

The Integrated Project of an Energy and Sustainable Community as an Input for Urban Regeneration and Development

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Abstract. Today the ways in which urban regeneration and development planning is tackled are an important aspect to reflect on to manage a sustainable urban growth scenario. European impulses to counter the effects of climate change and recent Local Authorities reforms have paved the way for the definition of flexible tools to foster a multi-level governance. This paper presents the policymaking process for the Sustainable Development Agenda of the Metropolitan City of Cagliari (Italy), as a continuous process of contextualisation of the SDGs and discusses the institutional context for promoting integrated projects for sustainability as an opportunity to agree mutual commitments and obligations for their implementation. A decision support tool based on the cognitive mapping technique together with specific selection criteria allow to build several clusters, representative of embryonic forms of integrated projects for sustainability. An integrated project for an energy and sustainable community will be started to test the method, as a starting point for the activation of initiatives of an aggregative nature, starting from subjects who have the ability to operate independently in the field of production and more rationale use of energy: They also can make an important contribution to initiating a broader change in behaviour in the use of spaces and in the management of services.

Keywords: Urban regeneration and development planning · energy and sustainable community · Metropolitan Agenda for Sustainable Development · integrated projects for sustainability

1 Background

An important aspect to reflect on are the ways in which development planning is tackled today. The European institutions have allocated a substantial part of the EU budget for the promotion and development of a common policy for the improvement of cities and social life, as, in the coming years, cities will play a crucial role in responding to

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the effects of climate change and prevent any kind of emergency [1, 2]. While the S3 Smart Specialization Strategies are being implemented, the upcoming S4 + strategy "Smart Specialization Strategies for Sustainable and inclusive growth" foreshadows a new perspective of urban and territorial growth based on the potential of places [3].

In line with the European Green Deal, the S4+ strategy proposes a model of urban growth that emphasizes sustainability in a socio-environmental context based on the capacity of places to express their potential in terms of benefits, rather than a context with a strict socio-economic characterization, as understood in S3. This model offers strategic perspectives to less developed or central cities and regions throughout Europe, especially to low-density settlement territories, where size and environmental quality are constitutive elements of their organized life. Among the measures of the GDE, the Just Transition Fund, goes precisely in this direction: it will co-finance sustainable initiatives in the most backward and vulnerable regions, those that could suffer huge losses in the transition from obsolete production models to more sustainable ones [4].

The metropolitan one represents the optimal dimension for experimenting with integrated interventions toward sustainability. In 2019, the MAATM (today Ministry of the Environment and Energy Security – MASE) launched a process of collaboration and support to the 14 Italian metropolitan cities for the definition of the Metropolitan Agendas for Sustainable Development[1]. The aim is to implement the Sustainable Development Goals (SDGs) at an urban and metropolitan level and, at the same time, place the interventions in a context made up of several levels of government. The metropolitan Agenda for sustainable development is intended as a device for the orientation and integration of planning and programming tools towards SDGs: this device is functional to "strengthen and qualify the attention towards sustainable development within the Metropolitan Strategic Plans, with a view to full integration of all the dimensions of sustainability in the metropolitan planning, programming and management tools."[2]

In this perspective, the path started by the Metropolitan City of Cagliari (CMCA) for the definition of the Agenda represents a process of experimentation of a modus operandi for the implementation of the sustainability goals and, in this sense, aims at the construction of a model of a sustainable urban growth for the metropolitan area: the sustainable metropolitan infrastructure, as a new urban and territorial organization oriented towards the principles of sustainability. The Agenda translates the SDGs and principles into shared guidelines for urban planning and implementation tools and provides the methodological elements for identifying and promoting integrated projects for sustainability, as an opportunity to agree on mutual commitments and agreements among stakeholders for their implementation.

2 The Policymaking Process

The methodological path that led to the definition of the Agenda is a continuous process of contextualization of the sustainable principles and goals divided in two main moments, according to the following steps (Fig. 1).

[1] Art. 34 D. Lgs. 152/2006 e s.s.m.m.i.i.

[2] *Ibid.,* Art. 1 p. 4.

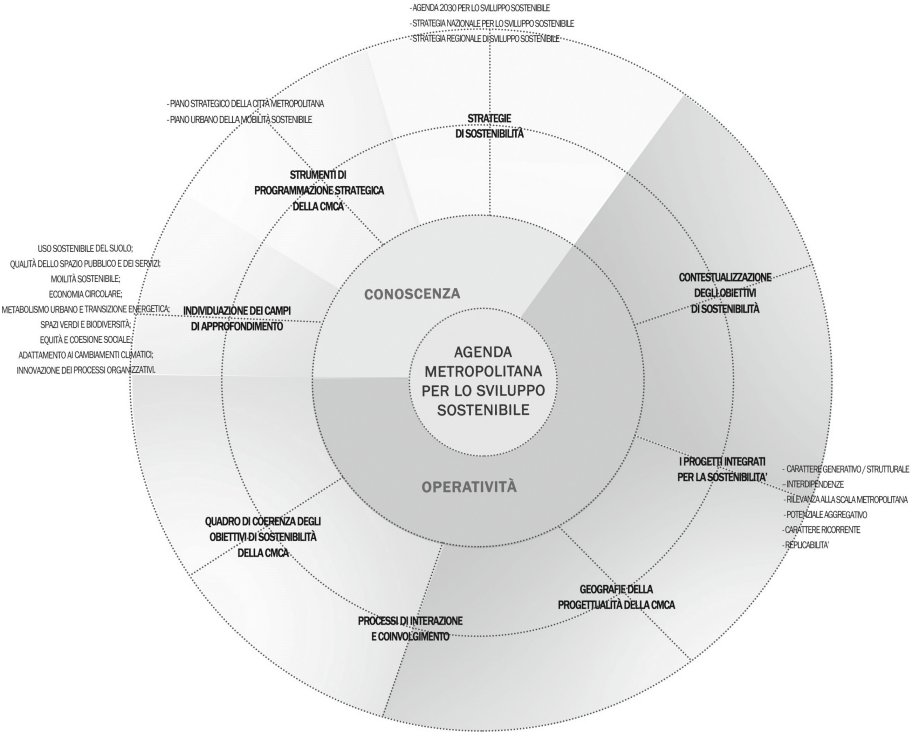


Fig. 1. The basic steps of the policymaking process

2.1 Construction of a Shared Reference Framework for Knowledge Management

The first step aims at the construction of background knowledge from the superordinate sustainability tools and strategies. To this end, a device has been developed with the aim to organize the body of knowledge and allow the single and cross-reading of sources.

For our purposes, we compared extra-territorial and territorial strategies for sustainable development, such as the 2030 Agenda, the National Strategy, the Sardinian Regional Strategy, and the strategic planning tools of the CMCA, such as the Strategic Plan and the Urban Mobility Plan Sustainable. To broaden the spectrum of principles and emerging perspectives on sustainability, the cognitive framework takes into consideration the "Bologna Charter for the environment: metropolitan cities for sustainable development", the Urban Agenda for EU, and other experiences, such as the sustainable development model of Urbanismo Ecosistémico [5] developed and tested in Spain.

However, this analysis aims to return a unitary and homogeneous synthesis of the main contents of the different tools, to overcome the fragmentation, the diversity of scale and terminology of the different tools, programs, and strategies (Fig. 2).

2.2 Construction of the Interpretative Model

The next phase of the work focuses on the construction of an interpretative device that guides the strategic vision of the Agenda.

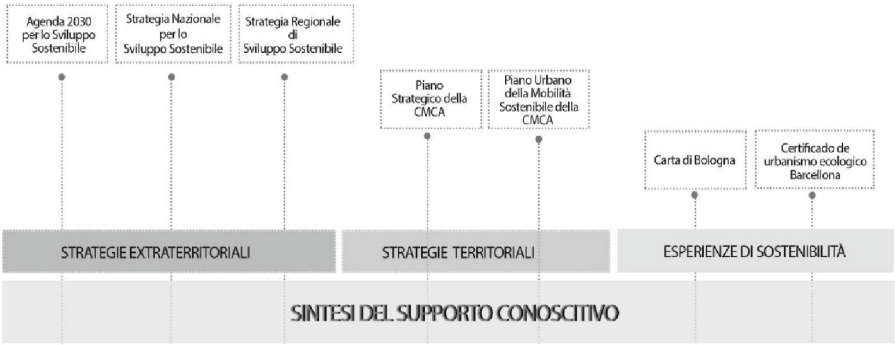


Fig. 2. The reference framework: initiatives, programs and strategies for sustainability

The contents of the cognitive framework, i.e. the set of themes, objectives and related operational guidelines, emerging from extra-territorial and territorial sustainability strategies, have merged into nine "fields of action" which are the operational lens of the methodological device of the Agenda.

Note that the fields of action are to be understood as thematic in-depth areas of supra-municipal and metropolitan interest. They are characterized by resources, uses of space and social practices to which a precise relevance is recognized in relation to a common metropolitan sustainability-oriented strategy. In this sense, the communication and involvement processes of the metropolitan city technostructures and local institutions have been launched around the fields of action.

At the end of this process, 9 thematic in-depth areas are identified to focus on future territorial and urban transformations: *sustainable soil use*; *quality of public space and services*; *sustainable mobility*; *circular economy*; *urban metabolism and energy transition*; *green spaces and biodiversity*; *equity and social cohesion*; *adaptation to climate change*; *organizational process innovations.*

More specifically, through the analysis of the programmatic documents and planning tools in force at local and supra-local level, some "relevant aspects" for the metropolitan city have been identified for each field of action. These relevant aspects, together with some guidelines and lines of action, act as a starting point for the discussion with the (technical/political) delegates of the municipalities and with the different sectors of the Authority. The output is the construction of the CMCA geography of sustainability-oriented urban planning and an initial expression of the contextualized sustainability goals for the metropolitan city.

2.3 The CMCA Geography of Sustainability-Oriented Urban Planning

The participatory process involved local institutions, local stakeholders, and citizens. The activation and dialogue activities were carried out with the delegates of the 17 Municipalities that constitute the Metropolitan City of Cagliari. Each Municipality has identified the participant according to the "field of action" in discussion, identifying the most qualified (technical/political) referent in relation to the local urban planning. 8

meetings (5 workshops) developed around 9 thematic in-depth areas resulted in almost 130 projects collected[3].

The geography of sustainability-oriented urban planning that emerges from the technical panel with the Municipalities aim to collect information and interpret the local structures in relation to problems, opportunities, actions, places, etc. and start a systematization and evaluation of the planned actions, funded or not, aimed at outlining possible interdependencies among the projects and strengthening the synergistic effects between the single actions. The delegates of the CMCA sectors, gathered in a Board Committee, contributed to the construction of the geography of the metropolitan urban planning. They are encouraged to collaborate with the aim of recognizing the interdependencies between the activities in progress and becoming aware of the added value brought about by the synergies.

Therefore, in addition to contextualize the SDGs, the geography of the sustainability-oriented urban planning represents the knowledge basis for the subsequent step of identifying integrated projects for sustainability.

3 A Policymaking Tool: The Integrated Projects for Sustainability

Operationally, through comparison criteria and a policymaking tool, the authors carried out an overall reading of the metropolitan sustainability-oriented urban planning that emerged from the comparison with the delegates of the municipalities and the CMCA sectors. This activity flowed into the identification and representation of some groupings of urban planning actions and projects which were shared and discussed by the CMCA Board Committee. In other words, the groupings of the identified projects are the germs of the integrated projects for sustainability and the inputs for discussion and further exploration through an interaction between experts and stakeholders.

The technique of cognitive maps was used to construct and represent goals, actions, problems, key concepts, options to structure the groupings of projects. For our purpose, the authors have tested cognitive maps technique through a cognitive mapping software. Banxia Decision Explorer®[4] allows to prompt the development of a model[5] by highlighting *values, beliefs, and assumptions an individual has about a particular issue* [6], and so it captures not only knowledge about the background context but also the possible relationships between the concepts and the underlying motivations.

More specifically, a cognitive map is made up by nodes representing constructs - options, facts, goals and so forth, which are also linked to each other by arrows, to form action-oriented chains of argument. Such maps are often structured in a way that identifies values, aspirations, aims and goals at the top, and more detailed options and actions for achieving those goals at the bottom. Moreover, links are inserted between

[3] The meetings took place from October 2021 to March 2022 in presence and remotely, in relation to the provisions on the pandemic emergency.

[4] Banxia Decision Explorer Software Decision Explorer (1990), 3.3.0 academic v., Banxia Software ltd., Kendal, UK (web site: <http://www.banxia.com>).

[5] The technique of cognitive maps is based on G. Kelly's "Personal Construct Theory" which maintains that subjects see the world through a clear model formed by "constructs", and the personal construction system constitutes people's "construct space".

constructs to indicate that one construct "causes" or "may lead to" another one. Note that a chain of argument starts with a "tail" concept and ends with a "head" concept. Tail concepts represent triggering events or initial causes or "drivers" of change, such as action possibilities that could lead to more or less desirable outcomes, while head concepts represent "end states" or "aspirations". Moreover, different styles of font, font size and colour are used to distinguish between and display different kind of constructs, such as goals, strategies/issues, options/assertions, agreed actions and analyses results.

Aided by facilitators, participants at the meetings and workshops are prompted to list actions and projects for attaining the sustainable goals related to the "field of action" in argument and discussing some of the cause-effect connections between many of them. This involved asking participants questions like "how?" and "why?", both to elicit the issues and to draw the network of interconnections among them. A "how?" question allows the workshop to explore subjective points of view that are unexpressed and latent, whereas a "why?" question elicits the consequences of a particular action or point of view, along with ends and outcomes. Asking such questions is named process of "laddering". To give an example, with reference to the thematic area "mitigating hydraulic and hydrogeological risk", the "construction of retarding basins" makes it possible to "reduce the run-off time and collect rainwater".

Decision Explorer® software allows to perform several analyses for highlighting key issues in the model, by using for example cluster analysis, domain analysis and centrality analysis[6] [7–9]. Yet, the analysis of the "clusters" allows us to define the areas of interest or thematic areas that emerge from the model.

Afterwards the authors tidied up the maps and built up the model's hierarchy, by identifying and discussing what concepts seem to be actions (blue), goals or objectives (red), what seem to be key issues (yellow/red), and what appear to be the agreed actions to achieve the latter (square) (Fig. 3).

Yet, in the systematization phase, the following criteria guided the definition of the groupings of actions/projects:

- *generative / structural character*: capacity to trigger other projects in the same and/or other fields of action;
- *interdependence with other projects or fields of action*: capacity to establish relationships with other sectors and to produce synergistic and multiplier effects of individual initiatives;
- *relevance on the metropolitan scale*: capacity to pursue sustainability goals in relation to the context;
- *aggregating potential, in terms of social and institutional energies*: capacity to build links and aggregations between stakeholders with widespread interests on relevant issues (water, waste, energy, transport, etc.) starting from local conditions; ability

[6] The latter, on the one hand, give an indication of the importance of some fundamental themes within the model and, on the other hand, highlights the necessity of further tests on less represented constructs. Domain analysis gives us an indication on the complexity of each elementary point of view in the whole model, by calculating "density" of links. By contrast, centrality analysis allows to explore the complexity of each theme in the whole model, by calculating how many links it forms with other issues in more than one level from the centre. The higher the score in both analyses the more significance the issue has into the model.

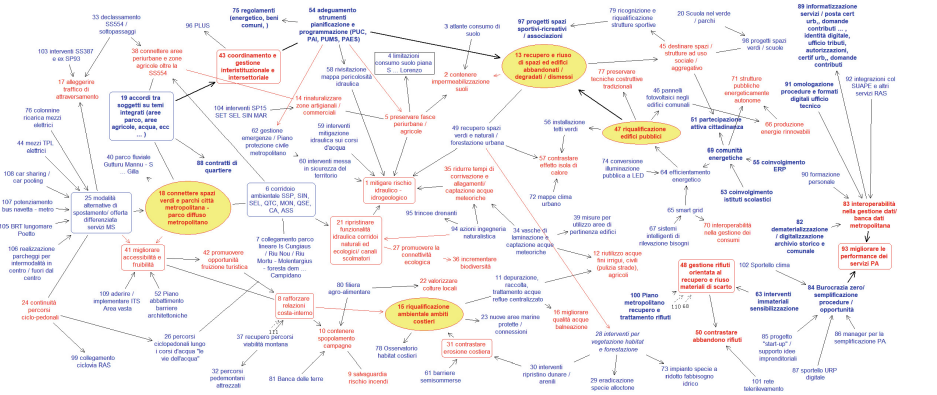


Fig. 3. The cognitive map of the projects expressed by the CMCA municipalities**.**

to bring out subjects who could act autonomously and who can make an important contribution to the activation of the project;

– *recurring nature*: capacity to be repeated frequently in different territories of the CMCA to respond to widespread problems or offer specific services;
– *replicability*: capacity to be repeated in different territories of CMCA without major modifications.

The first groupings of interventions are embryonic forms of integrated projects for sustainability, organized into thematic areas. The thematic areas allow, on the one hand, to contextualize, spatializing them, the sustainability goals and, on the other hand, they are the inputs for discussion and further exploration through an interaction among CMCA sectors delegates, experts and stakeholders with the aim to define an integrated project for sustainability. Therefore, since the aim of this phase is to reveal the possible interdependencies among projects, the delegates of the CMCA Board Committee were invited to make explicit the ways of acting and the related problems, both from the point of view of procedures and specialist skills, and to identify and exchange good practices and experiences.

The first 5 integrated projects for sustainability are:

1. *Project of connections between green spaces and parks of the Metropolitan City of Cagliari. The interconnected metropolitan park;*
2. *The urban and environmental redevelopment project of the metropolitan coastal system;*
3. *The energy and sustainable community project through the redevelopment of public spaces and buildings;*
4. *The integrated waste cycle project;*
5. *The P.A. performance improvement project.*

In this perspective, the integrated projects for sustainability aim at stimulating collective action between the sectors of CMCA and between CMCA and the Municipalities and, around these, build consensus and the progressive definition of agreements

among stakeholders for their implementation, on the example of the River Contracts[7], Agreement Programs[8], *etc.*

They are the fundamental elements of a new urban and territorial organization oriented towards the principles of sustainability, the sustainable metropolitan infrastructure. The next step is to focus the attention on each integrated project for sustainability to define shared guidelines for urban planning and implementation tools.

4 The Integrated Project of an Energy and Sustainable Community in a Pilot Area of the Metropolitan City of Cagliari

The last phase of the planning process proposes to implement the "Integrated project of an energy and sustainable community" in a pilot area of CMCA (Fig. 4). The project arises from the grouping of two main thematic areas. The first thematic area concerns the "Recovery, energy requalification of public buildings and structures", which has as its key objective: "Make public structures and facilities energetically autonomous". It refers to the actions financed by the tender on the energy efficiency of public buildings promoted by the POR FESR 2014–2020[9], which concerns the energy efficiency of municipal buildings and the production of energy from renewable sources and smart grids for energy distribution.

Another action characterized by a high *recurring nature* in the metropolitan area concerns the "Integrated and smart management of public lighting systems", both as regards the arrangement of new lighting fixtures with LED technology (*relamping*), and as regards the renovation of the networks and energy supply infrastructures (*revamping*), promoted by Axis 2 - PON Metropolitan cities 2014–2020. The second thematic area concerns "Social and aggregative renewal and reuse of abandoned, degraded, disused spaces and buildings", and assumes as its key objective "Allocate spaces and structures for social / aggregative use", promoted by specific call for tenders. From the input of the energy efficiency, the integrated project for sustainability outlines a perspective in which single interventions of a punctual nature, considered by the referents themselves to be of strictly local importance, foster the development of new configurations, rules and behaviours. Note that they don't concern only the reduction and the conscious use of energy, but also unfold towards new forms of shared management of spaces and services to be recovered for the community.

4.1 Selection of the Pilot Area: The Terramaini Area

The pilot area is essential for experimenting the effectiveness of the method. The elements that guide the selection of the Terramaini as a pilot area can be summarized mainly for its relevance in the metropolitan area.

Firstly, the strategic importance in term of the environmental landscape is recognized at different scale levels by the special management tools and by the municipal and

[7] Art. 68 bis D. Lgs 152/2006.

[8] Art. 205 D. Lgs 152/2006.

[9] Asse Prioritario IV. "Energia sostenibile e qualità della vita" - Azioni 4.1.1.-4.3.1. http://www.sardegnaprogrammazione.it/.

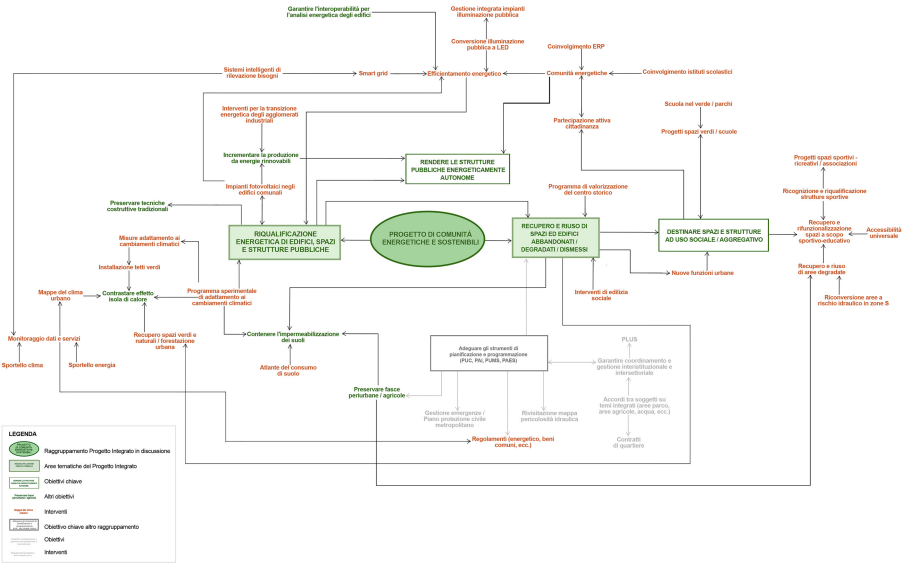


Fig. 4. The cognitive map of the integrated project for a "renewable energy and sustainable community"

metropolitan planning tools. It is, in fact, the "green wedge" defined by the Regional Landscape Plan of Sardinia as a connection system between the north-western bank of the Molentargius Pond, the Municipalities of Cagliari, Pirri and Monserrato up to the agricultural belt. Furthermore, the proximity to the Molentargius-Saline Natural Park, characterized by different levels of protection, suggests integrated policies for the enhancement and a distinct use of the area as a whole: the process starts from the school district and involves gradually other services, including the Terramaini park and the public sports facilities (Fig. 5).

Secondly, the projects planned for this area have a metropolitan relevance with supra-municipal effects in terms of sustainable development: the creation of an energy district, which involves the secondary schools in the area under the jurisdiction of CMCA, and a sports hub, which envisages the creation of a network of paths, watercourses, wetlands and vegetated areas to compose a new park system. These are supported by other projects, such as the "Restoration of the Waterways", which plans the canal navigable and usable with paths and charging stations for electric boats.

Thirdly, this area is a catalyst context for social and institutional energies to test self-organization formulas due to the presence of a highly specialized school complex[10]. Note that various learning communities and numerous sports associations enjoy the use of the area and manage spaces equipped for different sports (hockey, rugby, basketball, padel, football, *etc.*), including a municipal swimming pool and a nautical club. The

[10] The school complex is composed of: the "I.T.I. Marconi" Industrial Technical Institute; the "ITC Besta" Commercial Technical Institute; the "Vittorio Emanuele" National Boarding School; the "S. Pertini" Professional Institute for Social Services; the "ITI Scano" Industrial Technical Institute; the "Pietro Martini" Economic Technical Institute - Monserrato Headquarters; the Artistic and Musical High School "F. Fois"; the "Da Vinci" State Technical Commercial Institute.



Fig. 5. The Terramaini pilot area

active involvement of these users in the integrated project for sustainability can be seen in terms of *communities of practice* [10, 11], i.e. different paths linked to practices for experimenting with initiatives useful for satisfying collective needs: at the local level, in terms of communities of users, to define shared contractual regulation formulas for the use and the management of spaces and services and, from these, self-organized formulas for the sustainable use of resources (electricity, water, waste, etc.); at the metropolitan level, in terms of dissemination of good practices.

Finally, the integrated project for sustainability begins with the sharing of energy and extends to the sharing of other sustainability values and resources, triggering regenerative policies with a strong enabling character in terms of cooperation, collaboration and subsidiarity between different subjects. In this sense, it is precisely the local communities and their differences that allow global SDGs to be contextualized.

4.2 The Renewable Energy Communities. Prospects of Activation in the Metropolitan Context

Starting from 2016, as part of the so-called "Clean Energy" package, the European Commission has attributed to energy consumers a central role in the transformation processes of the energy markets. In the current scenario that looks to the reduction of CO2 emissions and control over the elements that govern their price, civil society is urged to participate actively and consciously in rethinking the energy system.

The EU Directive 2018/2001 introduces a governance model defined the "Renewable Energy Communities" (RECs) with the opportunity of energy sharing among its members[11].

Renewable energy communities are defined as legal entities made up of natural persons, small and medium-sized enterprises or local authorities, including municipalities, which on a voluntary basis, through the use of the already existing public distribution network, come together to produce and consume renewable energy. Furthermore, members can actively participate in the various phases of the energy production and management process as well as the economic resources provided by the incentives for the part of shared energy and possibly for the excess which must be minimized in favor of the first. These are based on a decentralized and widespread model in the areas of energy production and consumption.

Some technical requirements are binding for obtaining the incentives but, at the same time, they influence the geography and composition of the RECs. The renewable source plants must not exceed the power of 1 MW and the energy must be shared between plants and energy consumers connected to the same primary transformer station. If, on the one hand, the technical issues define standard constraints and requirements to be considered in the establishment and identification of the RECs, on the other hand, the shared purpose of the members must not be the generation of financial profits but open up new prospects for the territories depending on the diversity and specificity of the community and the places of their actions.

In addition to achieving environmental, economic and social benefits for the members of the Community and local context, RECs must trace a generative trajectory in terms of shared values and objectives. It shows a strict correlation with the concept of community: the "Manifesto of the Energy Communities for an active centrality of the Citizen in the new energy market"[12], promoted by the Energy Center Lab of the Turin Polytechnic,

[11] In Italy, the Directive was implemented with Legislative Decree No. 199 / 2021 and at the end of November 2022 the observations of the Implementation Document were published.

[12] "Manifesto. Le Comunità Energetiche per una centralità attiva del Cittadino nel nuovo mercato dell'energia". Energy Center Lab, Politecnico di Torino, giugno 2021. https://www.energycenter.polito.it/le_comunita_energetiche.

which places the accent on the local aggregation process activated in a REC through the innovation in the way of generating, consuming and managing energy and on the new opportunities for the users of the Community services, citizens and local contexts on which the effects of the activities and projects of the community are experienced.

From the comparison of experiences of RECs already active in Italy and Europe[13], the absence of a standard community model emerges. On the contrary, the diversity of experiences denotes the specificity of the local contexts and the centrality of individual or collective figures who, through awareness-raising and involvement actions, configure themselves as real "community animators". In the constitutive events of the RECs in Italy, as well as in Germany, Great Britain, Spain, *etc*., these figures often coincide with local administrators, sometimes stimulated by local entrepreneurs or university institutions as in the case of Magliano Alpi, the first Italian energy community.

There is no shortage of cases in which the citizens themselves activate the RECs, involving the municipality in a subordinate position: is emblematic of the experiences of the North Kensington Community Energy (NKCE)[14] made up of 144 members of different ethnic groups. In any case, the local authorities are the key figures in the processes of creation and activation of new subjects. This role is recognized by the different measures and sources of funding at national and regional level, which promote and incentivize the development of ERCs, directing funding to municipalities and public bodies.

In summary, a Renewable Energy and Sustainable Community (RESC) is founded on some Constitutional principles (art. 118 [12]). These are crucial for the activation of the principle of *subsidiarity*, the both vertical and horizontal, which concerns the collaborative relationship between public administrative bodies and citizens, including even private individuals; the principles of *adequacy* and *differentiation* concerning the definition of agreements, contracts, regulations, must take into account the different natures and complexities of the subjects involved, in terms of the roles they can assume and the contribution given for the management of the community, both as support to the territory; the principle of *autonomy* concerning the recognition and enhancement of the free initiative of citizens, especially in the forms of associations, for activities of general interest. In addition, there are conditions that strengthen the sense of community, such as: *mutual trust*, which goes beyond the rules and authorisations; solidarity, inclusion and equity, with particular attention given to disadvantaged subjects and contexts; responsibility, with particular attention given to the subjects who have a coordination and guidance role to support the associative thrusts of the stakeholders.

Starting from these elements, the energy district of the Terramaini area fosters new forms of cooperation, collaboration and subsidiarity between the "activator of the Community" (CMCA) and the users of the surroundings services and facilities of the energy district: the school communities and the sports associations.

[13] https://www.interregeurope.eu/sites/default/files/2021-12/Policy%20brief%20on%20renewable%20energy%20communities.pdf; https://www.legambiente.it/wp-content/uploads/2021//11/Comunita-Rinnovabili-2022_Report.pdf.

[14] https://www.interregeurope.eu/good-practices/community-energy-england.

5 Guiding Requirements for a Sustainability-Oriented Planning by the Integrated Project in the Pilot Area

The integrated project of the Renewable Energy and Sustainable Community of Terramaini makes it possible to further specify the SDGs from the metropolitan context to the specific one, to provide a level of direction and guidance for the actions.

Firstly, the integrated project is articulated through a set of operational key objectives referring to the Terramaini pilot area, which define the reference scenario.

Secondly, the integrated project outlines the types of *actions* to achieve the key objectives. They are divided into *activating* and *complementary actions*, according to their potential in guiding transformations. Yet, the actions are defined in relation to the specificities and uses of the local context. The actions concern: physical spaces, infrastructures and services; usage behaviors and ways of living; methods of collective organization and forms of organized action.

Thirdly, the integrated project focuses on the formulation of context-oriented "*project attentions*", as guidelines useful for guiding actions towards the reference scenario of the RESC. They are expressed in the form of operational and procedural guidelines for the implementation of the actions, which incorporate and pursue sustainability principles and objectives according to the characteristics of the local context (Fig. 6).

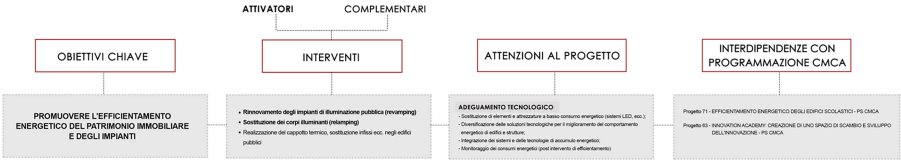


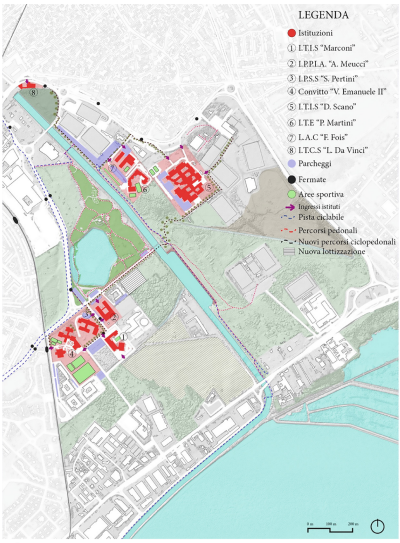
Fig. 6. Framework of the integrated project structure

The articulation of the integrated project reveals the will to foster transversal relationships among fields of action for sustainability (from the energy transition to environmental redevelopment, to the regeneration of urban spaces and facilities, to the improvement of their accessibility and usability, to the launch of forms of collaboration for the management of resources and services, *etc.*). Further interdependencies and opportunities can be traced by comparing them with other projects and initiatives in the metropolitan area.

5.1 Activation of an Energy and Sustainable Community in the Pilot Area of Terramaini

The institution of a renewable energy and sustainable community suggests some basic *spatial, technical-infrastructural* and *organizational* requirements. They involve different aspects in relation to energy sharing and technological and infrastructural adaptations, such as: relationships between subjects, procedures, regulations, relationships between planning tools and levels of government.

In the specific case, through the school energy district, the various upper secondary schools of the Terramaini learning district are experimenting with a model of self-consumption and shared management of energy. In other words, this represents the starting point to trigger the broader and more ambitious process of an energy and sustainable community. The integrated project outlines the ways to evolve towards the



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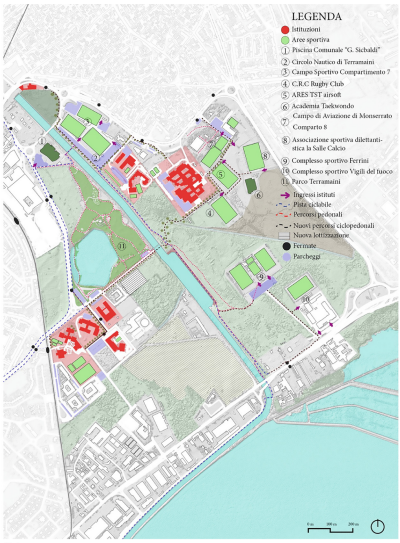


b)

OBIETTIVO CHIAVE Incrementare la produzione di energia da fonte rinnovabile

INTERVENTI Realizzazione **nuovi impianti di produzione dell'energia rinnovabile nelle scuole**

ATTENZIONI AL PROGETTO

Condivisione energetica e adeguamento tecnologico e infrastrutturale

- **generazione distribuita** da fonte rinnovabile destinata all'autoconsumo;
- **dimensionamento degli impianti** finalizzato a favorire **autoconsumo e condivisione delle eccedenze energetiche**;
- installazione di servizi e dispositivi alimentati elettricamente (es. colonnine di ricarica elettrica automobili, pensiline intelligenti, segnaletica allertamento meteo, videosorveglianza);
- implementazione, programmazione e attuazione delle prescrizioni relative alle autorizzazioni sugli immobili frequentati dal pubblico (es. certificati prevenzione incendi, agibilità ecc.);
- verifica vincoli normativi e possibilità offerte dalla semplificazione amministrativa per l'installazione di nuovi impianti

OBIETTIVI CHIAVE

- **Recuperare, riqualificare e rifunzionalizzare strutture e spazi pubblici in nuovi servizi ad uso sociale-aggregativo e sportivo-educativo**
- Valorizzare il potenziale aggregativo e associativo del patrimonio pubblico

INTERVENTI

- **Riqualificazione** funzionale **strutture sportive di** Terramaini e loro integrazione in **polo sportivo metropolitano**
- **Impiego di spazi scolastici per usi sociali ed aggregativi**
- Riqualificazione e rifunzionalizzazione di edifici pubblici dismessi in spazi ad uso sociale ed aggregativo

ATTENZIONI AL PROGETTO

Diversificazione offerta servizi e funzionamento integrato

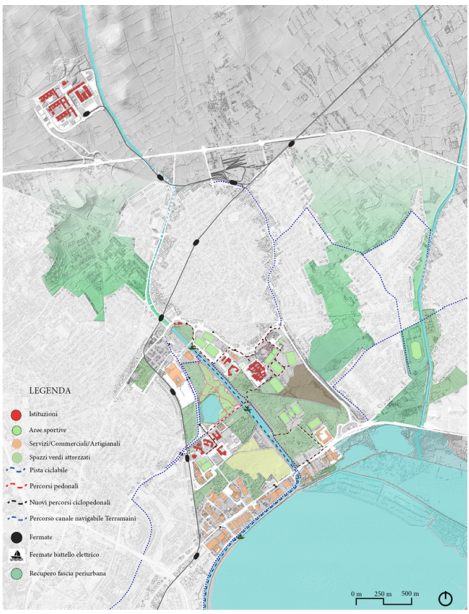
- **offerta di servizi diversificata, integrata e diffusa** sul territorio anche **differenziata nel tempo**
- **uso integrato e combinato** di **impianti sportivi, spazi verdi e per il tempo libero** per attività di interazione e aggregazione sociale
- **flessibilità d'uso** di spazi, strutture e dotazioni sportive
- **connessione fisica e accessibilità universale** di spazi e strutture

Potenziale associativo, di aggregazione, collaborazione e coesione sociale

- **condivisione** e **uso in comune** di spazi sportivi, ricreativi e servizi, attraverso forme di cooperazione e **gestione collaborativa**
- definizione di **impegni reciproci e accordi per la gestione condivisa e integrata di spazi e strutture**
- misure di sostegno a **iniziative associative** e alla costituzione di **reti di relazione** tra attori locali impegnati nella conduzione di nuovi spazi e servizi con potenziale aggregativo e di coesione sociale

c)

Fig. 7. The multi-scalar and multi-functional process of regeneration of the green wedge of the Terramaini area starts from the school energy district (a) and step by step triggers the complementary actions for involving spaces, services and facilities (b). Examples of context-oriented guidelines (c).



e)

OBIETTIVI CHIAVE	Realizzazione di **un sistema integrato e interconnesso di spazi e servizi urbani ed ecosistemici**
INTERVENTI	• **Valorizzazione dei cunei verdi come parchi metropolitani** a partire dalla rigenerazione dell'area sportivo-ricreativa di Terramaini • Realizzazione di un **sistema integrato e connesso di spazi pubblici aperti all'interno del tessuto urbano**
ATTENZIONI AL PROGETTO	***Connessione, accessibilità e funzionamento integrato*** – rafforzamento **connettività fisica** e **integrazione con tessuto urbano e ambientale circostante attraverso percorsi interni e collegamenti con l'esterno** diretti, sicuri e confortevoli che privilegino i modi di trasporto lenti – **diversificazione delle possibilità di spostamento** alle diverse scale, verso l'area e al suo interno – **unitarietà e continuità di spazi e percorsi** e **accessibilità universale** – **sicurezza e comfort** degli ambienti – **flessibilità, complementarietà e varietà di usi** degli spazi pubblici rivolti a molteplici categorie di fruitori – **permeabilità dei suoli** per contrastare i rischi e gli effetti climalteranti

OBIETTIVI CHIAVE	**Preservare le fasce periurbane agricole e recuperare la connettività ecologica dei corridoi fluviali**
INTERVENTI	• **Riqualificazione ambientale e valorizzazione attitudine agricola fasce periurbane inedificate** tra Cagliari, Monserrato, Selargius, Quartucciu e Quartu **e loro integrazione con gli spazi attrezzati esistenti** • **Recupero ambientale e rinaturalizzazione corridori fluviali** Riu Mortu, Riu Saliu, Riu Nou, Rio Is Cungiaus, **con inclusione delle aree a rischio idraulico**
ATTENZIONI AL PROGETTO	***Connettività ecologica e fisica e funzionalità ecosistemiche*** – **mantenimento dei cunei verdi** come spazi inedificati e **potenziamento del loro ruolo di servizi ecosistemici** – **connessione fisica, ambientale e percettiva** attraverso un sistema di percorsi alberati, aree verdi multifunzionali e spazi di relazione – **recupero aree agricole degradate, ripristino** originaria **vocazione produttiva e funzionalità ecosistemiche suoli; mantenimento usi agricoli** attraverso **pratiche colturali compatibili** – **contenimento dispersione insediativa** e **consumo di suolo con aree verdi multifunzionali** – ripristino e **potenziamento copertura vegetale** per contrastare i fenomeni di dissesto: **selezione specie in base a caratteri e qualità del territorio** (suolo, clima, morfologia, idrologia) – **compatibilità e flessibilità degli usi** nelle **aree a rischio** (per es. come zone urbanistiche S o G)

f)

Fig. 8. The multi-scalar and multi-functional process of regeneration of the green wedge (e). Examples of context-oriented guidelines (f).

condition of a community, extending participation to other public and private entities that share the principles and rules of behavior and involve other spaces, services and facilities.

In this sense, the activating project of the energy district is sustained and implemented by other complementary actions / projects in a multi-scalar process with the aim to enhance the generative role of the green wedge of the Terramaini area (Fig. 7 and 8).

Interdependencies and opportunities can be recognised with actions / projects involving the municipal and private sports facilities, the Terramaini park and the paths along the Terramaini Canal, the existing and new settlements and, on the large scale, the agricultural belt, the urban river channels (Riu Mortu, Riu Saliu, Riu Nou, Rio Is Cungiaus), industrial plants and factories along the main roads, *etc.*

In closing, the integrated project translates the SDGs and principles into shared context-oriented operational and procedural guidelines for urban planning and implementation tools.

6 Conclusions

To summarize, the integrated project of an energy and sustainable community pursues three practical things:

1. The activation of a reference model for urban planning and implementation tools. Starting from the key role of schools this model aims to try out and disseminate new behaviors, both in the production and management of energy, and in the management of their adjacent spaces, the sports facilities and nearby open spaces. These spaces become central for the promotion of opportunities for collective management (between schools and between schools and the city), in addition to be places in which innovative and sustainable forms of energy production and management are experimented.
2. The redevelopment and enhancement of the Terramaini area, confirming and strengthening its value as a green wedge, as a linear system of interconnected open spaces which perform the crucial function of ecosystem services. The green wedge of Terramaini stands out as a place within which the energy transition towards renewable sources takes place: highly natural spaces are connected to each other and made usable by the city, along with fundamental metropolitan services such as the schools, sports and recreation areas. The integrated project represents this area as an integrated and interconnected system of diversified spaces and services within the environmental matrix.
3. A clear and complete information on the distinctive features of an energy community and the technical and procedural steps for its activation and functioning. Last but not least, an opportunity to agree on mutual commitments and agreements among stakeholders for their implementation. In this sense, the integrated project recognizes the Metropolitan City as the most suitable entity to play a role of technical and administrative support through the key objective “to provide support at various levels

(to local authorities, stakeholders, enterprises and citizens) for the establishment of RESCs".

In conclusion, the aggregation potential of the integrated project starts from the sharing of energy and extends to the sharing of sustainability values, including those of inclusion and cohesion, participation and co-management, equity and equalization, supporting to local authorities, businesses, citizens, *etc*. This is the role as well as the objective of the integrated projects for sustainability within the Sustainable agenda of the Metropolitan City.

A fundamental element of the process is the coordination role of the Authority, which exercises the direction of the process, integrating institutional skills, favoring and supporting the associative thrusts of the project communities involved, and eliminating bureaucratic and procedural oppositions along with the transfer of knowledge, information and good practices for the metropolitan area in the medium and long term inspired by the principles and SDGs.

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