0	
Total	63851	0	190320	0	0	0	0	0	0	0	0	0	38445	0

Based on these considerations and on the governance process, it was decided to report the MEI to 2011, the year for which the Regional Environmental Information System of the Region of Liguria is able to produce complete energy balances at the regional, provincial and municipal levels, and from which it is possible drawing information on final energy consumption of Genoa territory.

In order to prepare the MEI, the Annual Consumption Finals for the year 2011 on the City of Genoa produced by SIRA has been specifically examined. These data have been then integrated and improved, for some sectors and energy sources, with data provided directly from other parties, trying to identify from time to time the most relevant sources, reliable and that can ensure continuous updating over time.

The sector with the highest energy consumption and from where the most of the GHG emissions derives is the civil one (public administration, commercial, residential and public lighting), representing the 77% of the total, against the 23% incidence of the transport sector (Figure 3 and Table 1). Regarding CO_2 emissions, the civil sector has a slightly higher weight, accounting for 79% of total emissions.

In the civil sector the leading cause of fuel consumption and emissions is due to the residential area affecting the total with a 44% amount in the case of energy consumption and 42% in the case of emissions; then the tertiary, with a weight of 27% and 31%, the public administration (5% in both cases), and public lighting (3% on fuel consumption and 4% in the case of CO_2 emissions).

Figure 3. 2011 energy consumption and GHG emission in Genoa Municipality territory

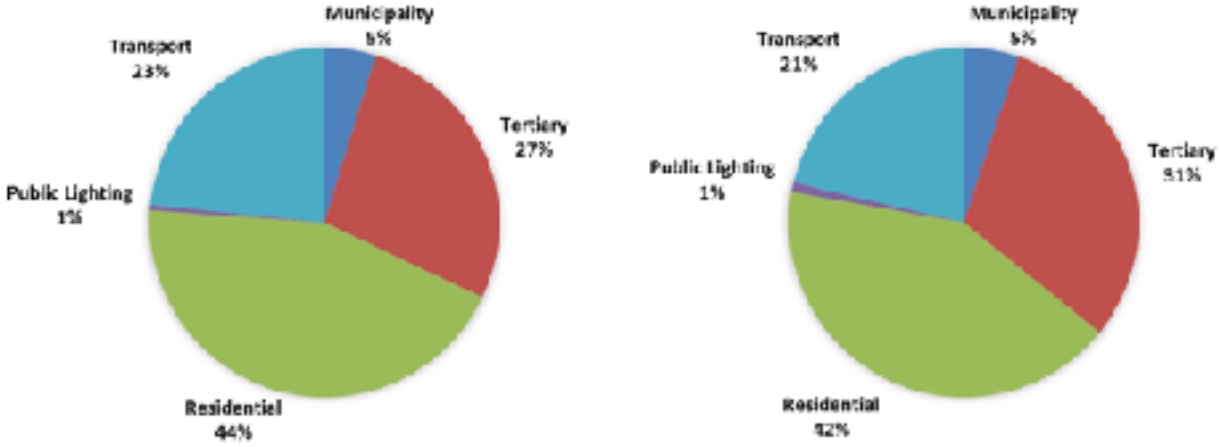


Table 1. 2011 energy consumption and GHG emission in Genoa Municipality territory

Sector	MWh	tCO_2
Municipality	335.867	100.889
Tertiary	1.942.206	609.117
Residential	3.130.950	831.458
Public Lighting	35.802	17.293
Transport	1.661.614	422.226
TOTAL	7.106.438	1.980.982

In the transport sector the percentage of consumption related to private transport (89%) is higher with respect to public transport (9%) and municipal utilities (2%); this percentage results being almost unchanged also within CO_2 emissions (Figure 4 and Table 2).

Figure 4. 2011 energy consumption and GHG emission due to transport in Genoa Municipality territory

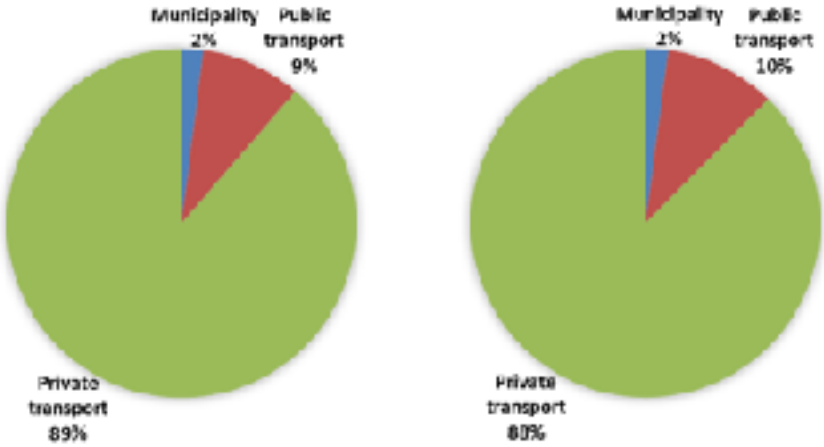


Table 2. 2011 energy consumption and GHG emission due to transport in Genoa Municipality territory

Sector	MWh	tCO_2
Municipality	33.493	8.836
Public transport	154.602	43.595
Private transport	1.473.519	369.795
TOTAL	1.661.614	422.226

4. Monitoring the Sustainable Energy Action Plans

The SEAP actions monitoring has been conducted with an approach designed to define both the progress of single actions and its environmental monitoring. In particular, the action progress analysis consisted in for the improvement verification updated to 2014 of the SEAP interventions, both qualitatively through the definition of eight classes (not started yet, in definition phase, started, in progress, advanced, completed, postponed, canceled) and quantitatively through progress percentages.

On the other side, the environmental monitoring concerned the estimated energy savings and the associated reduction of CO_2 to 2014 due to each action, as required by the JRC Monitoring Guidelines. In addition, where possible, values of energy production from renewable sources have been shown.

It should be underlined that the percentage allocation of CO_2 savings was conferred by assessments differing from case to case, in order to preserve the uniqueness of cases and the specificity conducted estimates. This allowed highlighting the presence of critical issues affecting interventions performance and, by means of the comparison between the progress and the environmental monitoring, to better understand the nature of the criticalities and then identify possible corrections or incentives.

The variety of monitored actions can be attributed in general to some typical situations. In some cases, actions progress can appear at an advanced stage, but the CO_2 reduction imputation is still equal to 0, because of the expected benefits will be activated with the commissioning. This is typical of infrastructural interventions, which also require the convergence of other actions to work at full performance. Another case is when CO_2 allocation is corresponding to the progress percentage, i.e., with regard to plants intervention actions, where the implementation immediately leads to the savings achievement. Finally, in the case of actions which cannot be monitored through numerically feedback, the action progress coincides with their CO_2 attribution, as in the SEAP drawn up these interventions provide an added value to the whole process and therefore their own presence contributes (indirectly in reality, but directly in the calculation) to reach the final target.

Moreover, in the case of actions to be redefined, points not equal to 0 have been assigned in the progress status where some alternative hypotheses have already emerged in the internal comparison to the administration. This has been done in the belief that preserving the sustainability objective of the plan, it is possible and adequate, in some cases, proceed with a relocation of the initiatives on the occasion of funding or new perspectives not yet present in the early stages of the SEAP preparation.

It is noted that the allocation of the CO_2 saving, in many cases, is the result of deterministic algorithms (even if calculated from estimates and approximations), in others a mixture of deterministic methods, also through tools simulation, and in others on the basis of examples from the literature or derived from observation of urban governance dynamics.

According to the innovative nature of the SEAP tool, the carried on monitoring activities stands out for its experimental nature, requiring a continuous monitoring in terms of scientific content and methods proposed.

Regarding the progress of Genoa's SEAP actions (Table 3), almost all of the interventions have been completed, started or, at least, defined. During the monitoring activities critical issues emerged, related to interventions no longer valid due to updates of administrative policies or extreme difficulty in the implementation, making necessary for some actions to be deleted. Plus, four actions related to local electricity production at the end of 2014 still not started mainly due to technological hurdles and realization extreme difficulties.

Table 3. Genoa's SEAP actions progress.

No. of actions	Progress state
4	Not started yet
13	In definition phase
15	Started
18	Ongoing
11	Advanced

18	Completed
6	Postponed
2	Canceled

In general, difficulties or delays in actions implementation are due to:

- procedural factors, such as appeals in tender procedures,
- boundary conditions, such as funding lack or market change (i.e. the decrease of electricity costs impacted of district heating and cooling interventions)
- difficulty in activating governance process, related to the retrieval of data, the involvement of the sector operators and sometimes inherent in the complexity of the action;
- need to raise awareness and create awareness on technological opportunities, processes that necessarily cannot be achieved in a very short time.

Concerning in particular the Building sector (EDI) actions, the monitoring activities showed them as generally in good progress: the short-term measures at least all started and several results completed (energy audits on municipal school buildings and conversion of fuel oil building plants) and long-term ones are mostly in definition phase.

The analysis of the progress of Public Lighting actions (ILL) shows almost the conclusion of the traffic light lamps replacement, while for energy efficiency measures on public street lighting systems results to be slower because of funding lack.

Regarding Transport actions (TRA), they generally present a discrete progress: most of the actions are in fact started, ongoing, advanced and completed. Three actions have been postponed and two deleted, because of the extreme difficulties in the realization of the interventions. It should however be specified that the total mobility system emitted, in recent years, smaller quantities of carbon dioxide in respect of foreseen trends and also less than implied on the basis of actions contents implementation.

Actions related to the Local Electricity Production of (PEL) show the conclusion of several short-term measures. Among the long-term interventions, thought, some interventions in general seem difficult in starting, due to 2011 and 2013 flood issues or the nature of new technology (i.e. hybrid solar panels, offshore wind platforms).

As for the district heating and cooling sector (DIS), interventions present a sharp slowdown in respect to the trend expected during the SEAP writing. In fact, in recent years, due to the decrease in electricity cost, the construction of new cogeneration plants results not to be as convenient as in 2009.

Genoa Municipality's planning activities (PT) has been, on the other hand, particularly fruitful: the long process of the City Urban Masterplan reached in 2014 its conclusion (also associated with the Green Urban Plan directions) and the mobility and traffic issues proceed through the Mobility and Traffic Management Urban Plans updates.

About the Public Procurement (PRO), the Municipality has also continued its commitment with regard to green purchasing of goods supplies and services.

As regards Participation and Awareness actions (PIN), many communication actions to citizens have been performed in collaboration with Smart City and Education Sector or within the European Energy Week.

5. Conclusions

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