RECs as a Tool for Urban and Environmental Regeneration. The Case of Roseto Valfortore

PEER REVIEWED

Antonio Basti

University of Chieti - Pescara

antonio.basti@unich.it

Monica Misceo

Italian National Agency for New Technology Energy and Sustainable Economic Development

monica.misceo@enea.it

Elena Di Giuseppe[1]

University of Chieti - Pescara

elena.digiuseppe@unich.it

1. Introduction.

The "Renewable Energy Communities" (RECs) are now one of the most current and effective models for pursuing the sustainability and urban development goals set by the European Union in the UAEU "Urban Agenda for the EU"[2] which, details the operational framework, working method, concrete actions and themes. A model based on a process of green and digital transition of urban transformation policies, based on the involvement of "local communities," rethinking of administrative arrangements, and "technological and energy transition." This holistic approach promotes cooperation among all actors in a given territory, working to develop solutions designed to improve the quality of life for citizens and favor the use of renewable, ecological, intelligent, efficient and connected technologies.

Beginning with these premises, the text that follows examines the state-of-the-art in this field, with specific reference to the European and Italian contexts. The study gathers and analyses the most "relevant directives, regulations, studies and best practices" currently available, with a focus

[1] Corresponding author.

[2] European Commission, *The Urban Agenda for the EU*, (2016a). Available online: https://urbanagenda.urban-initiative.eu/urban-agenda-eu (accessed on May 30, 2023).

https://doi.org/10.6092/issn.3034-8544/16738

on the areas of action and characterizing factors of the different contexts in which they can be applied.
In the wake of these studies, the focus of the text shifts to an "applied experiment" at the scale of a meta-design project in the town of Roseto Valfortore (FG), the object of a collaboration agreement with the local office of ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development), Energy efficiency Unit Department of Bari, that confronts the implications on the landscape and urban environment connected with the constitution of a REC.

2. State of the Art.

The concept of RECs (Renewable Energy Communities) appears at the EU level with the Renewable Energy Directive on the Promotion of the Use of Energy from Renewable Sources (RED II)[3] introducing the application to Renewable Energy Communities and Collective Self-Consumption Groups.
This is followed by the Electricity Internal Marker Directive (EIM), which introduces the Citizens Energy Community (CEC) institution.[4] In the same year, the European Union dismisses the Clean Energy for all Europeans package,[5] a suite of legislation comprised of eight Directives on energy-related themes (e.g., Energy performance in buildings, Renewable energy, Energy efficiency, Governance of the energy union, Electricity regulation, Electricity directive Risk preparedness Governance regulation, Electricity market design, Adoption process for the legal acts) for the purpose of democratic governance with clear and specific decision-making rules. The "Clean Energy for all Europeans package also addresses Energy communities," understood as local communities made up of people and institutions living on the ground, and adhering to the sustainable development goals set out in the European Green Deal strategy (EGD) for the European Union,[6] the main policy framework for achieving a transition to a climate-neutral and sustainable Europe by 2050. EGD's is an ambitious program, aspiring to the goals of reducing CO2 emissions, climate neutrality, curbing energy consumption, increasing the use of Renewable Energy Sources (RES) and reducing waste by promoting solutions related to individual and/or collective self-

[3] European Parliament and Council, *Directive (EU) 2001/2018 on the promotion of the use of energy from renewable sources*, Brussels, (2018). Available online: https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:32018L2001 (accessed on July 26, 2023).
[4] European Parliament and Council, *Directive (EU) 2019/944 of the of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU*, (2019a). Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L0944 (accessed on July 26, 2023).
[5] European Commission, *Clean energy for all Europeans package*, (2019b). Available online: https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en (accessed on July 26, 2023).
[6] European Commission, *The European Green Deal (EGD) COM/2019/640 Final*, (2019c). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640 (accessed on July 26, 2023).

consumption. Goals, moreover, already set at the EU level when the Energy Roadmap 2050[7] was adopted, for a low-carbon European economy by 2050 (-80/-95% greenhouse gases compared to 1990) based on the identification of new scenarios for decarbonization (energy efficiency, renewables, nuclear, carbon capture and storage). Funding programs such as the Next Generation EU are significant in fostering a strong momentum for the transition, to a cleaner and more sustainable energy system, and just in the context of energy policies, the EEF guiding principle "Energy Efficiency First"[8] emphasizes the importance of implementing the inclusion of energy efficiency measures as a priority in their planning and implementation.

The principles of EEF are evinced in the European REPowerEU Plan initiative[9] for the purpose of stimulating investment in promoting energy renovation innovation, employment and economic growth through energy upgrading of buildings. In support of the Urban Agenda for the EU,[10] maintaining the rigor of coherence and continuity within the programs of the Trio of Presidencies, an operational framework for the period 2016-2021 was developed by the EU ministers responsible for urban issues, subsequent to the "Amsterdam Pact"[11], The New Leipzig Charter,[12] and the current adoption of the Ljubljana Agreement,[13] the related multi-annual work program for the period 2022-2026 which concretize the beginning of a new phase of the UAEU in an implementation document, which possesses a framework for planning, implementing and monitoring an ecological, social and economic transition, aimed at promoting and regulating a framework for sharing knowledge, experience and good practices related to Energy Communities through multilevel and multilateral cooperation by observing the long-term structural change in energy systems, which are

[7] European Commission, *COM (2011) 885, Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the committee of the regions, Energy Roadmap 2050*, (2011). Available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52011DC0885 (accessed on July 26, 2023).

[8]European Commission, *Energy Efficiency First (EEF)*, (2021). Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-first-principle_en (accessed on July 26, 2023).

[9] European Commission, *REPowerEU Plan Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions,* (2022). Available online: https://energy.ec.europa.eu/system/files/2022-05/COM_2022_230_1_EN_ACT_part1_v5.pdf (accessed on July 26, 2023).

[10] European Commission, *The Urban Agenda for the EU.*

[11] European Commission, *Establishing the Urban Agenda for the EU "Pact of Amsterdam" Agreed at the Informal Meeting of EU Ministers Responsible for Urban Matters, Amsterdam*, (2016b). Available online:
https://ec.europa.eu/regional_policy/sources/policy/themes/urban-development/agenda/pact-of-amsterdam.pdf (accessed on July 26, 2023).

[12]https://ec.europa.eu/regional_policy/en/newsroom/news/2020/12/12-08-2020-new-leipzig-charter-the-transformative-power-of-cities-for-the-common-good

[13] Slovenian Presidency Consilium European, *Ljubljana agreement informal Meeting of Ministers responsible for Urban Matters. Brdo pri Kranju, Slovenia*, (2021). Available online: https://www.urbanagenda.urban-initiative.eu/sites/default/files/2022-10/ljubljana_agreement_2021_en.pdf (accessed on July 26, 2023).

considered essential for the "sustainable development of the city",[14] but which in their application to Energy Communities take on a systemic value oriented towards the development of "Smart Cities" or "Smart Territories."

Better yet, we could speak of "Smart Communities," intended not as a unique model to be applied indifferently, but as sustainable and digital communities, each characterized by a diverse organizational and managerial system inspired by local actors (public, private or third sector) committed to achieving precise objectives of sustainability, optimization, efficiency, and digitization.

In this arena, it is important to note how collaborative organizational models, combined with the opportunities offered by new digital technologies, constitute a cardinal point in "energy transition" and represent an opportunity for the creation of new arrangements based on the "green economy", on the modification of systems of producing, distributing and consuming green energy, on the affirmation of "local energy economies" and a greater "attention toward the social dimension." The principal actors in Smart Communities are public administrations, productive activities, universities, active citizens and integrator systems, all subjects deputized with the planning and management of network architecture. The first as components of decision-making bodies fundamental to the activation of new services, new infrastructures and investments oriented toward the promotion and conservation of human and environmental capital, relations and the common goods of a community. The second as promoters of an increase in productivity and employment through technological innovation. The third as subjects who implement training and research fundamental to the competitive development of local communities. The fourth component, citizens, as subjects with real needs directly involved in decision-making processes and the true protagonists of community life.[15] With Directive 2018/2001 RED II, the European Union made a strong push to renew the theme of energy production from renewable sources. At the national level in Italy, these objectives were adopted with Legislative Decree 162/2019 "Milleproroghe"[16] and the subsequent, final Legislative Decrees 2021/199 and 2021/210[17] respectively transpose the aforementioned Directives 2018/2001 and 2019/944. They are followed by Resolution 2020/318 of

[14] European Commission, *The Urban Agenda for the EU*.

[15] Bharani Alagirisamy and Poornima Ramesh. "Smart sustainable cities: Principles and future trends," in Indrajit Pal and Sreevalsa Kolathayar (eds.), *Sustainable Cities and Resilience. Select Proceedings of VCDRR 2021. Lecture Notes in Civil Engineering 183* (Singapore: Springer, 2022): 301-316.

[16] Presidency of the Republic, *Decree-Law 2019/162, converted into law 2021/228, art.42-bis* (2019). Available online: https://def.finanze.it/DocTribFrontend/getAttoNormativoDetail.do?ACTION=getSommario&id=%7B74782FF5-8835-4235-BFE0-F8D4DA1A7AB4%7D (accessed on July 26, 2023).

[17] President of Italian Republic, *Legislative Decree 2021/199*, (2021a). Available online: https://www.gazzettaufficiale.it/eli/id/2021/11/30/21G00214/sg (accessed on July 26, 2023).
President of Italian Republic, *Legislative Decree 2021/210*, (2021b). Available online: https://www.gazzettaufficiale.it/eli/id/2021/12/11/21G00233/sg (accessed on July 26, 2023).

ARERA (Regulatory Authority for Energy Networks and Environment), the Technical Rules established by GSE (Gestore Servizi Energetici), which set out the characteristics of participants, economic conditions, and the procedures for establishing RECs, and in light of ARERA Resolution 2020/727[18] and the issuance of the TIAD (Testo Integrato Autoconsumo Diffuso) on renewable energy configurations with the planned widespread self-consumption models pending implementation in conjunction with the approval by the EU, of the RECs Implementation Decree sent by the MASE (Minister of Environment and Energy Security) in February 2023.

Establishing an Energy Community in the Italian context, which is rich in valuable natural and cultural peculiarities and emergencies, however, poses the need to confront the requirements of conservation and protection of environmental and urban quality. It is therefore desirable, as emphasized by the European Landscape Convention19, to base actions on the principles of "safeguarding," "management," and "planning" of the territory capable of guiding choices and encouraging the identification of appropriate interventions useful for integrating new technologies with the peculiarities of Natural and Territorial Capital.

From a scientific literature perspective, it is interesting to mention the studies conducted by Susan Owens on "Energy Integrated Planning," which are based on the application of new planning processes aimed at energy efficiency, particularly in the urban context.[20] These concepts have been taken up by Paolo De Pascali and expanded to a multidisciplinary dimension of energy planning at the urban and territorial level, in which sustainable development goals are integrated with the preservation and enhancement of local resources, local identities and historical and environmental values. The suggested intent is to define transformations through a process that brings the culture of becoming back into the culture of limit, a prerequisite of participatory systemic design.[21] Reasoning is extended to evaluate energy planning based on the integration of energy and planning, considering the real potential of neighborhood spaces in terms of capacity, mitigation and adaptation in the design of environments. This involves analyzing possible actions that can be implemented to create distributed renewable energy systems, taking into account energy consumption and different physical-environmental conditions. The goal is to assess the quality and

[18] ARERA Autorità Di Regolazione per Energia Reti e Ambiente, *Deliberazione 727/2022/R/Eel Definition, pursuant to Legislative Decree 2021/199 and Legislative Decree 2021/210, of the Regulation of Diffuse Self-Consumption. Approval Of The Integrated Text of Diffuse Self-consumption*, (2022). Available online: https://www.nextville.it/normativa/50294/delibera-arera-27-dicembre-2022-n-7272022reel/ (accessed on July 26, 2023).

[19] Council of Europe, *European Landscape Convention, Firenze*. ETS No. 176 - Firenze, 20.X.2000, (2004). Available online: https://www.coe.int/en/web/conventions/-/council-of-europe-european-landscape-convention-ets-no-176-translations (accessed on July 26, 2023).

[20] Susan Owens, *Energy, planning and urban form* (London: Pion Ltd, 1986).

[21] Paolo De Pascali, *City and energy. The energy value of settlement organization*. Vol. 1786 (Milan: FrancoAngeli, 2008).

effectiveness of the proposed solutions through the processing of energy data, which requires the creation of specific energy mapping and the use of appropriate tools to assess their technical-financial and socioeconomic feasibility.[22] The latter reflections reveal the need to better define the role played by the project, which can be interpreted as a possible tool for governing transformation processes and controlling architectural and landscape quality, especially with reference to new REC-related infrastructure settlements.

3. Best Practices.

In complement to the literature references, it has been deemed beneficial to conduct an examination of the experiences and experiments conducted to date on the subject of Renewable Energy Communities (RECs) at both the community and national levels. The best practices under analysis concerning RECs can be distinguished based on the specific context in relation to the practical guidelines analyzed concerning the specificity of "participatory" design.
Starting from the "European experiences", the study focused on the results of the Renewables-networking platform project,[23] carried out with the support of the European Commission's DG Energy, which reviewed 37 real cases, all referred to a holistic model aimed at promoting environmental sustainability and improving social cooperation between all the actors involved.
As far as the "Italian context," it was useful to draw on the results of the LUMI Company,[24] studies, which show the existence of 26 Energy Communities, characterized by the development of smart grids, the jointly ownership of local services and/or infrastructures, the change in energy supply methods.
Among all the cases studied, we focused on the most relevant experiences similar and comparable with the case study investigated and described in the next paragraph, analyzing scope and characterization factors applicable to the different contexts. Particular attention was paid to projects focused on "urban regeneration models," based on the smart city concept and the use of technology as a tool useful to the smart change of the urban environment. These projects are interesting because put the attention on issues such as sustainability and energy security, and implement an energy community following a bottom up approach and

[22] Michiel Fremouw, Annamaria Bagaini and Paolo De Pascali, "Energy potential mapping: Open data in support of urban transition planning," *Energies* 13(5) (March 2020): 1264, https://doi.org/10.3390/en13051264.
[23] The platform aims to connect major European, national, regional and local stakeholders to facilitate the development of sound policies that will ensure the achievement of the minimum 32 percent renewable energy target for 2030, while monitoring best practices and obstacles in policies at national and subnational levels. https://www.renewables-networking.eu
[24] Consulting firm for marketing strategies in energy transition and digital innovation. https://luminetwork.it/

developing opportunities and benefits for the territory, focusing on people, the urban context and the landscape.

3.1 Case Study 1: Smart City Project, Graz, Austria.

The city of Graz is part of the *Eurocities* program, the network of more than 200 European cities in 38 countries, representing 130 million people working together to address common challenges and share best practices in the field of sustainable urban development, promoting transactional cooperation between cities to improve the quality of urban life.
The Smart City Graz project, follows the Smart City Wien pilot initiative, with which it shares an approach to urban planning of neighborhoods and creating a smart and sustainable urban environment. This is done by promoting energy efficiency, improving sustainable mobility, and integrating smart technologies for managing urban infrastructure and neighborhood green areas. The project involves 12 national and international partners, led by the City of Graz. It will start in Waagner Biro, a compact neighborhood with mixed urban use. A high-quality public urban space will connect residential, office buildings to the new school campus by 2025. The project responds to very concrete problems and is related to citizens' demands on how to have more residential space, but also decrease traffic and increase social infrastructure [Figure 1].

NATION	AUSTRIA
INTERVENTION AREA	GRAZ, (AT) 353 M S.L.M.
NUMBER OF INHABITANTS	265 000 INHABITANTS
ENERGY SYSTEMS	SMAT CITY - DISTRICT NET PHOTOVOLTAIC INVESTIMENT
COMPANY TYPE	LOCAL PARTNERSHIP
TECNOLOGY	PUBLIC URBAN SPACE RESIDENTIAL BUILDINGS
PRODUCTION	-

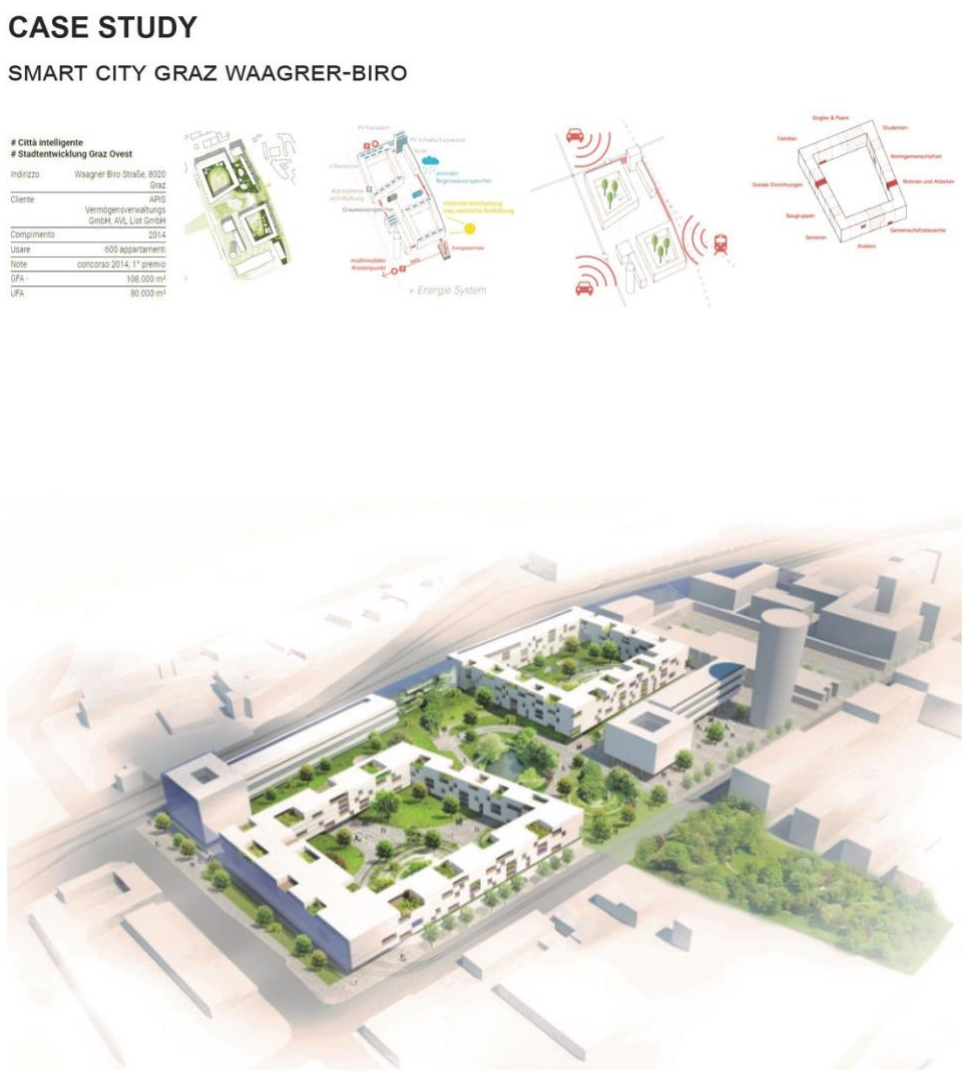


Figure 1| Smart City Graz project (AU). From top to bottom: general view of the intervention area, summary sheet of quantitative data, meta-design schemes of interventions, general view of the new neighborhood configuration.
Credits: https://www.renewables-networking.eu

3.2 Case Study 2: New Energy Model of Diffuse and Integrated Poly-generation, Madonie Park, Palermo, Italy.

In 2010, the first Diffuse Photovoltaic Park was built, located in highly degraded public areas (former landfills, lifting plants, asbestos roofing) allow to combine environmental, productive and social recovery, without consuming new land, lowering historical supply costs by about a quarter. The project, implemented and promoted by the Madonie Local Development Agency with the support of So.Vis.Ma S.p.A (Society for the Development of the Madonie) and Enel X as a technical partner, is based on a new energy model of diffuse and integrated poly-generation experimented in the city of Güssing, Austria, which is being applied with

the scientific support of which the ARCA Consortium[25] is the lead partner. The strategy made it possible to formulate a proposal that aims to introduce a pilot context for the analysis of energy demand and potential impact of the model tested with the STS-Med strategic project (funded by the European Commission under the ENPI CBCMED program). The analysis of data collected during specific energy audits with local stakeholders revealed the opportunity to combine the solar resource with the agroforestry resource, which is widely available in the area, through the implementation of a system of small-scale hybrid plants distributed throughout the territory. The complementary seasonality of the two resources, would, in fact, allow demand to be met in a balanced form, while the small scale would ensure respect for the landscape and enhancement of local biomass. To compare with international best practices and the belief that the Güssing model can be replicated, with appropriate adaptations, and to recover the "energy memory" of the territory with participatory modalities within the Madonie Ecomuseum, as media centers with highly qualified staff and employees of museum institutions, building on the memory of the territory's ability to produce energy through differentiated renewable sources. Outlining a role as a "living-lab of renewable energy" from national and international collaboration and structuring participatory forms between all actors (innovators, technicians, professionals, entrepreneurs and policy makers) who share the "vision" of the ambitious energy model and the integrated strategy of enhancement of local resources, with significant spin-offs on the productive fabric, employment and the very involvement of institutions with experimental laboratories of new technologies, to support the application of a generative model, through "Energy FabLab at School," i.e., laboratories for the fabrication of demonstration devices (exhibits). Later expanded to the building level through a phase of co-design and implementation of energy improvement interventions in schools and other public buildings in the area. The contents of the strategy focus on vision and participation; the action has the vision and challenging goal of 100% energy from renewable sources within 10 years, defining an overall short-, medium-, and long-term energy master plan that integrates the actions of municipal SEAPs (Sustainable Energy Action Plans) and their enhancement.[26]

The Union of Municipalities of the Madonie Inner Area will support such models through targeted information campaigns to increase public awareness of the importance of energy sustainability. Some of the municipalities involved have also joined the network of CERS (Solidarity Renewable Energy Communities).[27] The Municipality of Blufi in

[25] Public-private consortium composed of the University of Palermo and an entrepreneurial group specializing in industrial research and technology transfer for self-generation and energy autonomy.

[26] Source: *https://madoniereainterna.it/energia/*

[27] Source: https://www.comunirinnovabili.it/la-rete-delle-comunita-energetiche-rinnovabili-e-sostenibili/

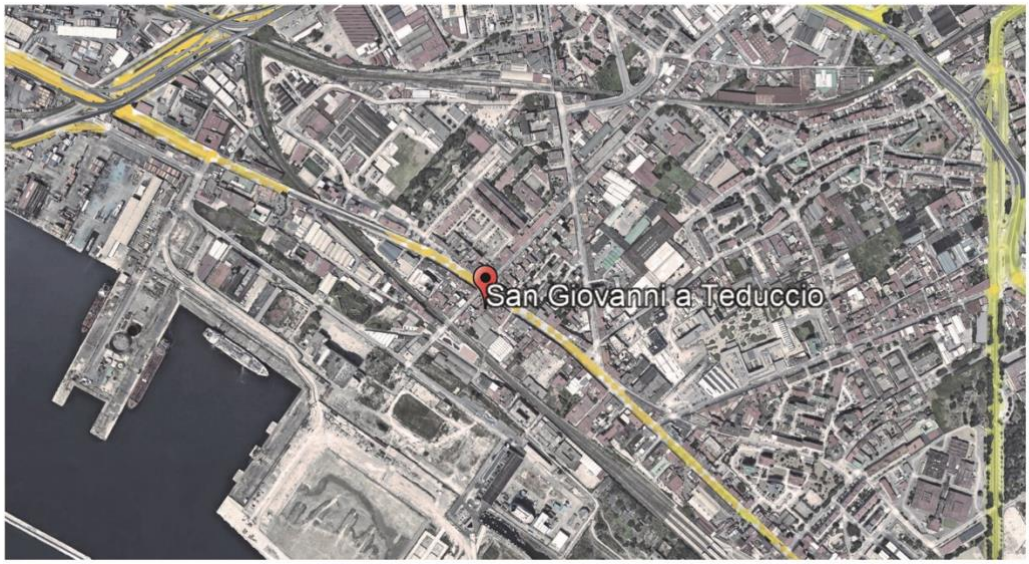
particular, located in the hinterland of Palermo and belonging to the Madonie Park, started the first photovoltaic system of the area's Renewable Energy Community with the aim of becoming an aggregating entity within the Park. Subsequently, the municipalities of Bompietro, Castellana Sicula, Geraci Siculo, Petralia Soprana, and Petralia Sottana connected to the same primary transformer substation to draw the energy produced in anticipation of setting up their own co-production plants [Figure 2].

REGION	SICILY
INTERVENTION AREA	MADONIE NATURAL PARK (PA)
SURFACE GROUND	39,941 HECTARES
TECNOLOGY	PHOTOVOLTAIC PLANT (50 KW) WIND POWER PLANT (- KW)

Figure 2| New energy model of diffuse and integrated poly-generation, Madonie Development Agency (IT). From top to bottom: general view of the intervention area, summary sheet of quantitative data
Credits: https://www.lumi4innovation.it/app/uploads/2021/11/GUIDA-Smart-Sustainable-City-lay-digital.pdf

3.3 Case Study 3: Renewable and Supportive Energy Community, San Giovanni a Teduccio Neighborhood, Eastern Suburbs of Naples, Italy.

A project of about 179 kW, of photovoltaic systems, financed by the "Fondazione con il Sud," promoted by Legambiente and the local community starting with the fundamental role of the "Fondazione Famiglia di Maria" and the 40 families with social hardship involved in the CERS "Renewable and Solidarity Energy Community" and who will enjoy the benefits of this new energy system. The first CERS example of Italy with a project that is an example of good practice with the aim of revitalizing a difficult neighborhood in the field of renewable energy, which will also see the families involved in a path of awareness and increased awareness of energy issues, in order to make the benefits efficient in function of the community [Figure. 3].



REGION	CAMPANIA
INTERVENTION AREA	SAN GIOVANNI A TEDUCCIO (NP)
NUMBER OF INHABITANTS	25 000 INHABITANTS (40 FAMILIES)
TECNOLOGY	PHOTOVOLTAIC PLANT (53 KW)

Figure 3| Photovoltaic plant, San Giovanni a Teduccio (NP). From top to bottom: general view of the intervention area, summary sheet of quantitative data.
Credits: https://www.lumi4innovation.it/app/uploads/2021/11/GUIDA-Smart-Sustainable-City-lay-digital.pdf

4. The Case Study of Roseto Valforotre – Test Analysis.

The best practices analysis has allowed the knowledge of the key elements useful and necessary for starting up a Renewable Energy Communities. Energy community means to start from a collective dimension, to take new paths towards zero-km energy production and consumption. It means re-establishing a relationship with the environment, starting from the use of renewable sources for the realization of a sustainable economic and social system for present and future generations. Energy Community means mutual support, cooperation, exchange: all concepts at the base of living together.
A common key element is the role played by the local administrations in a territory. In fact, local administrations assume the role of promoters of the Renewable Energy Community, starting from the research and collection of needs and opportunities of the territory, through program, plans and implementation tools necessary for the realization and management of the Renewable Energy Communities also from an administrative and maintenance point of view.

The creation of an Energy Community in Italy, some country rich in peculiarities and valuable naturalistic and cultural emergencies, needs to involve the stakeholders in charge of the conservation and enhancement of the territorial heritage, to "develop a methodology for a meta design approach" able to combine these aspects with the establishment and development of the REC.

Based on these consideration, the study has focused on the case study of the Municipality of Roseto Valfortore (FG), a municipality included among "The most beautiful villages in Italy"[28] and characterized by a significant cultural, historical, architectural, landscape and tourist heritage. The basic idea was to verify the feasibility of establishing a Renewable Energy Communities in the municipality of Roseto Valfortore with the aim of making it a self-sufficient reality on the energy aspect and, at the same time, to promote its economic development by starting from the valorisation processes of all the local resources that concern economy, environment, culture, architecture, institutions, and people.

The approach to the Case Study found concreteness in the close relationship between the Department of Architecture, ENEA and the company Friendly Power S.r.l. in the person of V. Raffa, an economist who kindly made available his own technical-economic feasibility studies developed on the case study[29] document later used to support the calculations of renewable energy requirements and productivity, potentially realizable subsequently estimated.

From the methodological point of view, the study developed from a careful examination of the PPTE (Regional Territorial Landscape Plan) of Apulia to arrive at the identification and perimeter of the survey area, observing and interpreting its hydro-geo-morphological structure, ecosystem-environmental structure and anthropic and historical-cultural structure.[30] It also continued by analyzing geographic, demographic, environmental and economic ISTAT (National Institute of Statistics) data. Site visits to the site of municipal interest to assess the problems of the area, interviews with citizens and the mayor formed an integral part of the study.

The analysis of anthropic transformations has highlighted, among others, some critical issues in the way renewable energy production plants have been established "[...] whose proliferation has occurred without any planning and attention to the landscape values of the area," as highlighted in the accompanying document to the PPTR of the Apulia Region, which continues "[...] the absence of effective policies in favor of the mountains and minor centers has exposed, in addition, local governments to the flattery of royalties provided by companies engaged in the installation of

[28]See the website: https://borghipiubelliditalia.it/borgo/roseto-valfortore/.

[29] Vincenzo Raffa, *Distributed energy generation and energy communities. The case of Roseto Valfortore* (Naples: Edizioni scientifiche italiane E.S.I. Spa, 2020).

[30] Analyses developed through the use of GIS software and related Geoportals cadastral mapping of the Internal Revenue Service and the National Directory of Spatial Data (RNDT).

wind turbines".[31]

It also highlighted some programmatic inconsistencies among the various urban plans, with particular reference to PRG (General Regulatory Plan) forecasts of new urban expansion areas in blatant contrast with nature conservation constraints placed by superordinate instruments. A non-negligible aspect that has led to the need to consider the development of a procedure for coordination and verification of planning choices, also with regard to decisions on the establishment of new RES (Renewable Energy Sources) plants so as to prevent significant alterations of the landscape and identity assets.[32]

At the building scale, the study continued through the reconstruction of a three-dimensional model of the entire urban fabric [Figure 4],[33] in order to arrive at an assessment of the possible locations of RES plants, articulating the analysis with respect to the two types of building artifacts, public and private, due to the different procedure required for the activation of the authorization and implementation processes [Figure 5].

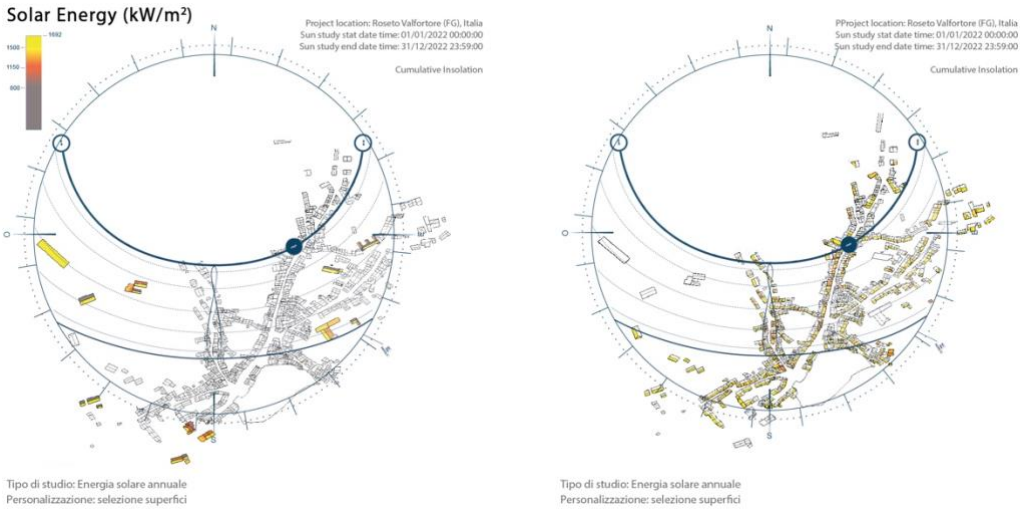


Figure 4| Sunshine analysis of the roofing surfaces of public (left) and private (right) assets. Credits: Elena Di Giuseppe.

[31] Puglia Region, Territorial Planning Department, *PPTR - Piano paesaggistico Territoriale Regionale* (2015).

[32] Dario Fossati and Anna Rossi (eds.), *L.O.T.O. Landscape Opportunities. La Gestione Paesistica delle Risorse Territoriali. Complessità Territoriale e Valorizzazione del Paesaggio. Esperienze a Confronto in Lombardia* (Milan: Regione Lombardia, 2006). Available online: https://www.contrattidifiume.it/.galleries/pubblicazioni/AZIONI_PILOTA_LOMBARDIA_LOTO.pdf (accessed on December 5, 2023).

[33] A model was developed using Autodesk Revit software, incorporating an analysis of sunlight exposure on roofing surfaces and the corresponding annual solar irradiance expressed in annual kW/m2. This analysis was conducted using the Insight Building Performance Analysis plug-in.

Figure 5| Analysis of municipal energy needs and photovoltaic productivity potentially installable on public (left) and private (right) assets.
Credits Elena Di Giuseppe.

In light of the activities carried out, it is possible to identify three different areas of intervention with respect to which to focus the activities of meta-design and verification of settlement compatibility:

- "*The area of architectural integration at the territorial and landscape scale*," with respect to which it is necessary to combine the needs for integration of plant infrastructure with the preservation of identity and natural features. Aspect also emerged from the analysis of case studies (New energy model of diffuse and integrated poly-generation, Madonie Development Agency, Italy).
- "*The area of architectural integration at the urban scale*," with respect to which it is necessary to search for consistency between the needs for the inclusion of plant infrastructure and urban planning forecasts for new settlements for collective services. Aspect also emerged from the analysis of case studies (Smart City Graz Project, Austria, and New energy model of diffuse and integrated poly-generation, Madonie Development Agency Italy) based on the concept of functional integration.
- "*The area of architectural integration at the building scale*," with respect to which it is necessary to combine the needs for integration of plant infrastructures with the preservation of the historical architectural heritage. From this point of view, the distinction between public and private interventions appears relevant, the latter to be evaluated also in relation to the deployment of appropriate incentive tools also aimed at building redevelopment and urban regeneration. Aspect also emerged from the analysis of the case studies (Smart City Graz Project, Austria, New energy model of diffuse and integrated poly-generation, Madonie Development Agency, Italy, and Photovoltaic Plant, San Giovanni a Teduccio, Naples).

Finally, the result of the work was the construction of a meta-design elaboration articulated by areas of intervention consistent with the objectives of urban-building development and territorial protection set by the local administration, appropriately accompanied by a careful analysis both from the point of view of identifying the implementing party (public or private) and from the point of view of the contribution that the

individual project actions, accompanied by an estimate of productivity, aimed at self-production and/or energy self-sufficiency of the local community [Figure 6, Figure 7].

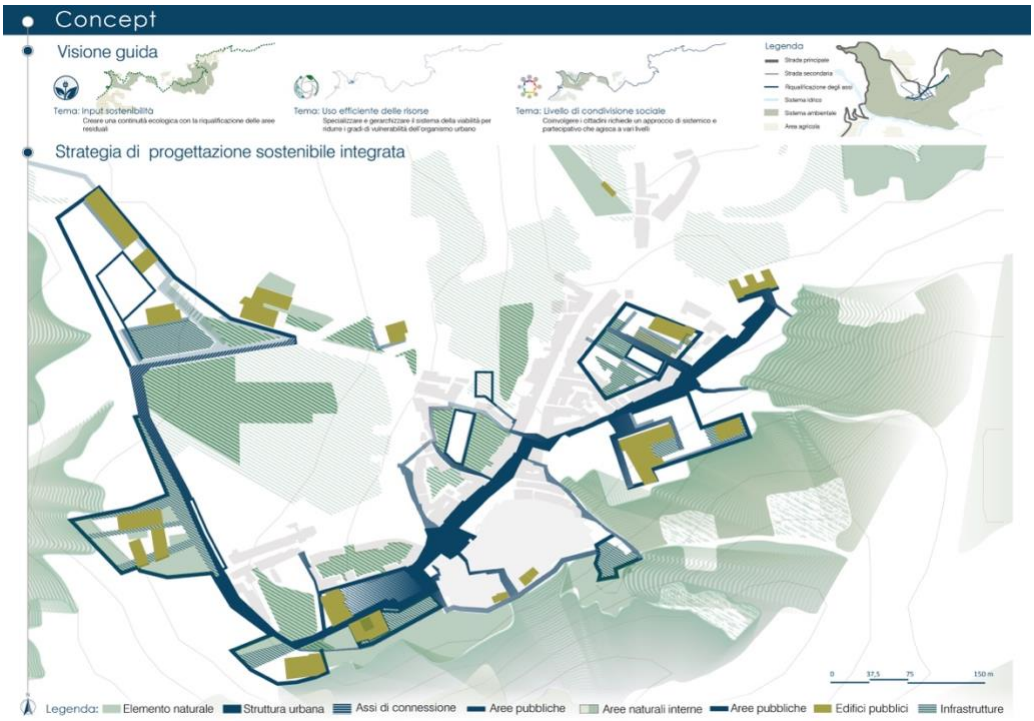


Figure 6| Integrated sustainable design strategy.
Credits: Elena Di Giuseppe.

Figure 7| Integrated sustainable design actions.
Credits: Elena Di Giuseppe

5. Conclusions.

The work done has highlighted all the complexity that characterizes the implementation of an energy community in both small and large communities. From the regulatory and literature review, a fairly exhaustive picture emerges from the technical-financial and legal point of view on how RECs are set up and activated, as well as from the analysis of application experiences, an approach predominantly oriented to diffuse generation emerges, in which solar photovoltaic technology plays a predominant role especially with regard to installation interventions on existing buildings. Little in-depth or even absent appear to be the aspects related to the realization of new medium-large installations and architectural integration. Just as totally unexplored appear the issues concerning the assessment of landscape compatibility with settlement contexts and the potential interaction with possible urban regeneration and enhancement programs, except for the Smart City Graz (AU) project. In this regard, the experience conducted has revealed the need to adopt a holistic and multidisciplinary approach, geared toward rethinking territories with a view to enhancement and revitalization, and based on a path of progressive approach supported by planning documentation suitable for verifying and validating individual project steps. First of all, an adequate census of locally available renewable energy endowments (FER),[34] on which to base integrated energy production strategies, as indicated by application experiences (see Figure 2) followed by an equally adequate process of verification of landscape and historical-architectural compatibility, preferably based on the methods proper to the competition of ideas and the sharing and participation of choices of transformation of the territory, in which local authorities and stakeholders are supported by research centers and central institutions in the definition of objectives and requirements for the protection of cultural heritage.

It also drew attention to the need to verify the consistency between land/urban planning choices and energy choices made at the local level, in order to encourage the development of interventions based on the functional integration of community services and new facilities, so as to improve urban endowments and reduce land consumption. Research areas related to:

- the identification of appropriate financial models and incentive mechanisms, especially to support private interventions;
- collaboration through national and international knowledge networks;
- the structuring of participatory forms among all stakeholders;
- the analysis of the costs of development, installation and maintenance of new energy infrastructure;

[34] For example, the presence of areas historically devoted to the cultivation of forest biomass for heating, wind, solar, hydroelectric or geothermal areas.

- the ways of participation and active involvement of local communities in decision-making processes;
- the assessment of environmental impacts throughout the life cycle;
- the ways of creating educational and entrepreneurial opportunities related to REC management.

Recipients of this study can be identified in local governments (municipalities and regions) that would like to equip themselves with innovative and integrated tools/regulations that contemplate the census of locally available renewable resources, the protection and enhancement of the territory, and actions for the establishment of RECs. Not least the energy companies (ESCOs) involved in said processes.

References

Alagirisamy, Bharani, and Poornima Ramesh. "Smart sustainable cities: Principles and future trends," in Indrajit Pal and Sreevalsa Kolathayar (eds.), *Sustainable Cities and Resilience. Select Proceedings of VCDRR 2021*. *Lecture Notes in Civil Engineering 183* (Singapore: Springer, 2022): 301-316.

ARERA Autorità Di Regolazione per Energia Reti e Ambiente, *Deliberazione 727/2022/R/Eel Definition, pursuant to Legislative Decree 2021/199 and Legislative Decree 2021/210, of the Regulation of Diffuse Self-Consumption. Approval Of The Integrated Text of Diffuse Self-consumption*, (2022).
Available online: https://www.nextville.it/normativa/50294/delibera-arera-27-dicembre-2022-n-7272022reel/ (accessed on July 26, 2023).

Council of Europe, *European Landscape Convention, Firenze*. ETS No. 176 - Firenze, 20.X.2000, (2004).
Available online: https://www.coe.int/en/web/conventions/-/council-of-europe-european-landscape-convention-ets-no-176-translations
(accessed on July 26, 2023).

De Pascali, Paolo, *City and energy. The energy value of settlement organization*. Vol. 1786 (Milan: FrancoAngeli, 2008).

European Commission, *COM (2011) 885, Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the committee of the regions, Energy Roadmap 2050*, (2011).
Available online:
https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52011DC0885 (accessed on July 26, 2023).

European Commission, *The Urban Agenda for the EU*, (2016a). Available online: https://urbanagenda.urban-initiative.eu/urban-agenda-eu (accessed on May 30, 2023).

European Commission, *Establishing the Urban Agenda for the EU "Pact of Amsterdam" Agreed at the Informal Meeting of EU Ministers Responsible for Urban Matters, Amsterdam*, (2016b). Available online: https://ec.europa.eu/regional_policy/sources/policy/themes/urban-development/agenda/pact-of-amsterdam.pdf (accessed on July 26, 2023).

European Parliament and Council, *Directive (EU) 2001/2018 on the promotion of the use of energy from renewable sources, Brussels* (2018). Available online: https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:32018L2001 (accessed on July 26, 2023).

European Parliament and Council, *Directive (EU) 2019/944 of the of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU*, (2019a). Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L0944 (accessed on July 26, 2023).

European Commission, *Clean energy for all Europeans package*, (2019b). Available online: https://energy.ec.europa.eu/topics/energy-strategy/clean-energy-all-europeans-package_en (accessed on July 26, 2023).

European Commission, *The European Green Deal (EGD) COM/2019/640 Final*, (2019c). Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640 (accessed on July 26, 2023).

European Commission, *Energy Efficiency First (EEF)*, (2021). Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-first-principle_en (accessed on July 26, 2023).

European Commission, *REPowerEU Plan Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions,* (2022). Available online: https://energy.ec.europa.eu/system/files/2022-05/COM_2022_230_1_EN_ACT_part1_v5.pdf (accessed on July 26, 2023).

Fossati, Dario, and Anna Rossi (eds.), *L.O.T.O. Landscape Opportunities. La Gestione Paesistica delle Risorse Territoriali. Complessità Territoriale e Valorizzazione del Paesaggio. Esperienze a Confronto in Lombardia* (Milan:

Regione Lombardia, 2006). Available online: https://www.contrattidifiume.it/.galleries/pubblicazioni/AZIONI_PILOTA_LOMBARDIA_LOTO.pdf (accessed on December 5, 2023).

Fremouw, Michiel, Annamaria Bagaini, and Paolo De Pascali, "Energy potential mapping: Open data in support of urban transition planning," *Energies* 13(5) (March 2020): 1264, https://doi.org/10.3390/en13051264.

Owens, Susan, *Energy, planning and urban form* (London: Pion Ltd, 1986).

Presidency of the Republic, *Decree-Law 2019/162, converted into law 2021/228, art.42-bis* (2019). Available online: https://def.finanze.it/DocTribFrontend/getAttoNormativoDetail.do?ACTION=getSommario&id=%7B74782FF5-8835-4235-BFE0-F8D4DA1A7AB4%7D (accessed on July 26, 2023).

President of Italian Republic, *Legislative Decree 2021/199*, (2021a). Available online: https://www.gazzettaufficiale.it/eli/id/2021/11/30/21G00214/sg (accessed on July 26, 2023).

President of Italian Republic, *Legislative Decree 2021/210*, (2021b). Available online: https://www.gazzettaufficiale.it/eli/id/2021/12/11/21G00233/sg (accessed on July 26, 2023).

Puglia Region, Territorial Planning Department, *PPTR - Piano paesaggistico Territoriale Regionale* (2015).

Raffa, Vincenzo, *Distributed energy generation and energy communities. The case of Roseto Valfortore* (Naples: Edizioni scientifiche italiane E.S.I. Spa, 2020).

Slovenian Presidency Consilium European, *Ljubljana agreement informal Meeting of Ministers responsible for Urban Matters. Brdo pri Kranju, Slovenia*, (2021). Available online: https://www.urbanagenda.urban-initiative.eu/sites/default/files/2022-0/ljubljana_agreement_2021_en.pdf (accessed on July 26, 2023).