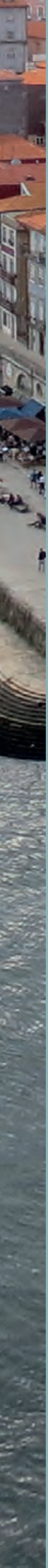

# Conservation / Sustainable Design

## Heritage Challenges in Historic Urban Landscapes

VIII EAAE CONSERVATION
NETWORK WORKSHOP

European Association for Architectural Education
Association Européenne pour l'Enseignement de l'Architecture

EDITORS
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This book presents the papers written by 43 participants following the 8th Workshop CONSERVATION/ SUSTAINABLE DESIGN organized by the Conservation Network of the European Association for Architectural Education and the UNESCO Chair “Heritage, Cities and Landscapes. Sustainable Management, Conservation, Planning and Design”.

The workshop was hosted in the Faculty of Architecture of the University of Porto between 21st and 24th of September 2022 and was attended by 49 participants from 23 Universities, representing 9 countries: Portugal, Italy, Romania, Spain, Ireland, United Kingdom, Brazil, Belgium and Montenegro.

The views and opinions expressed herein are those of the authors and do not necessarily reflect the opinions and beliefs of the editors. Illustrations to the text were provided by the authors. All papers were peer-reviewed.

European Association for Architectural Education
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UNESCO CHAIR "HERITAGE, CITIES AND LANDSCAPES. SUSTAINABLE MANAGEMENT, CONSERVATION, PLANNING AND DESIGN"

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# . Introduction

# I Heritage Conservation *versus* Urban Development

# II Contemporary Design *versus* Pre-existing Features

# III Traditional *versus* Innovative Technologies

# Between Energy Transition "Supremacy" and Conservation Demands

## Towards new forms of dialogue


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Set against an enchanting backdrop, the historic centre of Porto, declared a World Heritage Site since 1996, expresses multiple values, embodied in the landscape and residential fabric, in the architectural and artistic heritage, and "transmitted" through the local communities, true carriers of the identity of the city. The new "Management and Sustainability Plan" for the UNESCO Historic Centre of Porto, Luiz I Bridge and Monastery of Serra do Pilar site, drawn up in 2020, proposes a future vision that respects the "Outstanding Universal Values" of the urban historical landscape, intended to retain and attract new residents, investors, and tourists, in a mixed and intergenerational community perspective (Historic Centre of Porto 2021: 41). In line with the principles of management of UNESCO sites, as well as the programmes and best practices ratified in international conventions, the new Plan intends to strengthen the policy implemented by the previous one (2010), including in the field of action the pillars of sustainable development at a social, economic, and environmental level.[1]

The four strategic axes of the Plan ("Heritage," "Population," "Housing and communities," "Economy, environment and mobility") and the lines of action envisaged within them focus on the communities of residents and new, desirable, inhabitants; in fact, the new Plan entrusts them with the role of guarantors of "material" conservation, of "immaterial" tradition, of the actual implementation of the sustainability objectives.[2]

1 In particular, the following objectives are reported: "Revitalisation and inclusive social development (through retaining of the local population residing in the Historic Centre and the attraction of new inhabitants); Revitalisation and sustainable economic development, the stimulation of economic growth and the capacity to create new conditions of employability; Cultural revitalisation promoting the implementation of cultural/creative programmes, projects and activities; Environmental sustainability, ensuring the capacity to respond to the recovery from natural risks caused by climate change and strengthening environmental sustainability by reducing car traffic and carbon emissions; Integration in the metropolitan area; Stimulation and maintaining of participation of the Historic Centre of Porto in international sharing networks" (Historic Centre of Porto 2021: 43-44).

2 Sustainable development is defined in more than one strategic axis, and not only in the environmental one: 92-95:
- In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," Action Line "sustainable rehabilitation," project/method no. 3. Integration of energy efficiency principles, respecting the authenticity and integrity of buildings and promoting the circular economy.
- In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," Action Line "sustainable rehabilitation," project/method no. 7 "safeguarding of the fifth elevation" (integration in projects of mechanisms for assessing changes in roof coverings).
- In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," Action Line "Research knowledge," project/method no. 12 "Guide for rehabilitation of the Historic Centre of Porto."
- In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," Action Line "Research knowledge," project/method no. 14 "Study on landscape values and view systems (including the buffer zone)."
- In the strategic axis "Population, Housing and communities," objective to "Increase residential attractiveness and Housing," Action Line "Residential attraction with social diversity," project/method no. 44 "Fostering housing comfort and reducing energy poverty."

The eighth workshop organised as part of the "Conservation" Subnetwork of the European Association of Architectural Education, held in Porto in September 2022, also proposed, as a working theme, the relationship between "Conservation and Sustainable Design."[3]

This text, written after the workshop, seeks to propose partial answers to develop topic no. 3 "Traditional *versus* Innovative Technologies"[4] starting from the possible programmes, actions, and interventions, compatible with the protection and enhancement of the UNESCO site, which respond to the objectives of environmental sustainability.

The text starts with an examination of the Management Plan for the Historic Centre of Porto and the literature already published that offers reflections on the state of the art in terms of energy improvement in historic urban landscapes. It introduces the theme of Renewable Energy Communities (RECs), encouraged by the European Community as future perspectives for solving problems related to energy supply and consumption. The Energy Communities already active in Italy and in the Douro region are then recorded, with particular reference to those inserted in sensitive landscape and historical contexts and in areas subject to protection, highlighting the limits, criticalities and relationships with the protection of historic cityscape (FIG. 1)

FIG. 1 The historic centre of Porto, view of the brick roofing, the so-called system of "fifth elevation," which is the subject of attention and safeguarding stressed in the *Sustainable Management Plan* for the UNESCO site (Giovanna Franco).

3 Main topic of the workshop: "The EAAE Conservation Network Workshop proposes to reflect on these worldwide challenges, by examining the specific case of the city of Porto as a starting point for a broader debate on other international examples."

4 The main question posed in the workshop: "While traditional solutions are generally more compatible with pre-existing structures, they are not always feasible because of the availability of materials, know-how, regulation standards, etc. How to foster compatible interventions and respond to the current demands for sustainability (energy efficiency, low carbon emissions, materials recycling, etc.) in management, conservation and maintenance plans?"


FIG. 2 The Guide for energy and environmental enhancement of traditional buildings of the UNESCO site in Porto.

The conservation of the integrity and authenticity of the tangible and intangible heritage of Porto and the correct measures to guarantee its protection also take into account the risks and threats of an "environmental" nature, in addition to those linked to tourist densification, to the possible transformation of the historic centre into "widespread hotel," to the movement of residents to other contexts, also due to problems related to the renewed needs of liveability (difficult accessibility, lack of proximity services, spatial characteristics of the accommodation not always suited to new needs).

Among the environmental risks, the new Plan considers climate change and its induced effect on the so-called heat islands, as well as on the possible rise in the ocean level, the problems deriving from the energy crisis and the implementation of the objectives of the 2030 Agenda. Among these, the fight against energy poverty, decarbonisation, the reduction of polluting emissions and the energy transition towards forms of self-sufficiency are the subject of reflection here.

Over the past ten years, the city of Porto has undertaken programmatic actions oriented towards the "ecological transition," such as the incentive for electric cars and a soft mobility system, upgrading of the underground line and the conversion to public lighting systems with low energy consumption. However, a first reading of the Plan does not clearly reveal a strategy that reconciles the drive towards energy independence and the hoped-for use of renewable energy sources with the active protection of the built heritage and landscape. This, perhaps, can provide a framework for reflection.

Together with the actions promoted by other countries, the city of Porto too, through its organisation Porto Vivo — SRU, drafted, in 2010, a guide aimed at explaining, in a concise and easily communicable manner, the actions to improve behaviour — predominantly thermal — of traditional buildings included in the UNESCO site, compatible with the conservation of constructive characters and material values (De Oliveira et al. 2010).[5] The reference to the Guide is also present in the already mentioned lines of action of the new Plan (FIG. 2).[6]

It is one of the many European and non-European initiatives, the most significant of which can be attributed to the Anglo-Saxon context, which deals with, pragmatically, even if supported by well-clarified methodological principles, the problems, and possible solutions which

5 The Guidelines have been set up together with the Porto Energy Agency, the Faculty of Engineering of the University of Porto and the Regional Directorate of Culture.

6 Strategic axes EE1 – Heritage, Action Line A1 Sustainable Rehabilitation, Project/Method 3. Integration of energy efficiency principles, respecting the authenticity and integrity of buildings and promoting the circular economy (Historic Center of Porto 2021: 92)..

7 Among the numerous guides to energy efficiency interventions in historic buildings see, by way of example only: Changeworks (2008); Cornwall Council Historic Environment Service; Historic England (2018); Historic Scotland (2013).

8 The term is extremely unsuitable for traditional construction but is now in common use because it has been adopted in the regulations.

users or owners can resort to in undertaking interventions to improve indoor comfort and energy consumption.

Dissemination of the knowledge and training of technicians and active citizenship are key objectives that governmental and non-governmental bodies, for example in the United Kingdom, have long identified as priority actions to inform the population and raise levels of awareness also on this delicate issue (FIG. 3). The demonstration, through works already completed and documented with construction site photos and with results that can also be read from the analysis of energy consumption, becomes a vehicle for communicating examples of good practices.[7]

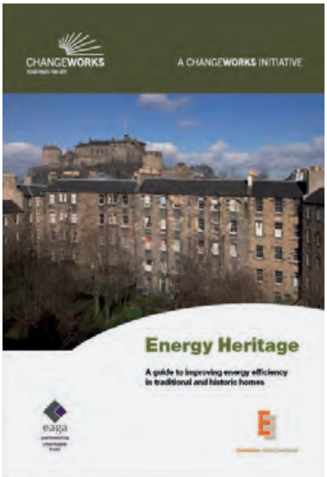


FIG. 3 Changeworks, Edinburgh World Heritage, Guide to improving energy efficiency in traditional and historic homes, 2008.

In line with the afore-mentioned works, the "handbook" drawn up for the historic centre of Porto identifies, with photographs and drawings, the constructive characteristics of the historic building, in any case limited to the external walls, openings and roofs, characterised by the presence of characteristic skylights (called "clarabóias") (FIGG. 4-5). It then analyses, in a simplified manner, the thermal behaviour of the elements of the so-called "envelope,"[8] expresses the objectives to be achieved in terms of "standards" and outlines the principles of compatibility between improvement needs and conservation requirements. This is followed by a number of representative graphic diagrams of the various interventions deemed "compatible" with the material conservation: internal insulation of walls and roofs, insertion of double glazing in the windows and skylights.

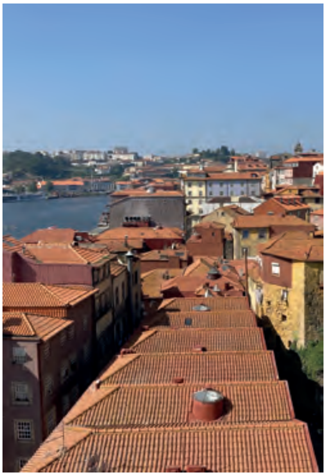

FIG. 4 A view of the traditional skylights, called "clarabóias" (Giovanna Franco).

Although legitimate criticisms can be advanced on a methodological level on the concept of "standard"[9] as well as on the application of thermal performance calculation systems by applying "abstract" and built models for materials and components resulting from recent building production,[10] the solutions proposed by the Guide are overall respectful and recommend avoiding replacement interventions where these are not necessary due to an advanced state of deterioration.

Particular attention is then dedicated, in a specific chapter, to the inclusion of technologies powered by solar energy, even if limited only to panels for the heating of domestic water and/or of air conditioning systems. Great emphasis, also in the literature published subsequently, is dedicated to the use of this technology, considered innovative because it is not dissonant with such a sensitive context.[11]

FIG. 5 Detailed view of the "clarabóias," considered as one of the characters of traditional constructive system (Giovanna Franco).

The recommendations contained in the Guide, which are also all acceptable, are in any case limited to small installations with a very restricted surface area, proposing the following principles: 1. the surface

9 The European Directive and the consequent national legislations carry the obligation of achieving the same objectives in an undifferentiated manner on any built context.

10 With specific reference to the actions in place for the historic centre of Porto,the following applies: "The simulations have shown that the introduction of insulating and solar thermal panels would be ineffective in terms of energy and cost efficiency, as well as improving comfort. This study reinforces the notion that traditional buildings perform better than expected in terms of energy consumption and can be retrofitted and upgraded with low cost and passive solutions" (Moura Flores 2019).

11 "The placement of solar thermal panels on roofs was initially criticised and opposed. Some argued that the black panels would be visible from the streets and would contrast with the cultural values of the site. However, the solution was very simple.

of collectors must not exceed 10% of the total surface of the roof; 2. collectors must be installed with the same slope as the pitched roof; 3. collectors must be aligned with the top ridge; 4. collectors must be installed on pitched roofs with SE-SW orientation; 5. collectors must not be installed on triangular geometry pitched roofs; 6. collectors must not be installed on portions of the pitched roof close to the gutters and in any case must not be visible from the road; 7. the fastening of the collectors must guarantee the absence of infiltration and the onset of any other pathology; 8. the installation of storage tanks on the roof is not permitted (De Oliveira et al. 2010: 35-38).

Some considerations can be advanced, also on the basis of experience obtained from other contexts:

- the impacts on the historic urban landscape take into account a "scale factor": if a single solar thermal panel inserted in an extended surface of brick roofing can be considered "acceptable" because it is not visible from the street (but actually from the upper floors!), the replication of panels on many or all the roofs of the historic centre would alter their perception, entering into greater conflict with the presence of the "clarabóias" (FIGG. 6-7);
- the recommendations for correct insertion of solar panels cannot be applied, in an undifferentiated manner, also to photovoltaic technology, which requires a much larger surface area to satisfy housing needs in terms of self-consumption[12]; the Guide, unfortunately, does not mention this technology; in fact, there might be a possible risk of contradicting one of the guiding actions of the plan, identified as the safeguarding of the fifth façade[13];
- the use of solar technology for the thermal needs of individual building units cannot be considered a significant action for the implementation of the environmental sustainability objectives as expressed above (well-being, health and efficient use of energy) and as ratified by the member states of the European Union for the relatively negligible contribution in terms of impacts.

Actions planned by the Municipality of Porto after the drafting of the Plan expressly mention the future increase in the production of energy generated by photovoltaic panels, occupying the surface of around

FIG. 6 Detail of the red façades and roofs in a renovation intervention (Giovanna Franco).

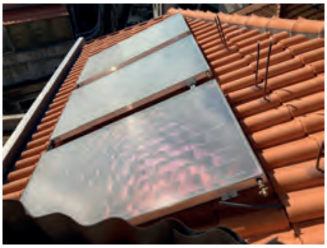

FIG. 7 Insertion of solar collectors during a renovation in the HCP. This type of action is allowed and recommended in the Guide, as not visible from the street, but the "granular" multiplication of such devices certainly will have greater impacts of scale on the Historic Urban Landscape.

It started from recognition of the principle that the azimuth and elevation of solar panels relative to the Sun need not be precise. In fact, changing the azimuth or elevation by ±15° results in 2-3% less solar energy capture than the ideal orientation. This means that it is more important to fine-tune the typical timing of solar-heated water use than to worry too much about the tilt and orientation of the panels. Also, as new households tend to be smaller, smaller areas of solar panels are used. It was therefore possible to instruct all installers to install the solar panels flush with roofs, where they would not be visible from the street. This solution was recognised as being perfectly acceptable and in line with the natural 'contamination' of the original roofs, where many skylights were already previously located" (Santos, Valença and Oliveira Fernandes 2017: 94).

12 For a residence for four users, an area of approximately 20 square meters of photovoltaic panels is estimated.

13 In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," action line "sustainable rehabilitation," project/method no. 7 "safeguarding the fifth elevation" (integration in projects of mechanisms for assessing changes in roof coverings).

thirty buildings managed by the Municipality, the first step in a broader strategy to exploit the solar potential of thousands of square meters of roofs of the buildings managed by the Municipality of Porto.

In the near future, the complex relationships between sustainability and heritage face wider horizons. Possible risks, as well as opportunities, are inherent in future programmes if the actions to be taken are not in balance with the recognised and codified material and immaterial values. Effectiveness of the actions, and not efficiency of the devices to be installed, will be the true objective to be pursued.

In this framework, new forms of small production, not necessarily inserted in a "granular" fashion on the roofs of historic buildings, can be a starting point for research and actions with integrated and respectful approaches.

## CONFIGURATION MODELS FOR ENERGY PRODUCTION AND WIDESPREAD SELF-CONSUMPTION [GF]

In recent years, many European countries have given priority, in their energy programmes, to transition policies towards "digital" and "green" economies, addressing two central issues: on the one hand, the security of supply and the accessibility of energy prices and on the other, economic competitiveness. Within this framework, Europe, within the Green Deal, has set its own objectives to become the first climate-neutral continent, aiming for an economy without direct greenhouse gas emissions, decoupling economic growth from resource use, protecting natural capital and, at the same time, the health and well-being of citizens.

The REPowerEU plan has further strengthened the European ambitions for 2030, defining the increase of energy efficiency target from 9% to 13% and the target for the use of renewable sources from 40% to 45% and identifying, as essential objectives, energy saving, diversification sources, the gradual independence from fossil fuels and the adoption of smart investments.

In Italy, for example, the liberalisation of the energy market, which began in 1999, paved the way for a profound restructuring of the gas and electricity sectors, abolishing the national monopoly and, consequently, promoting new initiatives in the field of production and supply. The transition to decentralised systems, together with economic support policies, has encouraged the use of renewable energy sources, with induced impacts which, after at least a decade, present "lights and shadows." In fact, many production plants have followed profit and maximum efficiency logics unrelated to the potential expressed by the territories, promoting the large scale (ground-mounted photovoltaic systems consisting of hundreds or thousands of panels, geothermal and wind plants) and generating heavy environmental costs (Gross and Mautz 2015; Bolognesi and Magnaghi 2020).

The Renewable Energy Community model, which is able to offer a change of pace with respect to large-scale installation, is now being looked at as one of the strategies to be adopted in the near future as it offers opportunities for community cohesion and the development of innovative social practices (Moser and Maturi 2022).

Recent Italian regulatory provisions,[14] aimed at the transition to decentralised energy systems, leave room for small-scale investments with the entry into the energy market of new players such as local administrations, small and medium-sized enterprises and citizens gathered in association form.

Self-consumption of energy is therefore the purpose for which a “coalition” of users is formed with the aim of producing at affordable prices and consuming and managing energy in a “decentralised” manner. From a legal and regulatory point of view, the difference between groups of self-consumers and the Renewable Energy Community is inherent in the territorial extension: while, in fact, the first is limited to a single building or condominium, the second has a territorial limit associated with the possibility of sharing the energy produced. The great novelty introduced by this model, starting from 2011, is that energy users can transform themselves into prosumers (producers-consumers) (Coenen and Hoppe 2021).

However, the state of the art differs from country to country; in the following paragraphs, an examination of the active and forthcoming energy communities in Italy and Portugal is presented, limited to the region around the Douro.

## A MAPPING OF THE MAIN RECS IN ITALY [MC]

The map of active and planned RECs in Italy updated in January 2023 and the associated database, created with the open source software QGIS, were drawn up from data published in the “EU energy communities map” (European Commission 2023; Wierling et al. 2023), in the “Renewable Communities” report by Legambiente (Eroe and Polci 2022), in the “Community Energy map” (De Vidovich, Tricarico and Zulianello 2021), in the sector literature (De Lotto et al. 2022; Manni and Valzano 2022; Moser and Maturi 2022; Todeschi et al. 2021) (FIG. 8).

The groups of self-consumers, farms and agricultural cooperatives and projects presented by 2021 that have not, to date, been developed were excluded from the mapping, selecting, from the one hundred and eighty-eight starting RECs, fifty RECs that are active or in an advanced stage of implementation.

14 Italian Legislative Decree 8 November 2022, no. 199.

FIG. 8 Map of active and planned RECs in Italy as of January 2023. Categorisation according to the presence and type of constraints (historical centres, landscape or monumental constraints), database in QGIS environment, elaborated by the authors (Marta Casanova).


The database contains general information (name of the RECs, website, date of foundation, active or planned RECs), location (state, region, municipality, address, geographical coordinates), data on renewable sources (technologies, capacity), type of location of the system (on the ground, on the roof, on canopies...), information on energy management promoters and intermediaries. Through the portal of the Italian Ministry of Culture “Vincoli in Rete” (Ministry of Culture 2023), data on environmental, monumental, landscape protection constraints, location in historic centres or within UNESCO sites were also verified.

Fifty RECs were analysed in detail, of which thirty-nine are active and eleven are planned. 90% of the RECs analysed use only photovoltaic systems; in thirty-six cases the panels are placed on the roofs of buildings, flat or pitched, in two cases the photovoltaic panels were installed on the roofs of canopies in car parks, in two cases ground systems are envisaged in agricultural areas and only three RECs contemplate mixed locations (Table 1).

The REC of Foiano Val Fortore (BN) is the only one that has envisaged the installation of a wind plant (499 kW) which integrates a photovoltaic plant (939.51 kW) and a hydroelectric one (58.40 kW).

The active and planned RECs are uniformly distributed throughout Italy; Sicily is the first Italian region for the development of renewable energy communities, seven active and one being planned, followed by Lombardy, Lazio and Sardinia. The only region in which there are no active or planned RECs is Valle d’Aosta.

In 70% of the RECs analysed, the Municipalities were the promoters, making existing photovoltaic systems available and, in some cases, providing for the installation of new systems on the roofs of public buildings. In most cases, the RECs see the participation of public and private subjects, in only seven cases the initiative is completely private, while in two cases it is exclusively public.

TABLE 1 Selection of Italian RECs mapped in the database and under landscape, monumental or historic constraints. Data are concerning the technology used (PV photovoltaic, W wind), the capacity (kW), the type of constraint, public-private (PPP) or private (PVT) participation, active (A) or planned (P) RECs, as well as the coordinates extracted from the GIS with reference system EPSG:32632 were extracted and reported in the table.

| | TECHNOLOGY | CAPACITY (kW) | LOCATION | RESTRICTIONS | PUBLIC / PRIVATE PARTICIPATION | ACTIVE /PROJECT | COORDINATES EPSG:32632 |
|---|---|---|---|---|---|---|---|
| **ITALY** | | | | | | | |
| **CE Rinnovabile e Solidale "Critaro"** | | | | | | | |
| San Nicola da Crissa (VV) | PV | 66 | roof | historic centre | PPP | A | 1134250,734 4304759,981 |
| Stakeholders | | | | | | | |
| **Amendolara** | | | | | | | |
| Amendolara (CS) | PV | | roof | historic centre | PPP | A | 1133858,9 4318104,607 |
| Stakeholders | Amendolara Municipality | | | | | | |
| **CER San Daniele 1** | | | | | | | |
| San Danile del Friuli (UD) | PV | 54,4 | roof | landscape heritage | PPP | A | 809078,741 5118551,379 |
| Stakeholders | Energy Center of the Politecnico di Torino, Comunità Collinare del Friuli | | | | | | |
| **CE di Ventotene** | | | | | | | |
| Ventotene (LT) | PV | 300 | roof | landscape heritage | PPP | A | 873747,852 4525619,972 |
| Stakeholders | Lega Navale di Ventotene, Ventotene Municipality | | | | | | |
| **CE Quartiere Tannino** | | | | | | | |
| Sestri Levante (GE) | PV | 29 | roof | listed building | PPP | P | 532693,707 4902345,869 |
| Stakeholders | Sestri Levante Municipality | | | | | | |
| **Monticello Green Hill** | | | | | | | |
| Monticello Brianza (LC) | PV | 10 | roof | landscape heritage | PVT | A | 524440,183 5061671,26 |
| Stakeholders | | | | | | | |
| **Henergy City Hall - CER Magliano Alpi** | | | | | | | |
| Magliano Alpi (CN) | PV | 40 | roof | historic centre | PPP | A | 404499,175 4923456,949 |
| Stakeholders | Magliano Alpi Municipality, Energy Center of the Politecnico di Torino | | | | | | |
| **CER Nuove Energie Alpine** | | | | | | | |
| Area Vasta: Valle Maira e Valle Grana (CN) | PV | 40 | roof | landscape heritage | PPP | A | 363140,953 4919761,881 |
| Stakeholders | ANCI 22 participating municipalities, Unione Montana della Valle Grana | | | | | | |
| **CEVS - CE della Val Susa** | | | | | | | |
| Susa (TO) | | | | landscape heritage | PPP | P | 349946,031 4999830,576 |
| Stakeholders | Unione Montana Valsusa di Bussoleno, Unione Montana Alta Valle Susa di Oulx | | | | | | |
| **CE Melpignano** | | | | | | | |
| Melpignano (LE) | PV | 157 | roof | historic centre | PPP | A | 1155200,087 4580866,067 |
| Stakeholders | Melpignano Municipality, Università del Salento, Officine Creative, Cooperativa Comunità Energetica Melpignano | | | | | | |
| **CE Biddanoa E' Forru** | | | | | | | |
| Villanovaforru (VS) | PV | 44 | roof | historic centre | PPP | A | 488778,839 4386941,956 |
| Stakeholders | Villanovaforru Municipality | | | | | | |
| **CE di Borutta** | | | | | | | |
| Borutta (SS) | PV | 53 | roof | historic centre | PPP | A | 492336,834 4393507,429 |
| Stakeholders | Borutta Municipality | | | | | | |
| **CE di Berchidda** | | | | | | | |
| Berchidda (OT) | PV | 608 | roof | historic centre | PPP | P | 478520,602 4485928,491 |
| Stakeholders | Berchidda Municipality, Sardegna Region, Dipartimento di Ingegneria Elettronica dell'Università di Cagliari | | | | | | |
| **CE di Ussamaranna** | | | | | | | |
| Ussamaranna (SU) | PV | 71 | roof | historic centre | PPP | A | 513993,1 4515029,345 |
| Stakeholders | Ussamaranna Municipality | | | | | | |
| **PAESC CE di Ragusa** | | | | | | | |
| Ragusa (RG) | PV | 193 | roof | landscape heritage, historic centre | PPP | A | 947126,984 4190440,74 |
| Stakeholders | Ragusa Municipality | | | | | | |
| **ComOn Light** | | | | | | | |
| Feria (SR) | PV | 20 | roof | landscape heritage, historic centre | PPP | A | 1036002,832 4129990,94 |
| Stakeholders | Feria Municipality | | | | | | |
| **Blue Green Energy** | | | | | | | |
| Blufi (PA) | PV | 65 | roof | landscape heritage | PPP | A | 1012559,958 4166354,54 |
| Stakeholders | | | | | | | |

FIG. 9 View of the roof of the Ferla auditorium with the photovoltaic array with coloured, integrated panels (Municipality of Ferla).

Among the thirty-nine RECs for which it was possible to find data relating to the capacity of energy production plants, 41% are small-scale (up to 50kW), 23% medium-sized (from 50 kW to 100 kW) and 36% large (with capacity greater than 100 kW).

The identified RECs were analysed to verify compatibility and any mitigation interventions in the event that they are located in restricted areas of environmental, monumental, landscape protection, within UNESCO sites or when located in historical centres.

Ten RECs are located in historic centres with photovoltaic systems on the roofs of public and private buildings, mainly on pitched roofs that are only partially visible from the street. All the RECs in historical centres with the exception of the PAESC Energy Community of Ragusa (Sicily) are found in small or very small municipalities with inhabitants ranging from 254 of the Energy Community of Borutta in Sardinia to 2716 of the Energy Community of Amendolara in Calabria.

Six RECs are located within areas subject to landscape constraints, two of which, ComOn Light of Ferla and the PAESC Energy Community of Ragusa, concern areas of historical centres. In only one case, in the Energy Community of Quartiere Tannino in Sestri Levante (Liguria), will the photovoltaic systems in the project be installed on the roof of a building subject to monumental restrictions.

Only in two cases were measures taken to mitigate the impact of photovoltaic systems. In the REC of Ferla (Sicily), the photovoltaic panels installed on the roof of the Municipal Auditorium are brown in colour, integrated into the roof, covering a regular band close to the eaves line; moreover, the shape of the eaves node with a low wall that rises from the perimeter wall limits the view of the system from the street (FIG. 9).

A particular case is that of the REC of Melpignano (Apulia), in whose regulation it is prescribed that photovoltaic systems installed on the roofs of public and private buildings in the historic centre must not be visible from the street.

The analysis and mapping of active and planned RECs in Portugal was limited to the Douro area (very few, indeed) (Table 2). In particular, the area of interest was defined on the basis of the "Unidades de Paisagem"[15] identified by the Directorate General of the Territory of the Douro region: "Area Metropolitana do Porto," "Douro" and "Entre Douro e Minho" that include the four UNESCO sites "Historic Centre of Oporto, Luiz I Bridge and Monastery of Serra do Pilar," "Alto Douro Wine Region," "Historic Centre of Guimarães" and "Sanctuary of Bom Jesus do Monte in Braga" (FIG. 10).

| | | TECHNOLOGY | CAPACITY (kW) | LOCATION | RESTRICTIONS | PUBLIC / PRIVATE PARTICIPATION | ACTIVE /PROJECT | COORDINATES EPSG:3857 |
|---|---|---|---|---|---|---|---|---|
| **PORTUGAL – DOURO AREA** | | | | | | | | |
| **Agra do Amial, Asprela + Sustentável** | | | | | | | | |
| Porto | | PV | - | roof | - | PPP | P | -8,607463719735323 41,17839023103142 |
| | Stakeholders | AdEPorto, Associação Porto Digital, Empresa Municipal de Ambiente do Porto, EM, S.A., CMPEA, EM, S.A., INESC-TEC, EFACEC Energia EFACEC Electric Mobility, S.A., Virtual Power Solutions, S.A., EVIO, FAP, IDNA, Municipio do Porto | | | | | | |
| **CER de Castelões** | | | | | | | | |
| Castelões | | PV | 86 | ground | - | PPP | A | -8,415660948718306 41,411421000683746 |
| | Stakeholders | | | | | | | |
| **CER de Vila Boa do Bispo** | | | | | | | | |
| Marco de Canaveses | | PV | - | roof | historic centre | PPP | P | -8,216109463827557 41,12750075614096 |
| | Stakeholders | Vila Boa do Bispo municipality, Associação Humanitária dos Bombeiros Voluntários de Marco Canaveses, Casa do Povo de Vila Boa do Bispo | | | | | | |
| **CER de Braga** | | | | | | | | |
| Braga | | PV | - | roof | - | PVT | A | -8,419365828653115 41,58615337426777 |
| | Stakeholders | DST Group | | | | | | |

TABLE 2 RECs identified in the Douro area of Portugal. Data on the technology used (PV photovoltaic, W wind), capacity (kW), type of constraint, public-private (PPP) or private (PVT) participation, active (A) or planned (P) CERs, as well as the coordinates extracted from the GIS with reference system EPSG:3857 were extracted and reported in the table.

Four RECs were surveyed and mapped by selecting the same data already defined for the Italian mapping, two of which are active and two are planned. By superimposing the map of the RECs with the map of the buildings and areas forming part of the "Património Imóvel," of the "Zona Geral de Proteção" and of the "Zona Especial de Proteção," which can be consulted in the webgis "Atlas do Património Classificado ou em vias de classição"[16] the presence of protection constraints in the areas affected by the RECs was verified.

The Comunidade Energética Renovável de Agra do Amial is located in the northwest area of the city of Porto. The REC will be part of the Asprela Sustentável project[17] which includes, in addition to the

15 Available at: <https://www.dgterritorio.gov.pt/paisagem/unidades-paisagem>.
16 Available at: <https://patrimoniodgpc.maps.arcgis.com/apps/webappviewer/index.html?id=7f7d5674280f41849c0a0869ced22d91>.
17 Available at: <https://asprelamaissustentavel.pt>. Partner of the Asprela Sustentável project: AdEPorto — Agência de Energia do Porto, Associação Porto Digital, Empresa Municipal de Ambiente do Porto, EM, S.A., CMPEA — Empresa de Águas do Município do Porto, EM, S.A., INEGI — Instituto de Ciência e Inovação em


FIG. 10 Map of the main active and planned RECs in the Douro area as of April 2023. Landscape units "Douro," "Entre Douro e Minho," and "Área Metropolitana do Porto" (in green) and location of UNESCO sites (in red), database in QGIS environment (Marta Casanova).

FIG. 11 Asprela + Sustentável project area with identification of the zones where the photovoltaic plants of the REC will be installed and the building of the Faculty of Economics of the University of Porto classified as a monument of public interest (MIP), database in QGIS environment, elaborated by the authors (Marta Casanova).

creation of the energy community, interventions on urban mobility and for the implementation of actions to promote the circular economy which envisage the involvement of citizens (FIG. 11). The area of Asprela, with a surface of approximately two and a half kilometres in the municipality of Paranhos, includes four social housing complexes, a university centre with seven faculties of the University of Porto and three Schools of the Polytechnic University of Porto. It also includes several private universities, two poles of innovation and technology transfer, university residences, three primary schools, a shopping centre, a number of hotels and industries, as well as one hundred and thirty-seven cultural associations and organisations.

Within the area affected by the Asprela + Sustentável project, the building that houses the Faculty of Economics of the University of Porto is classified as an MIP monument of public interest.

The project website shows that the buildings involved in the installation of the REC photovoltaic systems will be the social housing complexes and primary schools.

The Comunidade de Energia renovável of Castelões has planned the construction of a photovoltaic plant on the ground with an area of approximately 4.2 hectares located within a wooded area.

The plant was funded by 626 public and private investors. The REC does not fall within areas of landscape or monumental restriction or within UNESCO sites; however, near the photovoltaic plant there are two monuments of public interest: the "Estação Arqueológica de São João de Perrelos" and the "Casa de Santiago e Aqueduto."

In Braga, a city full of classified monuments in addition to the UNESCO site "Sanctuary of Bom Jesus do Monte in Braga," the first REC of Portugal was established which affects an industrial area north of the city. This REC entails the installation of photovoltaic systems on the roofs of industrial buildings and satisfies 40% of the electricity needs of the industries that are part of it.

Engenharia Mecânica e Engenharia Industrial, INESC-TEC — Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência, EFACEC Energia — Máquinase Equipamentos Eléctricos, S.A., EFACEC Electric Mobility, S.A., Virtual Power Solutions, S.A., EVIO - Electric Mobility, Lda., FAP — Federação Académica do Porto, IDNA — International Development Norway Association, Município do Porto; total funding 1,446,355.73 €, EEA Grants funding 983,229.37 €).

The Vila Boa do Bispo Renewable Energy Community in the "freguesia" (civil parish) of the same name of the Marco de Canaveses community is not yet operational. It was officially established in January 2023, but it has not currently been possible to identify the position, type and location of the planned plants. In the territory of the *freguesia* of Vila Boa do Bispo, which borders to the west with the Tâmega river, a tributary of the Douro, there are no monumental constraints or general protection zones.

The map of the RECs identified in the Douro area was compared with the national map of the least sensitive areas for the installation of ground-based photovoltaic systems[18] which identifies the possible "Go-To Areas" for the installation of renewable plants by combining the information deriving from eighty layers in order to exclude the unsuitable areas, essentially areas: with a slope greater than 20%, unusable land occupation (salt marshes, natural streams, artificial/modified streams, natural lakes and ponds, lagoons, aquaculture, coastal lagoons, river mouths), classified for nature protection (protected areas, Natura 2000 network, UNESCO biosphere reserves, RAMSAR sites, SCI, ZPE special protection areas, geosites), coastal protection, hydrogeological risk, mining interest, forest interest and areas subject to archaeological, monumental, ZEP (Zonas especiais de proteção) and ZGP (Zonas gerais de proteção). The map also excludes areas with land occupation for which it is believed that conversion to renewable plants would be controversial (vineyards, olive groves, rice fields, cork oak, holm oak, chestnut and stone pine forests).

This map does not take into account the intervisibility relationships and perception between landscape components as expressive components of landscape values, thus not considering the visibility of photovoltaic plants from the surrounding sensitive areas. This comparison showed that in all the cases analysed except that of the REC of Castelões, the areas identified as less sensitive do not interfere with and do not coincide with the areas affecting the RECs. In the metropolitan area of Porto the map identifies some peripheral areas, in Braga no areas near the industrial zone are identified, but a large area adjacent to the buffer zone of the UNESCO site "Sanctuary of Bom Jesus do Monte in Braga" is mapped as non-sensitive, in Vila Boa do Bispo the map identifies areas to the west of the city. The area adjacent to the installation of

FIG. 12 Less sensitive areas identified in the "Energy and Geology" geoportal: "Areas in mainland Portugal with lower environmental and heritage sensitivity for the installation of renewable energy production centres" (https://geoportal.lneg.pt/en/opendata/energy_info/) in the proximity to the REC of Castelões. Elaborated by the authors, with "Energy and Geology" geoportal as base map (Marta Casanova).

18 Identification of areas with less environmental and patrimonial sensitivity for the location of renewable electricity production units — consultable on the geoportal: https://geoportal.lneg.pt/mapa/?Mapa=AreasCandidatasRenovaveis undertaken as part of the REPowerEU plan (Simões et al. 2023).

the ground-mounted photovoltaic plant of the Comunidade de Energia renovável in Castelões, north of the Douro highway, was identified as a less sensitive area. The installation of further plants in the proximity of the existing one would affect its visual protection by making it highly visible from surrounding streets and buildings (FIG. 12).

## OBSTACLES AND BRAKES FOR THE DEVELOPMENT OF RECs: RELATIONSHIPS WITH SENSITIVE LANDSCAPE CONTEXTS [GF]

The recent literature on the subject (Brummer 2018; Coenen and Hoppe 2021; Tarhan 2015) highlights how the real take-off of the Energy Community model is encountering considerable difficulties. Among the main criticalities that constitute a brake on development, the following have been identified:

- the slowness of initiatives related to the involvement, in decision-making processes, of local communities or self-consumers, for example in the form of condominiums;
- lack of access to information relating to distribution network maps;
- the difficulty in acquiring economic resources, especially in the initial phase of initiatives;
- the discrimination of small-scale initiatives countering large energy companies;
- the lack or inadequacy of the necessary political and institutional support;
- a general scepticism on the part of individuals towards the installation of devices powered by renewable energy sources (the so-called NIMBY or not-in-my-backyard movement);
- the possible effect of "saturation" on local territories.

Some of these barriers can be overcome, as concerns Italy, after March 2023,[19] following measures that provide the framework of rules and contain procedural simplifications and technical specifications with respect to the transitional provisions in force from 2020.

However, the bureaucratic streamlining facilitated by regulatory developments will not be sufficient for the diffusion of the RECs; significant obstacles are linked to the difficult integration between "energy planning" and "urban planning."

Even at an international level, many feasibility studies actually encourage the economic optimisation of prosumers, mainly referring to energy demand forecasting and production system optimisation (Huang et al. 2015; Colombo et al. 2014; Todeschi et al. 2021).

Instead, the "race" towards the RECs will make it necessary to deal with forms of "self-government" of the local system through

19 Month in which the new TIAD "Integrated Text for Widespread Self-Consumption" came into force for buildings, condominiums and energy communities.

participatory planning processes, entrusting the territory with the role of "first level of political decision" (Bolognesi, Magnaghi 2020). This will involve, on a territorial and municipal scale, the implementation of an integrated methodology that systematises local energy potential (in terms of production capacity) without denying its value as a patrimonial "common good," thus balancing energy efficiency objectives with the constraints expressed by the territory itself (Brunetta, Mutani and Santantonio 2021). This is even more evident when models of Renewable Energy Communities are proposed in sensitive landscape contexts such as the UNESCO site of Porto or other Italian contexts.

A virtuous dialogue for the development of RECs compatible with the safeguarding, protection and enhancement of our territory must include institutions, companies, social partners, research bodies, universities and representatives of the Ministry of Culture. In this way it will be possible to perfect growth models a nd to rethink innovative and creative forms of development which can be combined with the historical landscape and environmental constraints, which can be replicated in contexts characterised by a significant architectural but also agricultural-forest heritage while, at the same time, overcoming cultural taboos that see environmental protection set against the use of renewable technologies (UNESCO 2021; Fondazione per lo Sviluppo Sostenibile 2022; Foster et al. 2020).

In comparing divergent objectives (energy transition and historical, landscape and environmental protection) it is necessary to adopt a reversal of perspective, going beyond the mere quantification of available areas with the prior exclusion of areas that are not available because they are subject to protection (Gerundo and Marra 2022).

Furthermore, the theme of the compatibility of solar technologies with sensitive sites from an architectural and landscape point of view has had a strong impetus in national and European projects. Feasibility studies, projects and guidelines have contributed to the "undermining" of a purely technical vision in favour of balancing apparently distant, if not even conflicting, objectives with an examination of the impacts induced by new technologies for the definition of compatibility criteria (Franco 2018; Lucchi et al. 2020; De Medici 2021; Tsoumanis et al. 2021).

These experiences can be taken into account in the future studies proposed by the Plan regarding the studies for the protection of the views of the UNESCO site and of the "buffer zone"[20] (FIG. 13).

FIG. 13 View of the edge of HCP (red line) and of the buffer zone (blue line). Identification of suitable areas (roofs surfaces) for possible Renewable Energy Communities should take in consideration areas adjacent to the UNESCO site, of less architectural value and less material and visual impacts (Marta Casanova). Google Earth.

20 In the strategic axis of the "heritage," objective of "safeguarding and improving the built heritage," action line "Research knowledge," project/method no. 14 "Study on landscape values and view systems (including the buffer zone)."

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