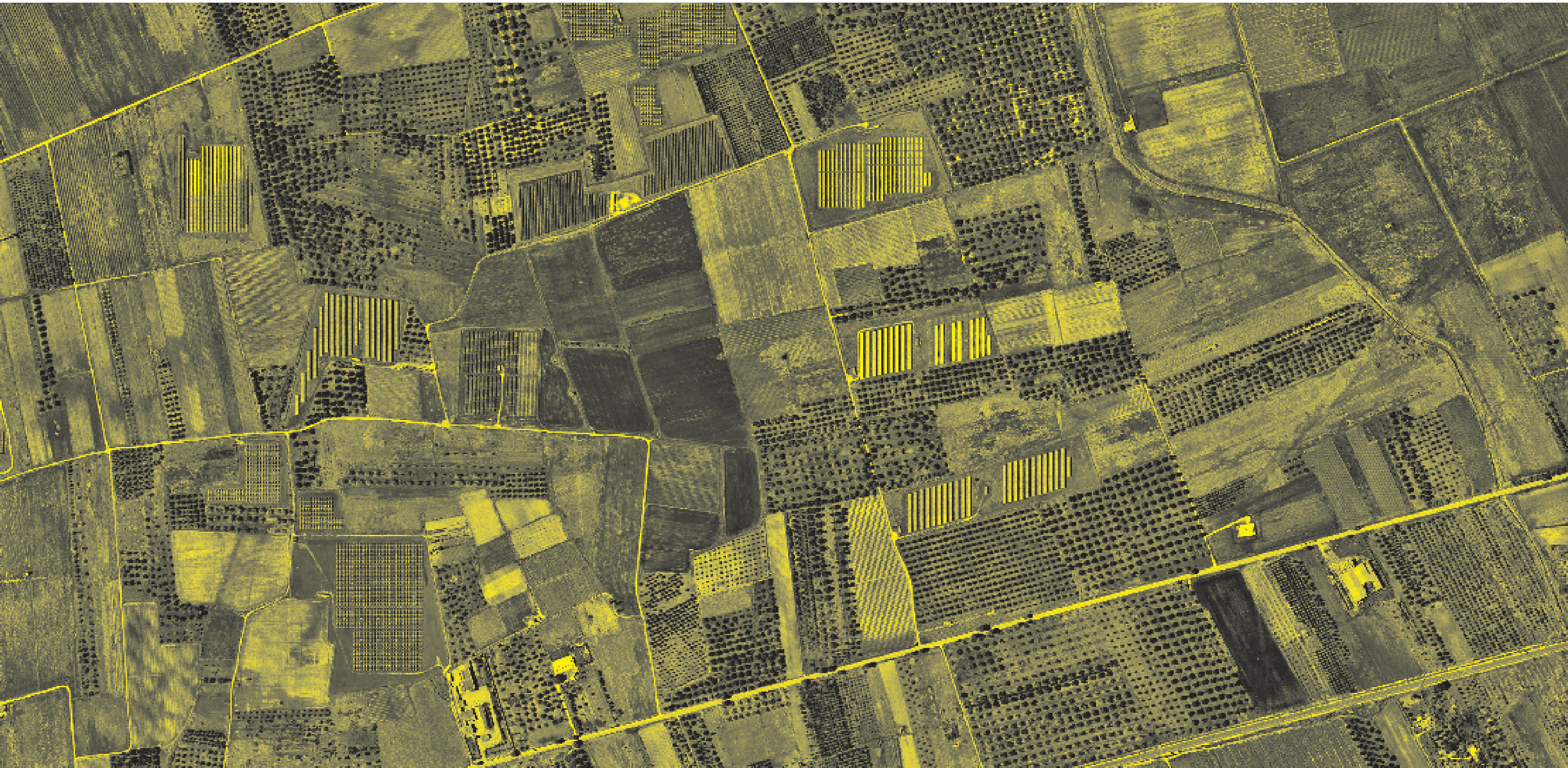
DESIGNING FORMS FOR FUTURE SOLARSCAPES

A VISION FOR THE ITALIAN PALIMPSEST

EDITED BY
ELENA VIGLIOCCO



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LetteraVentidue

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FOREWORD

ELENA VIGLIOCCO

October 2025

This book is the primary outcome of the research MUR program PRIN2022 *Next Genetarion Solar Landscapes. Method and Tools for next generation solar landscape design: the renewal of photovoltaic fields at the end of life*.
The main goal of the research was to promote new knowledge about the reuse and redesign – decommissioning and revamping – of photovoltaic fields at the end of life. The study assumed that reusing and redesigning these photovoltaic fields can be essential in constructing a new energy policy and renovating the landscape culture. The research intended to identify innovative interpretative methods that, through the optimisation of land use, can decrease the degraded and unused areas. In particular, the study has investigated the opportunities offered by the reuse and redesign of photovoltaic fields to develop new settlement models which can mend impoverished and fragmented landscapes and provide the partial recovery of agricultural productions. Since photovoltaic fields are spread across many Italian regions, the research project aimed to foster the identification of shared knowledge and landscape development strategies.
The research team consisted of three research units with distinct characteristics. The first research unit, composed of Elena Guidetti, Roberta Ingaramo, Simone Parola, Matteo Robiglio, Riccardo Ronzani, Ilaria Tonti, Elena Vigliocco (Principal Investigator and Reseach Unit Coordinator), with the contribution of Marco Cappellazzo and Antonia Spanò (LabG4CH), from Politecnico di Torino,

examined the architectural impacts of photovoltaic fields and identified morphological strategies to re-evaluate the relationship between solar fields design and landscape design. The second research unit, composed of Simone Baccaglini, Morris Brenna, Giulia Cazzaniga, Sara Anna Sapone, and Sara Protasoni (Research Unit Coordinator), with the contribution of Marco Agosti, from Politecnico di Milano, grounded in landscape research, focused on processes that have transformed the landscape to highlight new opportunities for decommissioning and revamping solar fields. The third research unit, composed of Stefano Maruccia, and Amedeo Reyneri di Lagnasco (Research Unit Coordinator), from the Università degli Studi di Torino, experts in agronomic research, focused on the specific evaluation of the opportunities/criticalities triggered by decommissioning. Due to this creative partnership, the research contributes to the definition and adoption of the best policies and practices addressed to policymakers and practitioners, aiming to increase the environmental, social, cultural, and economic impact of the reuse and redesign of photovoltaic fields.

At the end of this brief foreword, I would like to thank my colleagues who actively participated in the development and drafting of a multidisciplinary research project exploring a little-researched design field with uncertain operational implications. I thank the tenacity of my research unit and the young researchers who, alongside me, chose to venture into the field of architectural design applied to solar landscapes.

30 x 30 km

+

Cuneo / Fossano
N 44° 33' 28'' - E 7° 45' 12''

INTRODUCTIONS

30 x 30 km

Ravenna / Lugo
N 44° 26' 32'' - E 11° 54' 22''

30 x 30 km

Brindisi / San Pietro Vernotico
N 40° 30' 50'' - E 17° 59' 15''

NEXT SOLARSCAPES

REVERSING THE GAZE ON SOLAR ENERGY PRODUCTION

ELENA VIGLIOCCO

«Man, mobile or static, is first a creature of habit. The habit bred by primitive instincts resist change, however reasonable the change, and will wear away as the dropping of water wears away stones. All that any change in the conditions of life produce in the conglomerate man-mass at first is reaction toward the old order. Increased sentiment for the old, violence to the new».

Frank Lloyd Wright, *The Disappearing City*, 1932[1]

The book presents the initial results of research conducted with a broad range of tools, a set of hypotheses, and a vision about the present and the future of solar energy architectures and landscapes – Solarscapes. As in all complex accumulations of materials and ideas collectively produced, an introduction is not an easy task. I will try to approach it by outlining the hypotheses of the future solarscapes, and then by referring to the three episodes into which the work we have made has been articulated. They correspond to the main parts of the research that have reciprocally nourished each other during the elaboration: two examinations at different scales that return the two points of view of the disciplines that have worked together – architectural project and landscape –, and one design section.

The research framework

«The dialectic between city and countryside fundamentally defined the meaning of each. Today we have neither a dialectic – a real, mutual relationship – nor a definition»[2]. Today, cities are a predictable accumulation of roads, squares, buildings, and icons, but as soon as we leave the urban settlement behind us, we confront the unfamiliar. We have focused our design efforts on the urban settlements because of our desire for growth and accumulation[3], and progressively, we have lost our relationship with everything that is not urban. However, energy production plants are an exception. Overlooking the operational reasons that allow/require these plants to be located outside residential areas, energy factories, even in remote locations, remind us how much our lives and habits depend on our ability to transform the energy sources the planet offers us into energy. Hydroelectric, nuclear, thermoelectric, and many other power plants emerge like uninhabited urban settlements in the countryside, mountains, or sea. Because our awareness of the countryside is weak, we notice their presence only when we come across them. While at the end of the nineteenth century and in the first decades of the twentieth century, many economic resources were spent on the integrated design of the first hydroelectric power plants and dams, the

1 Frank Lloyd Wright, *The Disappearing City*, New York, William Farquhar Payson, 1932, pp. 7-8.

2 Rem Koolhaas, *Countryside. A Report*, Köln, Taschen, 2020, p. 2.

3 Vaclav Smil, *Growth: From Microorganisms to Megacities*, Cambridge, The MIT Press, 2019.

technical acceleration brought by the Second World War caused the project to lose control. Technological acceleration, however, isn't the only reason why the architectural quality of production facilities has lost interest. The second, and more subtle, reason is that the Second World War overturned investment prospects. While hydroelectric plants were financed by bourgeois entrepreneurs who invested their private capital and were interested in improving their image as enlightened philanthropists, the Italian Government increased its activism in the sector after the explosion of energy demand[4]. On December 6, 1962, the nationalisation of the electricity industry became law. The National Electricity Authority (ENEL) was established and entrusted with «all activities of production, import and export, transportation, transformation, distribution, and sale of electricity from any source»[5]. Under this law, the Italian producers sold their assets to the new public entity. ENEL absorbed the operations of over 1,000 electricity companies. This ushered in a period of investments and interventions justified by the public interest, which allowed ENEL to justify "questionable" operations but also opened the way to the idea that the exploitation of energy sources could take priority over other interests and, at the same time, be indifferent to the demands of the local communities[6]. Implementing a European directive, 40 years later the nationalisation, the legislative decree of 16 March 1999 liberalised the electricity market. The aim was to help contain final energy prices within a competitive environment. The production model changed, without going backwards, but adapting to new market conditions and ever-growing demand. To encourage changes in energy production, the government launched a campaign of economic incentives, including those for installing solar panels on buildings and the ground. Indeed, thanks to the flexibility of photovoltaics and its low costs, the idea was that, thanks to incentives, even small and medium-sized investors could enter the market. Since the mid-2000s, ground-based photovoltaic systems have begun to replace agricultural areas whose productivity was lower than that guaranteed by incentives.
20 years have passed, and conditions have changed. These small and medium-sized photovoltaic fields, now

4 Barbara Curli, *Il progetto nucleare italiano (1952-1964). Conversazioni con Felice Ippolito*, Soveria Mannelli, Rubbettino, 2022. Beyond the interest in Italian nuclear power, Curli's book effectively argues for the State's entry into the electricity production market.

5 Article 1, Law No. 1643 of 6 December 1962. Source: https://www.gazzettaufficiale.it/eli/id/1962/12/12/062U1643/sg [last access August 2025].

6 Among the examples of questionable operations is the management of the site on which the Galileo Ferraris thermoelectric power plant stands in Leri di Cavour (VC).

at the end of their life, are incoherent pieces within the agricultural landscapes they are embedded in, and, from an ecological point of view, they are impervious clusters. No planning or design efforts have been made for them, and their negative impact has now led to regulations limiting their new installation.

Starting from these premises, the research project focuses on the renovation of photovoltaic fields at the end of life, which are spread in all the country, as extraordinary opportunity to demonstrate how their decommissioning or revamping can be a large and powerful engine of regeneration, and ecological renovation for territories. The project of renewed solarscapes offers new opportunities for the reconciliation and reappropriation of topics only apparently far from architecture issues.
Since 80 GW of renewable energy must be installed in Italy by 2030 to comply with the European Green Deal[7], the innovative potential of photovoltaic field renovation has not been sufficiently explored. If any investigations are active in the field of the integration of photovoltaic in buildings[8] or in agriculture[9], those on the decommissioning or revamping are at the beginning and scientific literature is not sufficiently advanced.
Up to now, photovoltaic fields have been considered only as energy resources. Still, their decommissioning or revamping is an occasion to rethink the relationships between energy production and agricultural production, and to design new energy plants conceived as an active part of the landscape in which they are created and placed. The design of a new approach to solarscapes is urgent because photovoltaic energy is the most effective and powerful to achieve the 2030 UN Agenda on Sustainable Development goals[10]. Although national guidelines prefer the installation of photovoltaic panels on buildings, large ground-mounted photovoltaic systems will also need to be installed to achieve the established production level. Moving beyond the idea that photovoltaic fields are temporary production facilities, it is urgent to begin conceiving them as systems that can generate new energy landscapes. If properly designed, they can counteract soil depletion

7 The Italian PINIEC plans to reach 131 GW of renewable energy capacity in 2030, 79% of which will come from solar power. Ministero dell'Ambiente e della Sicurezza Energetica, *Piano Nazionale Integrato per l'Energia e il Clima*, June 2024. Source: https://www.mase.gov.it/portale/documents/d/guest/pniec_2024_revfin_01072024-pdf [last access August 2025].

8 For example, Alessandra Scognamiglio, Paola Bosisio, Vincenzo Di Dio, *Fotovoltaico negli edifici. Dimensionamento, progettazione e gestione degli impianti*, Torino, Edizioni Ambiente, 2009; Robert S. Hastings, Maria Wall, *Sustainable Solar Housing*, Vol. 1 Exemplary Buildings and Technologies, London, Routledge, 2007.

9 For example, Alessandro Agostini, Michele Colauzzi, Stefano Amaducci, *Innovative agrivoltaic systems to produce sustainable energy: An economic and environmental assessment*, in "Applied Energy", vol. 281, 2021; Christian Dupraz, Hélèn Marrou, Grégoire Talbot, Lydie Dufour, A. Nogier, Y. Ferard, *Combining solar photovoltaic panels and food crops for optimising land use: Towards new agrivoltaic schemes*, in "Renewable Energy", vol. 36, no. 10, 2011, pp. 2725-2732.

10 United Nations, *Transforming our world: the 2030 Agenda for Sustainable Development*, 2015. Source: https://sdgs.un.org [last access August 2025].

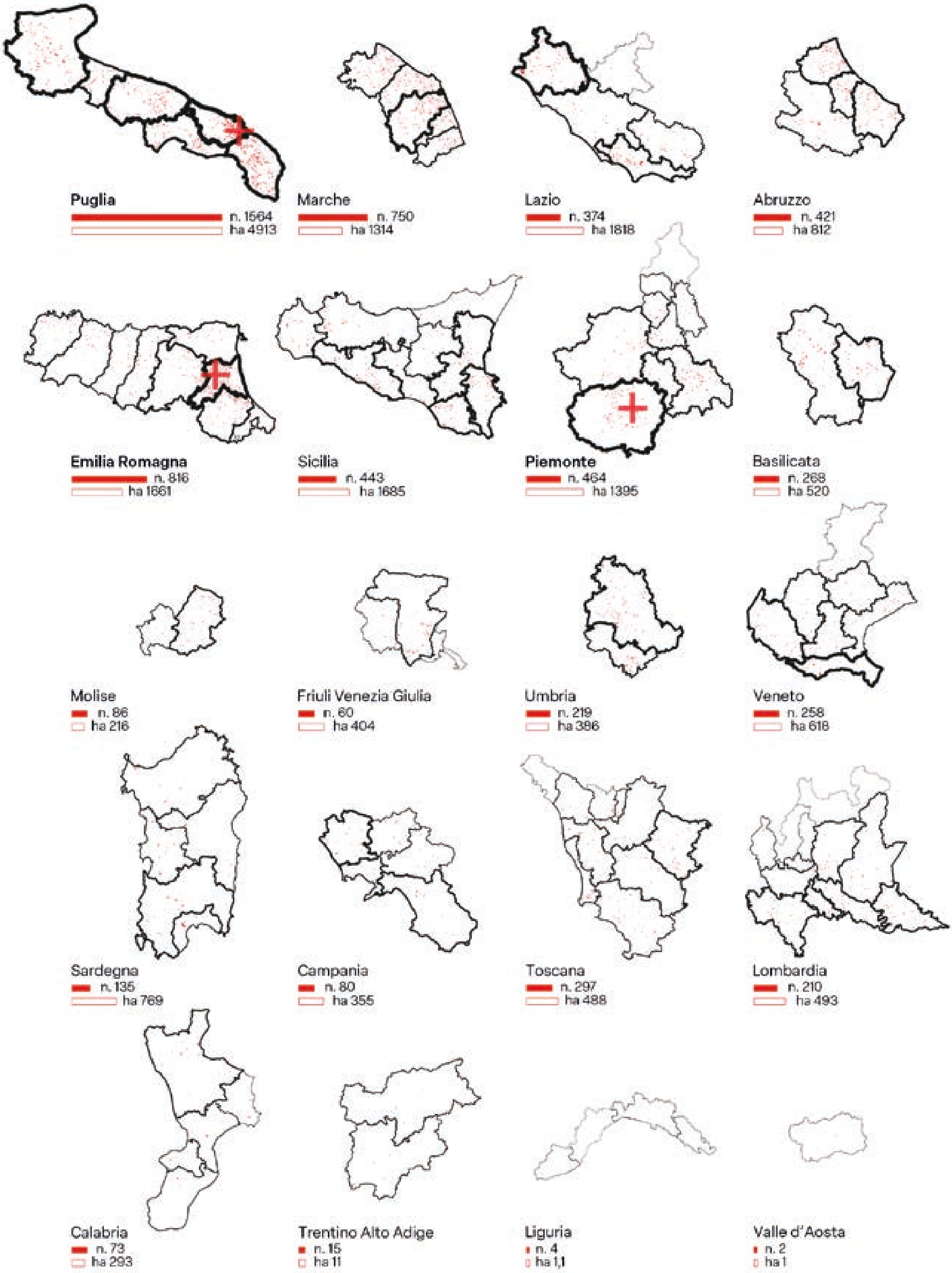
and erosion, the loss of productive agricultural land, the reduction of biodiversity, landscape degradation, and the deterioration of ecosystem services.
The decommissioning and revamping of photovoltaic fields installed with government incentives in the early 2000s in Italy[11], driven by the technological obsolescence of panels that reduce their production capacity after approximately 20 years, presents an opportunity to rethink the design approach for these plants. It is an opportunity to initiate a renewal of the entire narrative that connects energy production plants and the countryside, which includes agricultural and natural areas.
The research switches from a mitigation perspective to an enhancement and empowerment perspective rooted in the new solarscapes project. The reuse and redesign of photovoltaic fields belong to this new paradigm that exploits the reuse of pre-existing installations, optimising land use. The research explores a new paradigm in which landscape and ecological protection are a part of the latest energy and agriculture production needs, and identifies new productive morphologies that, reading the landscapes, empower their characters.
Two questions arise.
Because the opportunity offered by the decommissioning of ground-based photovoltaic fields at the end of life to redesign future solarscapes, what interpretative tools can be used to define the new forms of second-generation solarscapes, and what forms might they assume?

Understanding the spatial architecture of ground-based photovoltaic fields is a crucial step in research aimed at identifying reuse and redesign strategies to mitigate the impact of decommissioning or revamping. The primary objective is to map and geospatially analyze the phenomenon of ground-based photovoltaic fields on a national scale. In terms of methodology, the research adopts methods and tools proper to the field of digital geo-information to develop a cartographic project in a multiscalar GIS environment. This project aims to describe the landscapes of solar energy, considering the territory's primary topographical features alongside the currently available but limited resources on ground

11 Thanks to EU regulation 2001/77/CE, in Italy, from 2005 to 2013, there were five different incentive programs under the Conto Energia, each superseding, adapting, or redefining the previous one. The fifth Conto Energia ended on July 6, 2013, without issuing a new incentive plan for energy production. It was replaced, however, by tax relief on system costs.

photovoltaics[12]. Since no data distinguish ground-based photovoltaic systems from those on roofs, the research adopted a nominal power threshold of>500 kW as the lower limit for defining ground-based photovoltaic arrays. From the first step of the research, in Italy the total surface area occupied by ground-based photovoltaic fields is estimated at 18,147 hectares with a nominal installed power of 9,436 MW. The distribution of the plants reveals that the Italian region with the most significant number of photovoltaic plants on the ground is Puglia, with 1,564 plants (4,913 ha), corresponding to 25% of the total plants built and 25% of the total occupied surface area. With significantly lower numbers, the Emilia Romagna (12% with 816 plants), Marche region follows (11% with 750 plants), Piemonte (7% with 464 plants), and Sicilia (7% with 443 plants). Regarding extension on the ground, Lazio is the second region with the largest occupied surface area (12.30% with 1,818 ha), followed in third place by Sicilia with 1,685 ha. About the installed power, the most significant power is recorded in Puglia with 1968 MW, corresponding to 20% of all energy produced in Italy by ground-based photovoltaic fields. Looking at the provincial level data, Puglia has the most significant number of plants and installed power. The province of Lecce stands out with 519 plants both for occupied surface area (1153 ha) and for installed nominal power (about 455 MW), followed by the province of Brindisi with 332 plants (surface area 897 ha and nominal power 403 MW).
Interesting considerations emerge between the number of plants and occupied surface area, highlighting reflections on the presence of large or small plants.
For example, the province of Viterbo emerges as the second province in terms of occupied surface area (1,062 ha) despite a limited number of overall plants (179 plants), as does the province of Latina (91 plants for 521 ha) supporting the hypothesis of the presence of extra-large photovoltaic plants. The same condition occurs in the provinces of Rovigo, Udine and Foggia. In addition, Cuneo, Ravenna, Macerata, Pesaro-Urbino, and Ancona also emerge as exciting and are characterized by numerous medium and small plants.
Increasing the scale of observation, from a morphological

12 A series of open-source datasets - in tabular, spatial, and raster formats - have been collected and interrelated and are currently available on various specialised entities and regional and national mapping platforms. As mentioned, the most frequently consulted and utilised resources are those provided by Italy's energy service management entities, mainly GSE and TERNA. Their role in monitoring and disseminating scientific data is essential for researchers and professionals in the field. However, it is important to note that the accessible databases and published statistical surveys have historically presented information on the photovoltaic phenomenon in aggregate form without distinguishing between ground- and building-based systems. As a result, it is currently impossible to obtain detailed information on individual photovoltaic installations, such as their geometric properties, construction year, size, or cadastral data. Only in 2023 have GSE reports begun to provide quantities and surface area estimates, expressed in hectares by region, with this distinction.


Puglia
n. 1564
ha 4913
Marche
n. 750
ha 1314
Lazio
n. 374
ha 1818
Abruzzo
n. 421
ha 812
Emilia Romagna
n. 816
ha 1661
Sicilia
n. 443
ha 1685
Piemonte
n. 464
ha 1395
Basilicata
n. 268
ha 520
Molise
n. 86
ha 216
Friuli Venezia Giulia
n. 60
ha 404
Umbria
n. 219
ha 386
Veneto
n. 258
ha 618
Sardegna
n. 135
ha 769
Campania
n. 80
ha 355
Toscana
n. 297
ha 488
Lombardia
n. 210
ha 493
Calabria
n. 73
ha 293
Trentino Alto Adige
n. 15
ha 11
Liguria
n. 4
ha 1,1
Valle d'Aosta
n. 2
ha 1

Left page. The image shows, in a taxonomic/abacus form, the distribution of ground-based photovoltaic fields across Italian regions, classified according to the Nominal Power produced by each province. It also reports the total number of photovoltaic installations and the overall land surface occupied.

Sum Nominal Power installed per region > 500 kW [MW]

300-500
200-300
100-200
50-100
10-50
1-10

PV Fields
Sum Area

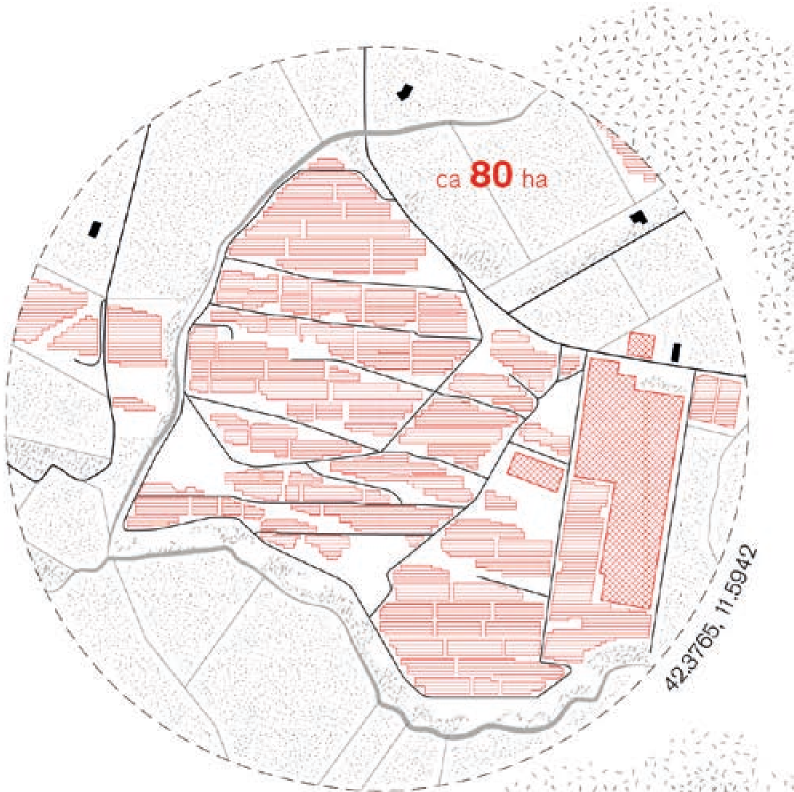
perspective, the relationship between the lot occupied by the energy plant and the footprint impressed from the panels themselves reveals many recurring features and critical issues. First, regardless of the installed quantities, the location of ground-based photovoltaic systems in the landscape is entirely random. From a planning perspective, depending on the power to be installed and the context (urban, industrial, or agricultural), the installation of ground-based photovoltaic plants can fall into different authorization categories[13]. In the case of ground-based photovoltaic systems in agricultural areas, the economic operator/contractor adopted simplified procedures based on the system's power. Special authorisation was required only when the plant fell within an area subject to restrictions. This has produced opportunistic behaviours that resulted in plants' random locations. Second, the organisation of the systems' layout, which optimises exposure to solar radiation, is indifferent to the texture of the landscape. This phenomenon is evident when observing the relationship between the shape of the lots and the footprint defined by the array of photovoltaic panels. The resulting shapes demonstrate the complete indifference between the system and the layout of the lots, which, when observed in its entirety, are the result of the stratification of signs that correspond to the palimpsest of the agricultural landscape. Third, ground-based photovoltaic fields are configured as clusters isolated from their surroundings. The need to protect peripheral systems from material theft requires the installation of video-monitored fences, making the systems both "protected" and "segregated" areas. For example, this means that, from a faunal point of view, the animal "life" that develops inside is isolated from the outside, with the pros and cons that this entails.

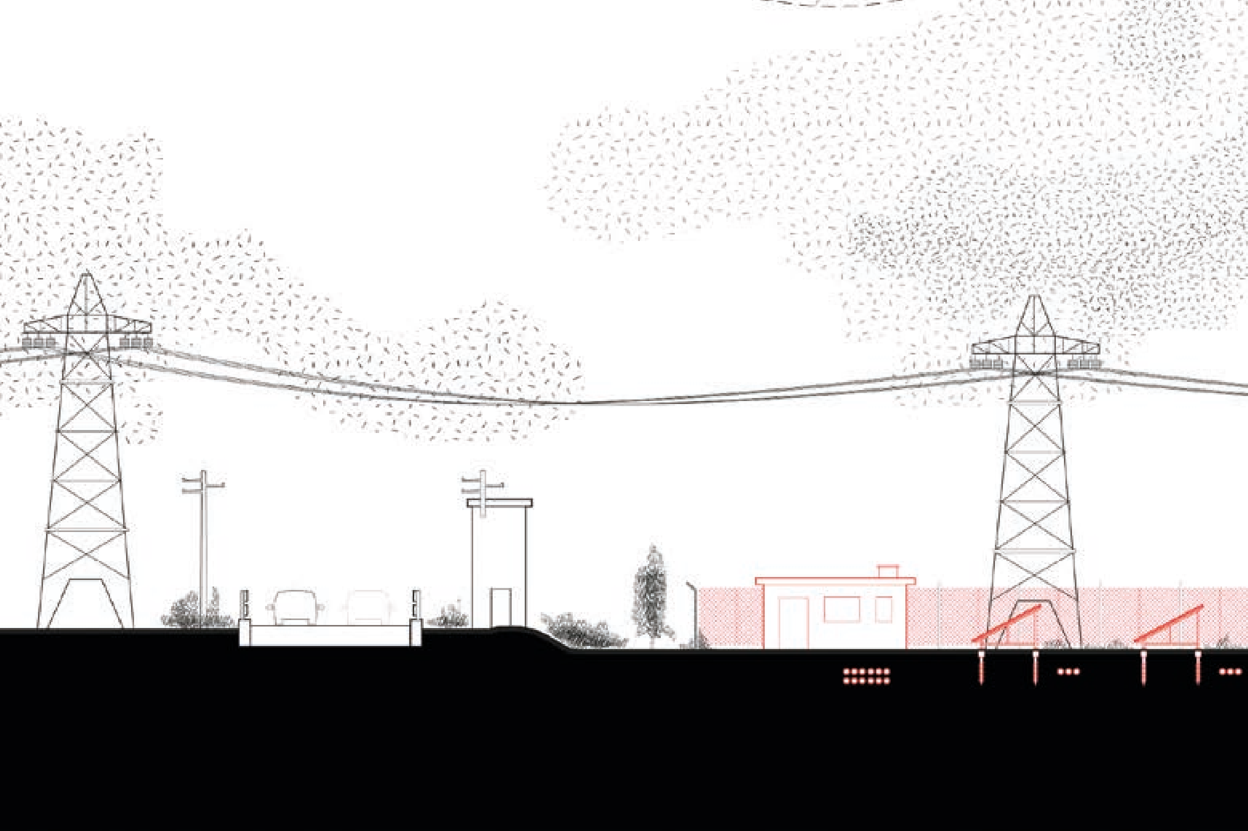
Three contexts and three analytical frameworks

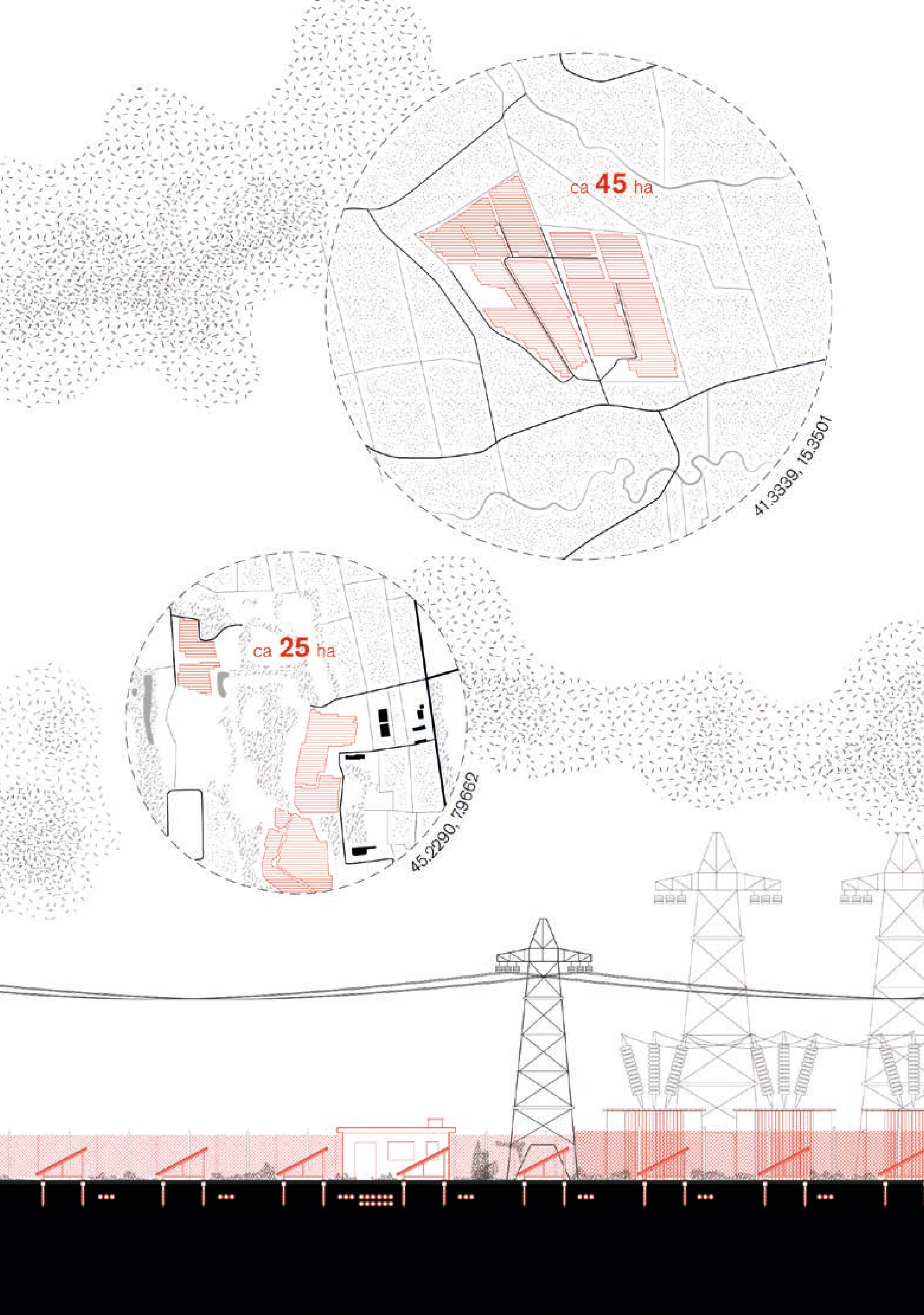
The research hypothesis concerns the decommissioning and revamping of ground-based photovoltaic fields at the end of life, which can be an opportunity for renovating the relationship between urban settlements and the countryside, and introducing a new approach to the project of the energy production system.
Given the morphological recurrence of ground-based

13 Italian legislation is quite cumbersome. Legislative Decree 63/2024 is in force, severely limiting the installation of photovoltaic systems in agricultural areas. However, it introduces a series of exemptions. The legislation on ground-based photovoltaic systems installed in the 2000s has undergone several changes, with a growing focus on environmental impact and land use. Legislative Decree 387/2003 initially introduced a single authorisation for systems of specific power ratings, simplifying authorisation procedures. Subsequently, Legislative Decree 28/2011 promoted using renewable energy sources, including photovoltaic systems, with financial incentives. Legislative Decree 199/2021 introduced further simplifications, especially for industrial and commercial areas, quarries, and landfills.

Productive cities made of
solar panels.






ca 45 ha
41.3339, 15.3501
ca 25 ha
45.2290, 7.9662

photovoltaic fields across the Italian landscape, the research selected three landscapes to develop insights that could be scaled to other contexts. Among the provinces most affected by end-of-life ground-based photovoltaic fields, the research has chosen three contexts that differed in topography and plant density.
The first context is in the province of Brindisi, in the locality of San Pietro Vernotico. Medium and small photovoltaic fields replace agricultural crops, creating a fragmented landscape. In this area, the presence of ground-based photovoltaic fields is large. Their overall impact is intensified by the olive grove crisis caused by *Xylella fastidiosa*, which has caused a decline in olive groves. The olive trees were the "natural" mitigation of the visual impact of these solar plants, which, despite a particularly dense agricultural texture, thanks to excellent solar radiation, have spread across the countryside.
The second context is in the province of Ravenna, where solar plans are increasing. In the landscape of Lugo, shaped by Roman centuriation, solar fields are opportunistically located where agricultural land is less valuable. This case is fascinating because the area is at high risk of flooding, and the photovoltaic fields are located regardless of this condition.
The third context is near Fossano, in the province of Cuneo. This case study is interesting because of the orography of the area. Different from the other two previous cases, the ground-based solar plants are in hilly terrain near a watercourse. Here, they tend to be in areas at high risk of flooding due to the lower productivity of the land and the consequent lower value of the plots.

First framework: measures and densities

The first objective of the research has been to understand the spatial characteristics of the territories through an investigation of their consistency, rationalisation, and measurement.

As Paola Viganò writes «any investigation produces original maps»[14]. This phrase means that all architecture and landscape research cannot escape from a cartographic exploration that can reveal innovative meanings. The construction of new representations

14 Chiara Cavalieri, Paola Viganò, *HM the Horizontal Metropolis a Radical Project*, Zurich, Park Books, 2019, p. 15.

can in fact open unexpected and innovative lines of reasoning. The research examines the three contexts from a quantitative and qualitative perspective. Increasing the observation scale compared to the first analytical phase, which studied the distribution of end-of-life ground-based photovoltaic fields at the national level that allowed the selection of the three cases, the three solarscapes were broken down into their basic components for comparative analysis. The elemental analysis, carried out with GIS tools, allowed us to name the individual components of the solarscape by focusing on the material components. The identification and analysis of each element allowed us to construct, for each solarscape, a specific knowledge atlas. Each element of the atlas was then compared with the others to identify any recurrences relating to the consistency and location of the photovoltaic fields on the ground.

Second framework: processes and traces

The second objective of the research has been to bring out the processes that structure the landscapes and the implications connected to the presence of photovoltaic fields.

The German Romantic philosopher, Novalis, said that great history is an unattainable undertaking, that only the small history projected onto places is practicable, and that it expresses a fragment of a unity too large to dominate[15]. Starting from the idea that transformation processes and practices are concentrated in places, the research increases the observation scale and delves into the processes that shaped the three contexts under examination. The research identifies and analyses the traces of successive human sedimentations beyond the current conformations. Each examination is structured around identifying the agricultural texture that marks and structures the three contexts, which, case by case, takes on different connotations. The three landscapes are described in their complexity as historically stratified palimpsests by identifying the traces and processes that shaped them.

15 Novalis, *Frammenti*, Milan, Rizzoli, 1976, pp. 273-274.

Third framework: next solarscapes

The third objective of the research has been to develop a vision for the future solarscapes: a radical strategy for the energy production system project that includes the countryside, the infrastructures, and the small urban settlements involved, starting from the decommissioning and revamping of the ground-based photovoltaic fields.

Concerning the mainstream debate on the transformation of the landscapes, the research aimed to construct, through design exploration, a counter-theory that seeks to identify possible morphologies for the renewal of solar landscapes intended as a minimum cohesive intervention unit. It is a counter-project focusing on territorial supports that work against common representations. The research protocol investigates the three different contexts through models and axonometric representations inspired by the model of Frank Lloyd Wright's *Broadacre City*[16]. In the frame defined by the scale, that change depending on the design level, the adaptation and valorisation of the existing spatial capital is represented and tested. New space figures are revealed and introduced to structure the new spatial morphology. Through prototypes, the research describes adaptations of urban and landscapes layouts, productive areas, infrastructures, and eco-systems. The research identifies three alternative Morphological Layouts (ML) based on the redistribution and relocation of photovoltaic fields on the ground to redesign the landscape and increase the ecological and perceived landscape quality. Each ML provides for decommissioning at least a part of the existing photovoltaic fields and their relocation to another area identified as suitable to increase the overall quality of the examined landscapes. The strategies are the starting point for developing specific solutions for decommissioning single photovoltaic fields that can be redesigned according to the opportunities offered on a case-by-case basis.

ML 1: Clustering in the landscape. This strategy aims to redesign a rural energy landscape in which the different productions, agricultural and energy, find integration. The principle is to build clusters for electricity production by working on the saturation of the current production areas.

16 Frank Lloyd Wright, cit., 1932.

ML 2: Pairing with infrastructures. The goal is to redesign a landscape in which photovoltaic fields are placed to become part of the infrastructural system that designs the territory, moving away from the idea of integration with the productive agricultural landscape.
ML 3: Filling Urban margins. The support infrastructure that organizes the location of the photovoltaic fields is the inhabited centre. The principle consists of assimilating the photovoltaic fields to urban artifacts capable of redrawing the edges of the settlements.

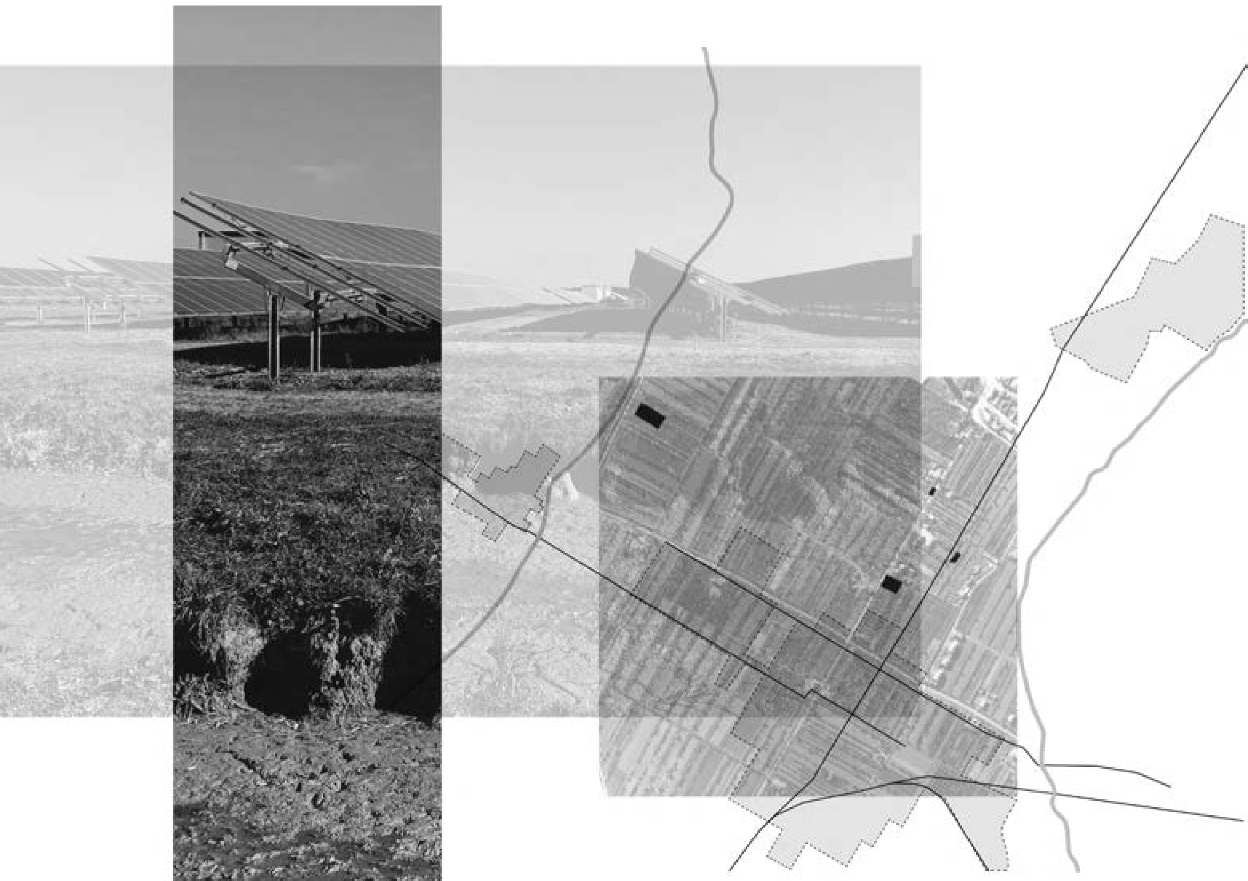
The three layouts are overlapping and non-exclusive, and involve two levels of action. The first, at the urban level, consist of determining the design actions to be applied case-by-case to ground-based photovoltaic fields – decommissioning/revamping, but also relocation. Looking at the landscape in its entirety, the first project action designs a strategy aimed at identifying the most coherent and performative solarscape morphology. The second, concerns the possible decommissioning or revamping interventions to be applied solar field per solar field. The scale increase determines the identification of possible interventions to renew the overall landscape. Possible solutions are tested for each of the three contexts examined.

Conclusion: a vision and a research protocol
Next Solarscape is a vision and a tool to overcome the current lack of design of solar energy landscapes, which follow opportunistic logic. What has been described is not a method but rather an action protocol to be adapted depending on the context being investigated. A protocol is less rigid than a method. The protocol adapts to specific situations and different cases. The solutions proposed for the three contexts investigated are just some possible solutions for their renewal and empowerment from a productive, ecological and perceptive point of view. The goal, however, is to propose new forms and options that show the intrinsic potential and adaptability of the proposed protocol. The research protocol is open to further investigation and (we hope) is a fertile ground for rethinking the current planning practice and solarscapes project.

ENERGY LANDSCAPES

PALIMPSEST, PROCESS AND SCALES

SARA PROTASONI



«The objective is no longer so much to think and act on the landscape, but to think and act with the landscape, engaging with society and its spaces by starting from the questions that the landscape itself poses [...] That is to say [...] the issues of the soil (in a philosophical sense, but also concretely biological and 'agronomic'), of living things, of the scales of thought and of urban and territorial action, of history and memory, and finally and above all, of the forms and values of collective (political) action in the planning of existence. The landscape therefore ceases to be an object (to be dealt with among others, and usually one of the last, in the name of an ideology of the picturesque), to become a method, a set of questions about societies and their spaces, and a horizon of meaning for action and thought»[1].

The research addresses the issue of transforming existing photovoltaic parks that have reached, or are approaching, their end-of-life. This is a phenomenon poised to become substantial, widespread, and extensive throughout Italy for a variety of reasons, though primarily due to the expiration of the various incentive schemes that supported the widespread installation of small and medium-sized ground-mounted photovoltaic parks between 2010 and 2020.
Within this framework, the interplay between national and local regulations and the European programmes aimed at achieving decarbonisation introduces a broad range of variables and uncertainties. The hypothesis put forward is that this new challenge – the transformation of photovoltaic parks at or nearing their end-of-life – also engages architectural and landscape design at various scales, along with their conceptual and operational tools. Specifically, the operational unit at Politecnico di Milano – DAStU has examined which conceptual categories and operational tools landscape architecture can effectively deploy within the processes that involve either revamping (aimed at the technological upgrading of the plant) or total decommissioning (aimed at reconfiguring the sites of former installations following their dismantling).
The research is based on the concept of new energy landscape, for which there is a wealth of detailed literature[2]. The concept is that, similarly to other major

1 Jean-Marc Besse, *Paesaggio ambiente. Natura, territorio, percezione*, Rome, DeriveApprodi, 2020, p. 119.

2 Among the other, Sven Stremke, Dirk Oudes, Paolo Picchi, *The Power of Landscape Novel Narratives to Engage with the Energy Transition*, Rotterdam, nai010 Publishers, 2022; Sylvain Allemand, Auréline Doreau, Bertrand Folléa, *Paysages et énergies. Une mise en perspective historique*, Paris, Herman, 2021; Dirk Sijmons, *Landscape and Energy. Designing Transition*, Rotterdam, nai010 Publishers, 2014; Martin J. Pasqualetti, *Reading the Changing Energy Landscape*, in Sven Stremke, Andy van den Dobbelsteen, *Sustainable Energy Landscapes. Designing, Planning, and Development*, Boca Raton, CRC Press, 2012, pp. 11-44.

Previous page. The collage shows the solar photovoltaic plant as the latest inscription on a deeply layered surface, not just a standalone feature. It invites considering the landscape as a dynamic, multi-temporal field where all epochs coexist and continually reshape one another. Collage by Giulia Cazzaniga, 2025.

infrastructural transformations (e.g., irrigation canal networks, land reclamation, hydropower systems in some Alpine districts, energy transport networks, roads and highways, etc.) it is possible and necessary to promote a profound cultural change, which looks at infrastructures for energy production as works that contribute to building a territory, concretely implementing (in a place, in a time and with respect to determined economic, technological and cultural conditions) the functional and meaningful relationships between the elements and systems of the inhabited world, between nature and artifice.
This delimitation of the research field raises several general issues of great complexity. These are currently held in abeyance but the research aims to contribute to a hypothetical response, based on the conviction that the processes surrounding solar photovoltaics involve a multiplicity of objectives, actors, techniques, and necessary and possible actions that must be addressed with an integrated approach. The objective is to promote a profound cultural shift in the conventional way the topic is addressed.

This shift is based on several premises.
1. The transition towards energy production from renewable sources is a shared goal at various levels, from local to global.
2. To be effective, the renewable energy production facilities must be exposed to their energy sources (sun, wind, water). Consequently, by their very nature, they radically alter the configuration of the territories on which they are located, not only with regard to morpho-spatial and eco-systemic aspects, but also cultural aspects related to shared representations and the narratives connected to them.
3. Moving beyond the conventional performance-based approach, which regards them exclusively as technological facilities, the research proposes to consider renewable energy production facilities as new landscapes, which can be defined as energy landscapes.
4. The transition from the idea of a facility to that of an energy landscape is based on a concept of landscape as a complex and continuously changing entity, the result of stratified transformations. These are caused

both by human intervention for the exploitation of natural resources and by natural processes (often unpredictable)[3] that modify places within a complex system of reciprocal relationships, according to the cyclic rhythm of the seasons and the linear progression of biological processes involving the various life forms that inhabit them.

5. This "processual" vision is embodied in an approach to the topic that considers the entire life cycle of the facilities. This includes planning, various levels of design (including permitting processes), construction, the management of the technological devices and the site as a whole (which includes routine maintenance and revamping interventions), and finally, the management of their end-of-life, which is specifically addressed in the research published in this volume.

Energy landscapes

The discourse surrounding energy landscapes fundamentally intertwines, alongside the diverse plants and technologies embedded within them, with a number of other entities and systems. These encompass cultural landscapes, traditional rural systems, open urban spaces, hydrological networks, and ecological corridors. Within these contexts, formal, spatial, and cultural dimensions are intricately interwoven, manifesting through multiple transformative dynamics of varying durations. In this interplay, spontaneous elements and phenomena are reshaped by anthropogenic actions, which, in turn, are profoundly influenced by these natural processes.This complex interaction between the spontaneous and the anthropogenic necessitates the invocation of interpretive frameworks and operational methodologies from diverse disciplines, including architecture, geography, history, and ecology. Such interdisciplinary approaches are essential for deciphering the palimpsest of space and time in which human communities and natural ecologies have mutually influenced one another through an ongoing process of co-evolution. Addressing the theme of energy landscapes in contemporary discourse requires a steadfast commitment to this premise. Acknowledging the intricate relationships between natural and human systems is imperative for the development of sustainable

3 Catherine Mosbach, *Travresées Crossing*, Paris, Ici interface, 2010.

energy solutions that not only respect but also enhance the cultural and ecological fabric of our environments.
In a recent essay, Peter Sloterdijk[4] outlines a metabolic history of *Homo sapiens*, centred on the history of fire as a general synonym for energy. Following this interpretation, it could be stated that the transformation of the surrounding environment by the human species to generate its environmental niche and transform it into a cultural world is always connected to the different possible forms of energy and the different ways of producing and distributing it.
In this approach, the relationship between nature and techniques, which underpins these intentional transformations, must be understood in all its complexity and ambivalence. Bernard Stiegler[5], revisiting the Platonic version of the myth of Prometheus and Epimetheus, highlights how the human species is the product of a twofold error. This marks its constitution not only as *Homo faber* but also as *Homo sapiens*, constantly forced to re-think and therefore re-modulate a posteriori the technological conditions of its existence, and continuously confronting the question of the limits of its transformative action.
Epimetheus, as recounted in Plato's dialogue Protagoras, is the twin brother of Prometheus. Having been given the task of distributing natural faculties to all living species, he forgets about humans, condemning them to be deprived of some essential prerequisites for their survival. Only the subsequent theft of fire and techniques, carried out by Prometheus at the gods' expense, would attempt to remedy this error by violating the boundary that should have distinguished the human from the divine sphere, and by instilling in humankind the belief that they possess almost divine tools for understanding and manipulating the world.
Today, it is clear that the constantly evolving artefacts and techniques necessary for human existence in the world must be continually scrutinised regarding their sustainability, the so-called "limits to growth"[6], and their ethical and political value. This is an unavoidable step to provide answers to some urgent and unpostponable challenges, such as the defence of biodiversity, considered an essential heritage for ecological balance;

4 Peter Sloterdijk, *Prometheus's Remorse. From the Gift of Fire to Global Arson*, Cambridge, The MIT Press, 2024.

5 Bernard Stiegler, *La technique et le temps, 1: La faute d'Épiméthée*, Paris, Galilée, 1994.

6 Donella H. Meadows, Dennis L. Meadows. Jørgen Randers, William W. Behrens III, *The Limits to Growth*, New York, Universe Books, 1972; Hans Jonas, Das Prinzip Verantwortung, Insel Verlag, Frankfurt 1979. Bruno Latour, Peteer Weibel (eds.), *Critical Zones: The Science and Politics of Landing on Earth*, Cambridge, The MIT Press, 2020.

the protection of primary resources such as water, air, and soil; combating climate change through emission reduction and the promotion of renewable energies; and ensuring equity in resource accessibility, guaranteeing that all peoples have the right to a dignified quality of life without compromising the future of coming generations. It is in relation to this broad frame of reference that the general theme of ecological transition, and more specifically, the construction, management, and decommissioning of facilities for producing energy from renewable sources, must be brought into focus. This is necessary to fully comprehend the reasons behind the current public debate, in which ideological simplifications, divergent positions, and irreconcilable conflicts emerge. Energy landscapes should be understood as contested landscapes, characterised by competing interests, values, and perspectives concerning their use, management, and worth. Recognising the social, economic, and environmental implications associated with energy production and consumption is, therefore, a critical consideration for addressing the complexities inherent in design and transformation processes.

Cultural landscape / Ecological landscape

As is well known, within the European tradition, the word "landscape" simultaneously indicates a thing and its representation, understood as perception, view, and prospect, and has even come to define a genre in the history of painting. In this sense, landscape is commonly invoked in reflections on infrastructure based on how it is perceived (individually and collectively): it becomes a represented landscape and, consequently, a cultural product, as established by the European Landscape Convention[7]. This approach opens up a field of action for "landscape architects/conservators" who, by centring on the problem of beauty[8], seek to define criteria and various forms of mitigation that would allow the issue of new infrastructure acceptance by a territory's inhabitants to be addressed. This purely visual idea of landscape is based on a dualistic notion that contrasts human beings (the subject) with their living environment (understood as an object), within an anthropocentric perspective.
A different idea of landscape underpins the work

7 The European Landscape Convention (ELC), adopted by the Council of Europe in 2000 with the aims to promote the protection, management, and planning of landscapes across Europe, states «landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors».

8 The notion that the primary (if not exclusive) role of landscape architecture is to address the formal and perceptual aspects of places remains prevalent in numerous fields. See, among the many other texts that could be cited, Lucius Burckhardt, (Markus Ritter, Martin Schmits eds.), *Why is Landscape Beautiful? The Science of Strollology*, Basel, Birkhäuser, 2015.

presented here by the Politecnico di Milano-DAStU group. It is now understood that the space in which we operate as landscape researchers and designers should be conceived as a field[9], a place open to all manner of relationships, through which various living entities traverse and transform it. It is inhabited, crossed, modified, cultivated, constructed, and devastated not only by humans, animals, plants, stones, mosses, clouds, viruses, and bacteria, but also by narratives, objets trouvés, and images, which are capable of constantly re-founding multiple processes and interacting to produce new and mutated forms. These forms coexist with ancient – sometimes very ancient – and highly resilient entities. Within this complex web of dynamics, time (in its multiple dimensions, from a single event to a geological era) plays a crucial role as a measure of transformative processes. This always raises the question not only of the survival or extinction of various living entities, but also of the inertia and modification of the constituent elements of physical space.
To comprehend landscape in this manner implies a systemic description based on relational scales that unlock significant worlds beyond the visible. These include the dimensions of the infinitely small and the infinitely large, which transcend our perceptual capacities. We must account for the microscopic scale when referring to organisms such as viruses and bacteria, or even the macroscopic, if not planetary, scale when referring to the worlds described by geography or geology[10].

Building upon the ideas articulated by Augustin Berque many years ago[11], landscape is something that is shared, mediated by words and images, and interpreted by cultural archetypes. It should not be regarded exclusively as a thing, but rather as a mutable set of relationships, connected to the capacity of living beings (human and non-human, animal and plant) to capture the messages of the natural environment and bring them into the circuit of their own acting/being. For the human species, this is a relationship of both ecological and cultural significance, understood as a synthesis capable of guiding human action within their living environment.
It is in this relationship that the dense network of

9 James Corner defines "Field Operations" as a dynamic, site-specific approach to urban design and landscape architecture that perceives landscapes as evolving systems rather than static entities. This methodology prioritises an in-depth understanding of the unique ecology, culture, and history of each site to foster the creation of innovative public spaces. Rather than adhering to a singular style, Field Operations emphasises process and interdisciplinary collaboration, aiming to design vibrant, functional, and authentic environments that adapt and transform over time. James Corner (ed.), *Recovering Landscape: Essays in Contemporary Landscape Architecture*, New York, Princeton Architectural Press, 1999.

10 Alessandra Capuano with Veronica Caprino, Liliana Impellizzeri Laino, Athanassia Sakellariou (eds.), *The Landscape as Union between Art and Science. The Legacy of Alexander von Humboldt and Ernst Haeckel*, Macerata, Quodlibet, 2023.

11 Augustin Berque, *Médiance, de milieux en paysages*, Paris, Reclus Belin, 2000 (original ed. 1991).

connections linking the elements of physical space (natural and artificial, living and mineral) with the universe of meanings and values is manifested.
The keyword for this perspective is "coexistence", which underpins positions that theorise the need to practice a relationship with the world centred on seeking a possible co-evolution between the different entities comprising the biosphere.
Designing landscapes as arenas for coexistence makes possible a relationship between nature and culture wherein the direct, sensory experience of the world of living things prepares the individual for a full (non-intellectualist) understanding of life. This is fundamental for humans to become custodians of rights and duties towards the community of living beings.
It is at this point that a new significance emerges for landscape design, which increasingly assumes a greater responsibility in the spatial and functional prefiguration of "common" living contexts for all living species. This is done consciously, through the shared objective of communal care across different spheres of intervention (from the state and political action to individual responsibility).
As Paola Viganò has highlighted in a recent volume[12], the post-structuralist critique regarding the large-scale causes and responsibilities for the environmental crisis – initiated by Michel Foucault's reflection on the relationship between the exercise of power and bodies and life[13] – challenges architecture to position its projects within a broader biopolitical framework. This moves towards a kind of affirmative biopolitics (a concept drawn from earlier studies by Roberto Esposito)[14] «committed, from the perspective of constructing and transforming the inhabited space, to keeping a population alive, protecting, educating, and emancipating it»[15].
From this perspective, investigating the potential transformation of end-of-life photovoltaic sites implies an approach that can never be deduced from the application of a single model, but is instead built through multiple approximations. This is achieved by investigating the profound changes that have affected a specific territorial area and the installations within it over a given time interval. These changes require different disciplines

12 Paola Viganò, *Il giardino biopolitico. Spazi, vite e transizione*, Rome, Donzelli Editore, 2023.

13 Michel Foucault, *The Birth of Biopolitics: Lectures at the Collège de France 1978-1979*, New York, Picador, 2008.

14 Roberto Esposito, *Bìos: Biopolitics and Philosophy*, Minneapolis, Minnesota University Press, 2008.

15 Paola Viganò, cit., 2019, p. 109.

(landscape architecture, agrarian sciences, natural sciences, and engineering, cultural sociology) to engage with one another, sometimes through antagonism, sometimes through positive synergies that can generate high-quality outcomes.
An adaptive project-based approach is emerging that can observe phenomena at different scales (from the geographical scale of the territory to the close-up scale of architecture). It can synthesise diverse knowledge (from natural sciences, earth sciences, and human sciences) and, above all, engage with transformation processes adaptively, by addressing decision-making, implementation, realisation, and management aspects in an integrated manner. This means working along a multidimensional and extended temporal axis to include different natural and anthropogenic cycles and processes[16]. Landscape architecture can usefully enter into the processes of defining and implementing transformations, not to perform a scenic embellishment, but to combine art and technique in defining effective solutions for managing rainwater, improving the quality of air, water, and soil, increasing species biodiversity, contributing to the development of complex ecosystems, and configuring places for new public uses and programmes, while simultaneously working on the legibility of the site and its cultural values[17].

Palimpsest: space, time and ecology

The emergence of landscape ecology as a specific field of research has prompted the disciplines of design and planning to consider not only the forms and uses concerning inhabited territories, but also the dynamic, multispecies relationships that constitute and transform space into a complex system of interactions involving soil, water, vegetation, animal populations, microbes, and even viruses and bacteria. Today, it is widely acknowledged that these components interact in complex and continuously evolving ways, and in ways that are not always visible, driving the continuous transformation of landscapes.
The concept of the palimpsest[18] allows us to highlight how landscapes are never entirely new, but are rather overwritten spaces where traces of the past coexist with

16 Anne Whiston Spirn, *The Language of Landscape*, New Haven and London, Yale University Press, 1998.

17 Elizabeth K. Meyer, *Sustaining beauty. The performance of appearance A manifesto in three parts*, in "Journal of Landscape Architecture", n. 3, 2008, pp. 6-23.

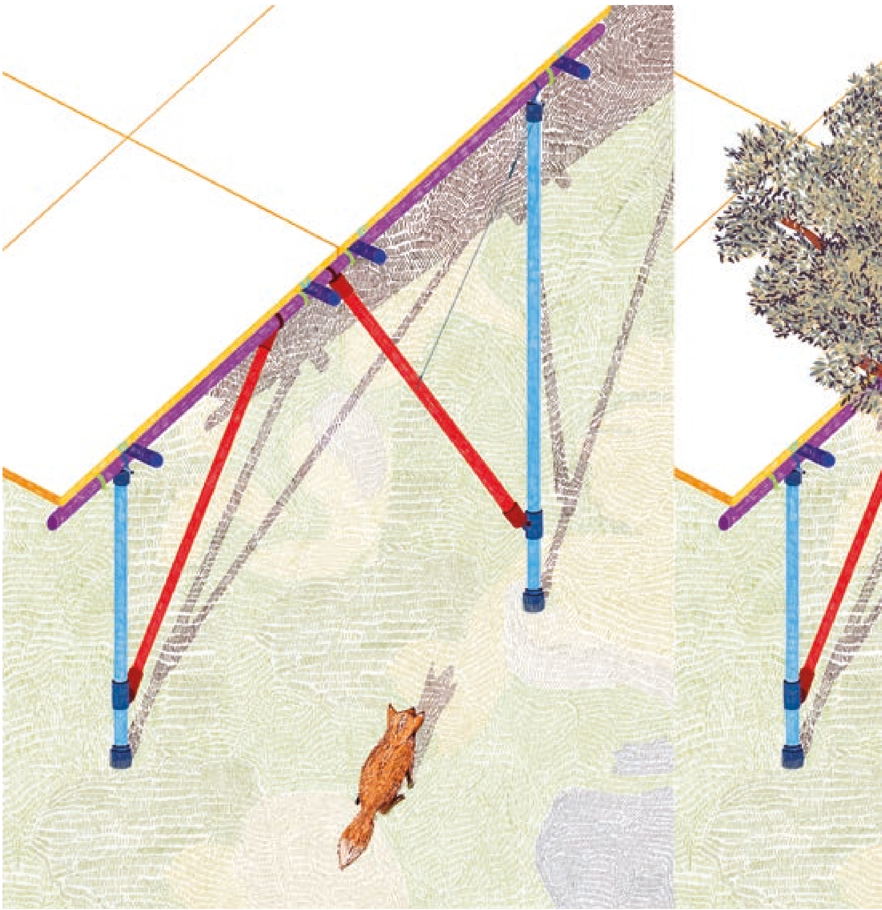
18 André Corboz, *The Land as Palimpsest*, in "Diogens", n. 121(31), pp. 12-34.

elements resulting from emergent processes. This vision resonates with contemporary ecological approaches that integrate biotic and abiotic systems – soils, waters, vegetation, animals, humans, and even microbes – into a single dynamic field of relationships. Within this, it is possible to recognise a design activity (collective and individual) that tends to guide the process towards predetermined goals, even if they are sometimes in conflict with one another. To use Corboz's words, the territory is a project. Yet, the project Corboz speaks of does not tend towards a closed and defined form; rather, it is the set of actions that trigger processes of transformation according to often unpredictable dynamics and geographies.

Corboz's insight consists in recognising that the landscape, much like a palimpsest, preserves traces of previous uses, forms, and meanings beneath its current surface. Human interventions, whether agricultural, infrastructural, or symbolic, do not completely erase the past but rather inscribe new layers upon it. This interpretation has supported a design philosophy that does not consider a place as a tabula rasa. Instead, it employs specific tools of description and interpretation necessary to account for the complexity of inherited forms, reading the site as a text. In relation to this text, the design process proceeds primarily through acts of negotiation: with the site, its history, and the multitude of entities that traverse, modify, cultivate, construct, and devastate it. From this perspective, architecture and landscape research become practices aimed at rewriting, annotating, and reinterpreting rather than simply imposing.

In contemporary landscape architecture, the narrative dimension implicit in this kind of design action has acquired increasing centrality. Indeed, landscapes are to be considered not only as physical environments but also as narrative devices, constructs capable of conveying stories, identities, and future aspirations. In this sense, the task of architecture also involves creating spaces that can stimulate the imagination, giving form to values and meanings, evoking individual and collective memories, and inspiring aspirations and desires for change within complex social, ecological, and cultural contexts.

The centrality gained from acknowledging the narrative significance of the landscape suggests moving beyond the conventional approach – which focuses on formal definition, ecological function, and decorative effect – towards engaging with the genius loci, the dimension of time, and the lived experience of its inhabitants. The landscape becomes a palimpsest, a stratified system in which it is possible to identify not only the traces of past actions and projects, but also potential for the future. The aim of design should be to construct landscapes that engage users and inhabitants as co-authors of the value

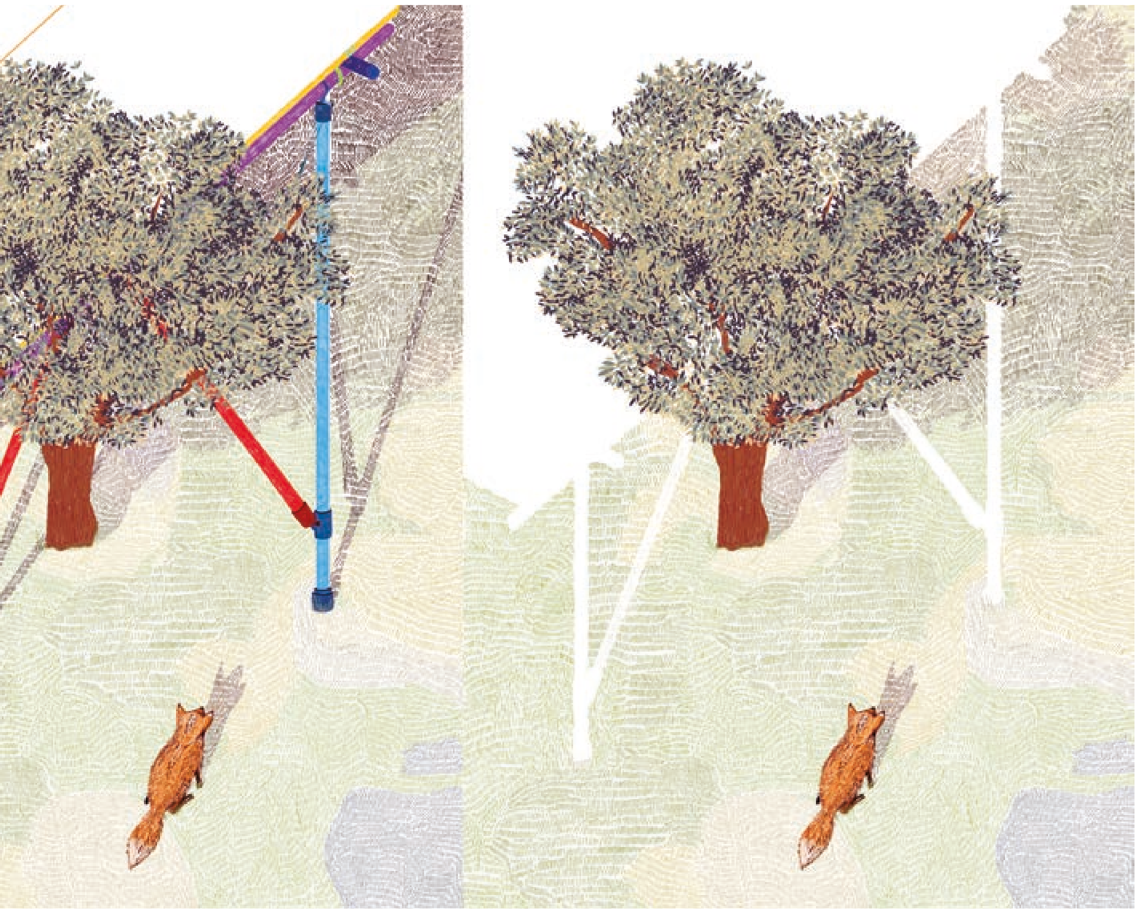


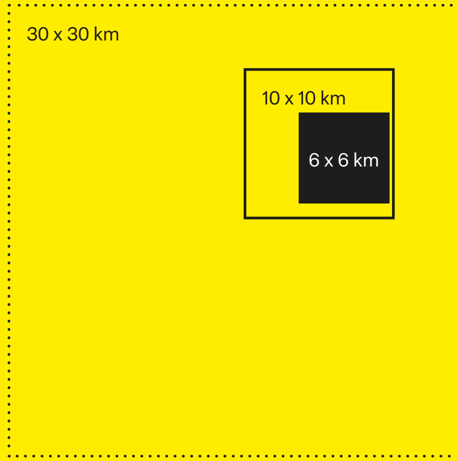
The evolution of the Energy landscape as a layered phenomenon encompassing technical elements and biodiversity.

Hand drawing by Simone Baccaglini, 2025.

and meaning of places, assigning a central role to their movement, the multiplicity of experiences of the different bodies that traverse the space, and the behaviours that inhabit it, both ritualistic and unforeseen. James Corner's idea of "recovering landscape"[19], developed over twenty-five years ago, moves in this same direction, highlighting how the importance of the narrative dimension of places must be deeply connected to issues such as programme, spaces for particular uses, and the broader topics of function, economics, logistics, the constraints derived from feasibility, and desires.

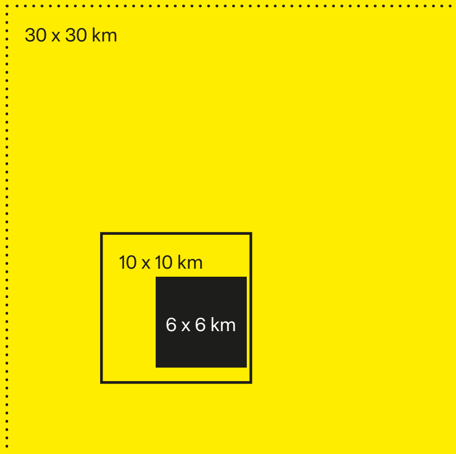
19 James Corner (ed.), cit., 1999.



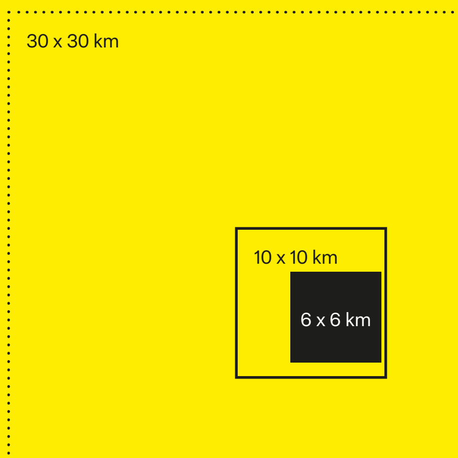


Cuneo / Fossano
N 44° 33' 28'' - E 7° 45' 12''

M E A S U R E S AND DENSITIES



Ravenna / Lugo
N 44° 26' 32'' - E 11° 54' 22''



Brindisi / San Pietro Vernotico
N 40° 30' 50'' - E 17° 59' 15''

MAPPING KNOWLEDGE

THREE ATLASES

ILARIA TONTI - RICCARDO RONZANI[1]

Measuring and mapping is a cognitive act.
What does it mean to be able to measure a territory and, starting from those measurements, construct maps that can reproduce the image of a landscape? What is the value of mapping energy morphologies in order to compare different contexts? Moreover, how can this operation open up the project?

The role of cartographic exploration

Mapping is not limited to census, systematization, and data representation. On the contrary, it has the potential to become an actual process of cartographic exploration capable of connecting critical observation, interpretative processes, and the identification of meanings, as well as highlighting both the spatial relationships and the contradictions of the contemporary landscape. Therefore, the map does not merely record phenomena, but orders, reworks, and makes them legible within a design-oriented logic. Mapping is both an analytical tool and a performative device that frames reality and constructs new narratives of the landscape[2].
Defining the concept of "field"[3] provides a conceptual framework of fundamental importance. It is neither sufficient nor proper to construct maps by isolating individual objects; rather, it is necessary to read extensive systems of relationships, flows, and transformations. An example of this is the morphology defined by different energy infrastructures (dedicated to energy production and distribution), which today significantly impacts large areas of land. Even more evident than other energy systems, renewable energies, spread over vast land areas, are a force for spatial reconfiguration[4] and landscape transition[5]. This transformative force requires new forms of representation, as shown by recent theoretical reflections on the relationship between energy transition and landscape design[6]. Photovoltaic fields have a particularly significant impact among all renewable energies due to their characteristics and extent.
In this sense, mapping ground-based photovoltaic fields means documenting and measuring the spatial impact on the ground of a phenomenon that began a few decades ago but is still at the center of a growing debate

1 The two authors jointly conceived and wrote this chapter, defining its theoretical framework, structure, and methodological approach, as well as the critical reflections. Ilaria Tonti curated all the mapping elaboration, from data collection and harmonisation at national and regional scales. Riccardo Ronzani contributed to the graphic post-production of the maps in the first section dedicated to the three Atlases of Brindisi, Ravenna, and Cuneo.

2 Jamer Corner (ed.), *Recovering Landscape: Essays in Contemporary Landscape Architecture*, New York, Princeton University Press, 1999. And, Jill Desimini, Charles Waldheim, *Cartographic grounds: Projecting the landscape imaginary*, New York, Princeton Architectural Press, 2016.

3 Stan Allen, *From object to field*, in "Architectural Design", n. 5-6, 1997, pp. 24-31.

4 David Bauer, Santiago Martínez Murillo, Philipp Misselwitz, Yulia Navatskaya, Joseph Smithard (eds.), *Power, flows, and transformation: Portraits of Berlin-Brandenburg energy spaces*, Belin, Jovis, 2025.

5 Martin Junior Pasqualetti, Sven Stremke, *Energy Landscapes in a Crowded World: A First Typology of Origins and Expressions*, in "Energy Research & Social Science", 36, 2018, pp. 94-105.

6 Sven Stremke, Dirk Oudes, Paolo Picchi, *Power of Landscape: Novel Narratives to Engage with the Energy Transition*, Rotterdam, nai010 Publishers, 2022.

on the adoption of renewable energy within a regulatory framework that seems uncertain in defining clear criteria for environmental and landscape compatibility.
Mapping photovoltaic fields and their territorial and landscape relationships means highlighting a phenomenon that raises complex issues of land use, ecological alteration, and perceptual transformation of landscapes. While the spread of solar energy is a necessary step towards reducing climate-changing/fossil fuel emissions, it also entails – despite the rhetoric of being a temporary and reversible action – permanent transformations of the soil and lasting changes in the ecological and landscape balance[7].

All these tensions embody the non-neutrality of the mapping operation. As a tool for documenting and interpreting processes that intertwine environmental and landscape issues, risk dynamics, and territorial enhancement processes, it creates tension between the spatial dimension of the project and current planning practices. Mapping, therefore, means building an indispensable tool for anticipating project scenarios.
Recent literature also points to the need to move beyond purely location-based datasets and reports[8] to achieve richer mapping forms capable of rendering the geometry, extent, and history of installations. This type of multi-level view, made possible by geospatial tools, allows photovoltaic fields to be interpreted as "technical lands"[9], that is, as territories in which environmental, infrastructural, and political values intertwine, generating new spatial figures that architecture and design must interpret.
With this in mind, this chapter aims to contribute to a critical reflection on the role of mapping, where ground-mounted photovoltaic systems take on the role of layer zero: a foundational level for comparing different themes (environmental, landscape, settlement) in three Italian contexts, and a knowledge base for developing design scenarios geared towards the decommissioning and revamping of end-of-life plants.
The objective is therefore twofold: on the one hand, to construct an interpretative atlas consisting of multiscale and multilevel maps; on the other, to provide reflections

7 Shiqi Tao, John Rogan, Su Ye, Nicolas Geron, *Mapping photovoltaic power stations and assessing their environmental impacts from multi-sensor datasets in Massachusetts, United States*, in "Remote Sensing Applications: Society and Environment", Vol. 30, 2023.

8 Lucas Kruitwagen, Kyle Story, Johannes Friedrich, Logan Byers, Sam Skillman, Cameron Hepburn, *A global inventory of solar energy generating units*, in "Nature", n. 598, 2021, pp. 604-610. And, GSE, *Atlaimpianti: Atlante Geografico degli impianti incentivati*, 2021; GSE, *Rapporto Statistico 2022. Solare Fotovoltaico*, 2023; GSE, *Rapporto Statistico 2023. Solare Fotovoltaico*, 2024. See www.gse.it.

9 Jeffery S. Nesbit, Charles Waldheim (eds.), *Technical lands: A critical primer*, Berlin, Jovis, 2022.

that can support design activities aimed at transforming energy landscapes. This work continues theoretical reflections on including energy infrastructure in energy landscapes[10] on involving nature as architectural design matter[11], on landscape planning[12], and on the horizontality of new settlement forms[13].

Photovoltaic system as layer zero

Within this general framework, the mapping and interpretation of ground-based photovoltaic systems play a central role in this research. As layer zero, they constitute the observation lens to restore the spatial characteristics of the complex energy infrastructure system and interpret the territorial dynamics induced within the Italian context.

The relevance of photovoltaics depends not only on its ever-increasing diffusion in our territories, but also on the methodological difficulties involved in their census and analysis. The absence of comprehensive databases, the fragmentation of sources, and the need to distinguish between building-mounted systems and ground-based photovoltaic fields make the process of cartographic documentation a critical, central, and necessary operation for organizing sources, defining perimeters, and relating heterogeneous data and elements within a unified framework.

Several international studies highlight the difficulty, even today, of obtaining an up-to-date and geometrically accurate spatialization of solar installations and their territorial impact[14]. The available global and national datasets often provide accurate location information, but they often lack fundamental attributes such as geometry, size, year of construction, or type of panels installed. Regional datasets (geoportals) include perimeters/surfaces, small energy production buildings, and aereal electric lines. However, these too lack precision and cartographic updates. This knowledge gap prevents an adequate assessment of the transformations induced by the solar transition on landscapes and ecosystems.

The mapping work proposed here aims to partially fill this knowledge gap by integrating different sources to provide a consistent, yet multi-scale and multidimensional interpretation of the phenomenon. This involved

10 Sylvia Crowe, *The landscape of Power*, London, Architectural Press, 1958. And, Dirk Sijmons, *Landscape and Energy. Designing Transition*, Rotterdam, nai010 Publishers, 2014.

11 Ian McHarg, *Design with Nature*, New York, History Press, 1969. And, Frederick Steiner, Richard Weller, Karen M'Closkey, Billy Fleming (eds.), *Design with Nature Now*, Cambridge, Lincoln Institute of Land Policy, with The McHarg Center, University of Pennsylvania, 2019.

12 Charles Waldheim, *Landscape as Urbanism: A General Theory*, Princeton, Princeton University Press, 2016.

13 Chiara Cavalieri, Paola Viganò, *HM the Horizontal Metropolis a Radical Project*, Zurich, Park Books, 2019.

14 Lucas Kruitwagen et al., cit., 2021. And, Shiqi Tao et al., cit., 2023.

identifying the extent of photovoltaic fields in relation to the actual footprint of the panels, recognizing the construction types and technologies used to place them within chronological sites, and tracing the relationships with the energy distribution network from the local scale to connections with large transformation hubs.
A further level of investigation concerned the architecture of the energy system: transformer buildings, electrical substations, fences, access routes, the trajectories of extra-high, high, and medium voltage lines, and the location of pylons. These elements, often overlooked in large-scale representations, are fundamental to understanding the overall spatial configuration of the infrastructure and its relationship with the territory. This approach enabled the correlation of the installations' technical characteristics to future decommissioning, maintenance, or reuse scenarios. In this sense, we can say that the mapping work took on the value of "architectural cartography", capable of bringing out the materiality of the photovoltaic system, beyond its mere area extension.
The result is a representation that connects the energy dimension with the multiple forms of the territory – agricultural, infrastructural, and landscape – with conditions of risk, constraint, and environmental protection. The description of the landscape, from mere localization to high-resolution geo-referenced mapping, allows the description and assessment of the environmental impacts and the relationships between energy production and land transformation[15]. This detailed mapping system is therefore a prerequisite for subsequent analyses and an indispensable tool for monitoring the cumulative effects of the implementation of renewable energy plants. This work is of fundamental importance and is an extreme interest in supporting the redesign of energy landscapes, combining end-of-life projections with new trajectories for possible developments.

The reading and mapping matrix

In order to systematically address the cartographic survey of the three selected Italian case studies – areas with a high density of photovoltaic plants located respectively in Puglia (province of Brindisi), Emilia

15 Shiqi Tao et al., cit., 2023.

Romagna (province of Ravenna), and Piemonte (province of Cuneo) – a descriptive and interpretative matrix was developed. This matrix combines a multiscale approach with interpretative themes.

The objective of the matrix was to provide a methodological tool to observe the photovoltaic system as a territorial infrastructure, capable of affecting not only the productive and energy structure, but also the spatial and landscape configuration of contexts. This approach made it possible to structure the investigation along three scales of observation:

- a geographical-territorial scale (30 × 30 km), useful for understanding large-area relationships, the distribution of plants in the landscape, and their links with the energy transmission and distribution network;
- an intermediate territorial scale (10 × 10 km), aimed at observing more specific spatial relationships with local contexts, particularly regarding land use, agricultural systems, and settlements;
- a territorial-urban scale (6 × 6 km), corresponding to the 10 km^2 project area, which allows for a detailed examination of the relationships with specific elements of the landscape and infrastructure, thus approaching the scale of urban and landscape intervention.

This multi-scale approach has enabled a process of analysis able to continuously zoom in and out and conveying the complexity of the interactions between the photovoltaic system and the landscape, avoiding reducing the phenomenon to a single scale of interpretation.

Alongside the scales of observation, the matrix is structured around three main themes, identified as cross-cutting keys to interpretation:

1. relationship with infrastructure – analyzing the connections between photovoltaic fields and local networks (hydrography, roads, railways, urban settlements) provides insight into the infrastructural nature of the plants and their dependence on existing service networks;

2. relationship with production – a comparison with agricultural and industrial areas as well as other forms of renewable energy highlights the forms of competition or coexistence between different production systems, suggesting possible scenarios of conflict or synergy;
3. relationship with risks and constraints – the intersection between photovoltaic fields and areas subject to environmental, landscape, or risk constraints (hydrogeological, seismic, landslide) highlights the limitations and critical issues of location, but also the opportunities to define more robust criteria for identifying suitable areas.

This thematic matrix allows spatial considerations, land use transformations, effects on ecosystems, and relationships with the landscape to be integrated with those related to planning and environmental sustainability.

All the maps created for the research form the essential basis for compiling the solar landscape atlases. The atlases are intended to describe the current situation and, as meta-design tools, can open up critical and prospective scenarios for the next steps in implementing the energy transition.
In line with the approach adopted by other researchers for the study of infrastructural landscapes[16], the atlas becomes an interpretative tool that highlights the relationships between energy, territory, and landscape, transforming mapping from a simple operation of census/measurement/geometrization into a practice of knowledge and project construction.

Atlases and comparative perspectives

The atlases of the three selected case studies represent the cartographic translation of the analyses conducted and collect thematic maps that, at different scales, summarize and relate territorial morphologies to energy morphologies.
The maps highlight the distribution of photovoltaic systems, their density in relation to the pattern of agricultural land, their relationship with settlements and

16 Jill Desimini, Charles Waldheim, cit., 2016.

the infrastructure system, and their alternation with the natural system.
The objective of these maps is the challenging attempt to translate these complex and interrelated phenomena into forms that can be traced on a map. Different forms, relating to different themes, are juxtaposed and superimposed within the same map, highlighting relationships and territorial patterns that are not readily perceptible at first glance.
The summary maps allow us to grasp the specific characteristics of each territory, highlighting the conditions of greatest vulnerability or, conversely, compatibility between energy systems and context.
The Comparative Atlases section enables the comparison of the three case studies across different themes – agriculture, landscape, infrastructure – and to adjust the observation according to the most relevant scale for each theme. The transition from the representation of individual cases to comparative analysis allows not only to identify similarities and differences, but also to develop a range of possible landscape and territorial situations useful for defining scenarios and design strategies for energy landscapes that are more aware of the heterogeneity of Italian territories and contexts.
What emerges from this multi-thematic, multi-scale, and comparative analysis is the structure of three territories and the image of three landscapes which, despite presenting some similarities, are clearly distinguishable.

Atlas 1

BRINDISI

N 40° 30' 50'' - E 17° 59' 15''

A fragmented landscape

The Apulian territory of the province of Brindisi reflects the contradictions of a forced industrialization project typical of southern Italy, marked by the presence of a significant petrochemical hub and large thermoelectric power plants built along the coast since the 1960s. The presence of strategic energy infrastructure makes this province subject to pressure to increase the installation of ground-based photovoltaic systems. In this area, it is possible to identify an extractivist model of energy production, which conflicts with the project of enhancing the territorial heritage and diverges from the idea of energy production tailored to the energy potential of the territories. It is, in fact, an area where the density of ground-based photovoltaic fields is significantly higher than in other Italian cases, with a widespread distribution within a productive rural landscape with long-term agriculture. Extensive vineyards and olive groves are the main crops. The latter are an iconic feature of the Salento landscape, which has been infected with the *Xylella fastidiosa bacterium* in recent decades. The territory also boasts a well-developed infrastructure, thanks to its dense network of roads (both paved and unpaved), highways, and railways. There are many elements of economic and environmental value, such as nature reserves and ecological conservation areas, as well as areas of anthropic and territorial interest, including stratified settlements, scenic-landscape roads, and archaeological sites.

The presence of several inhabited centres, an infrastructure, and a fragmented landscape, along with the extensive distribution of often dying olive groves and numerous small to medium-sized photovoltaic fields – randomly distributed throughout the territory and interspersed with large photovoltaic fields – generates a landscape whose constituent characteristics are challenging to recognize and interpret.

ILARIA TONTI - RICCARDO RONZANI

Agricultural and productive system

Cartographic sources

Agricuture: *UDS_Carta dell'Uso del Suolo*, 2011, Regione Puglia.

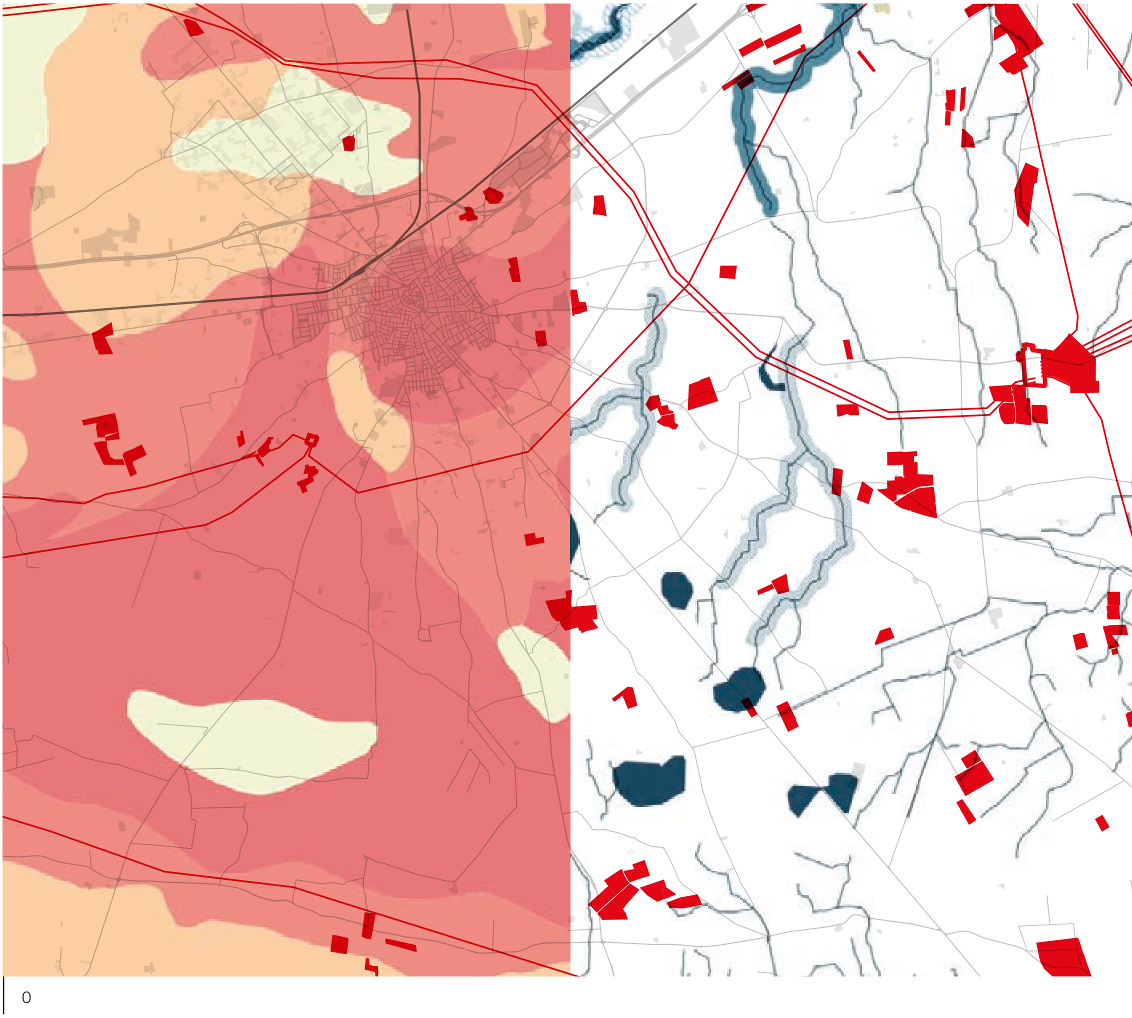
Production: *CTR_Carta Tecnica Regionale urbanizzato - Sistemi produzioni energetiche*, 2011, updated 2016, 1:25.000, Regione Puglia; *UDS_Carta dell'Uso del Suolo - altri insediamenti produttivi e agricoli*, 2011, Regione Puglia; © OpenStreetMap Contributors.

Agriculture

- Arable crops
- Grass and pasture areas
- Temporary with permanent cropsystems
- Horticultural crops and greenhouses
- Fruit orchards
- Vineyards
- Olive groves
- Wooded areas

Production

- Wind turbine towers
- Industrial/manifacturing buildings
- Industrial, commercial, manufacturing areas
- Agricultural productive sites
- Brownfield areas
- Construction sites and excavation areas



Land use capacity

Risk factors

Cartographic sources

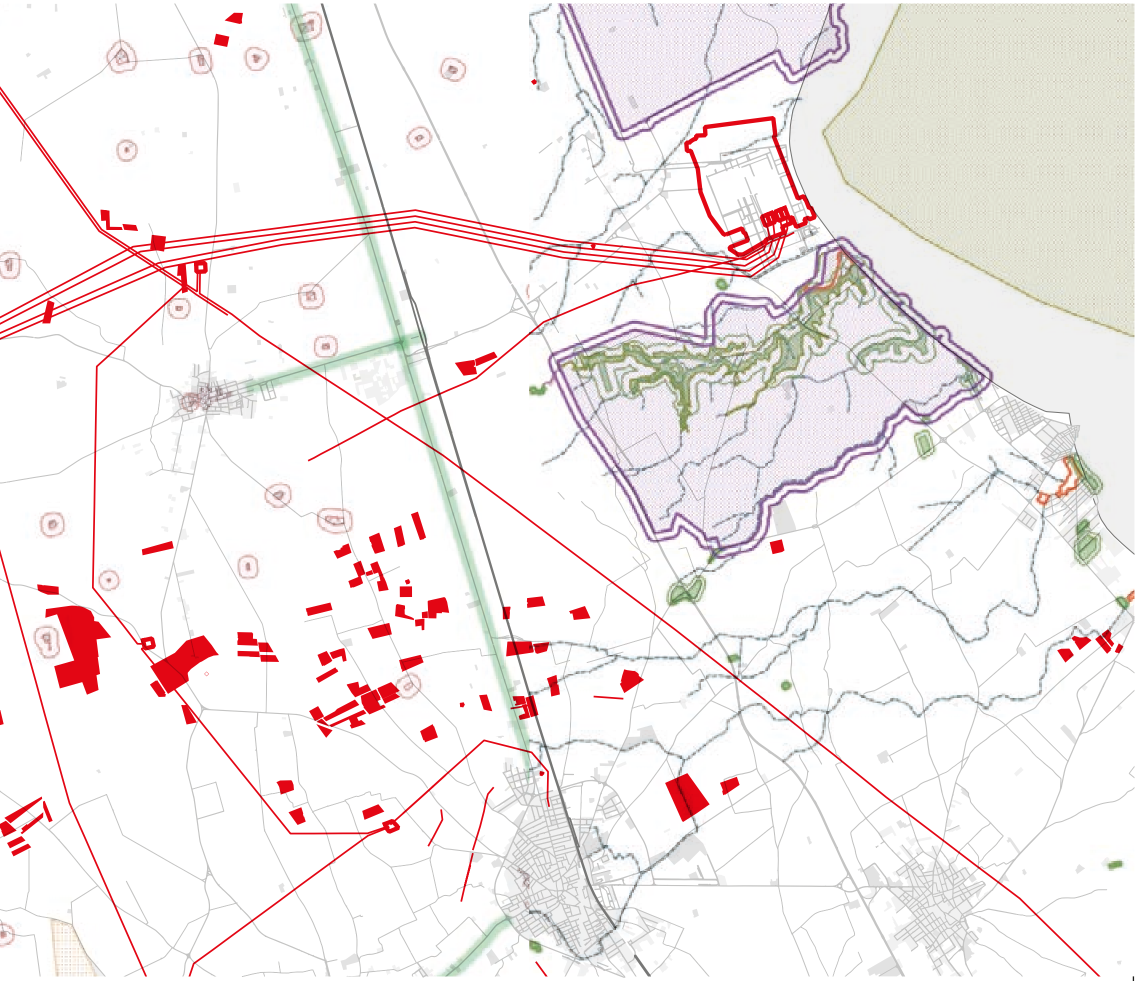
Land use capacity: *Carta della capacità d'uso dei suoli - LCC senza irrigazione*, 2007, 1:50.000, SIT Puglia.

Risk factors: *Mosaicatura nazionale pericolosità alluvioni*, 2020, ISPRA; *PPTR - Piano Paesaggistico Territoriale Regionale*, *Struttura idrogeomorfologica*, 2024, SIT Puglia.

Ecological and antropic constrains: *PPTR*, *Struttura ecosistemica ambientale*, *Struttura antropica storico-culturale*, 2024, SIT Puglia.

Soil quality classes
I
IIs
IIIs
IVs

Episodic waterways
Hydraulic hazards
High
Medium
Low
Hydrogeological requirements
Rivers, streams and public waters buffer (150 m)
Geomorphological and hydrological protection measures
Hydrographic network connecting the R.E.R. (100 m)



Anthropic constraints

Cultural and settlement components
UCP - Protection measures
Consolidated city, settlements stratification, Historical and cultural sites
Historical and cultural buffer zone
Perceptual value components
UCP - Protection measures
Landscape roads

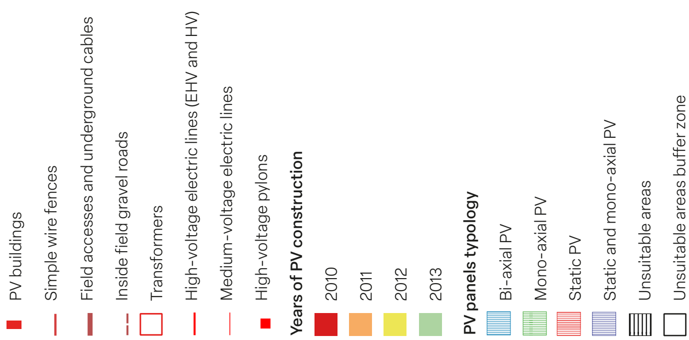
Environmental constraints

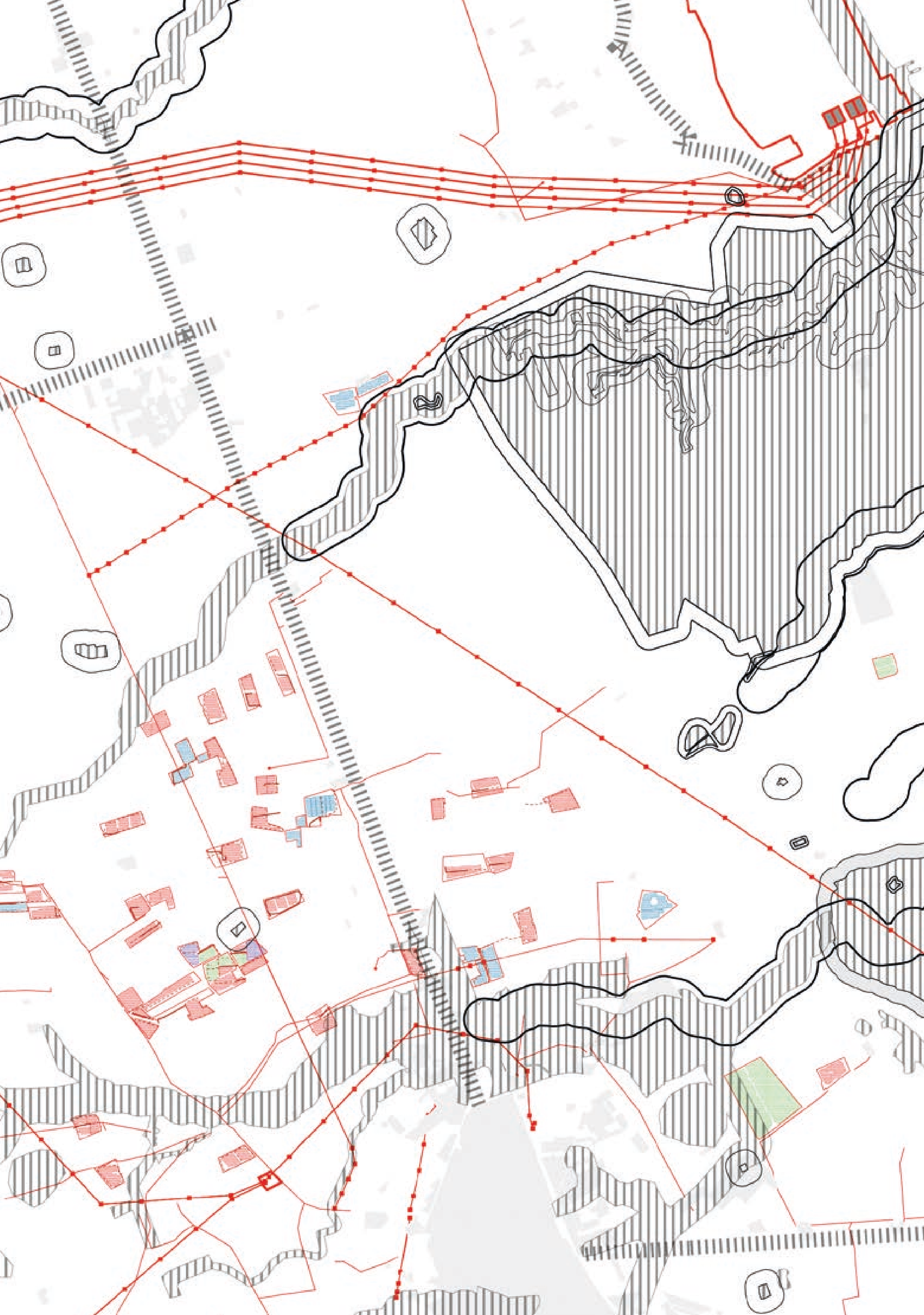
Protected areas, natural and botanical sites
BP - Requirements
Parks and reserves
Forests
UCP - Protection measures
Wetlands
Forest buffer zones (100 m)
Protected areas, and reserves buffer zones (100 m)
Sites of natural value / ZSC Natura 2000

Photovoltaic system and implementation through time

Cartographic sources

CTR _Carta Tecnica Regionale urbanizzato, 2011, 1:25.000, Regione Puglia;
© OpenStreetMap Contributors; © Google Earth Pro [2009-2024].

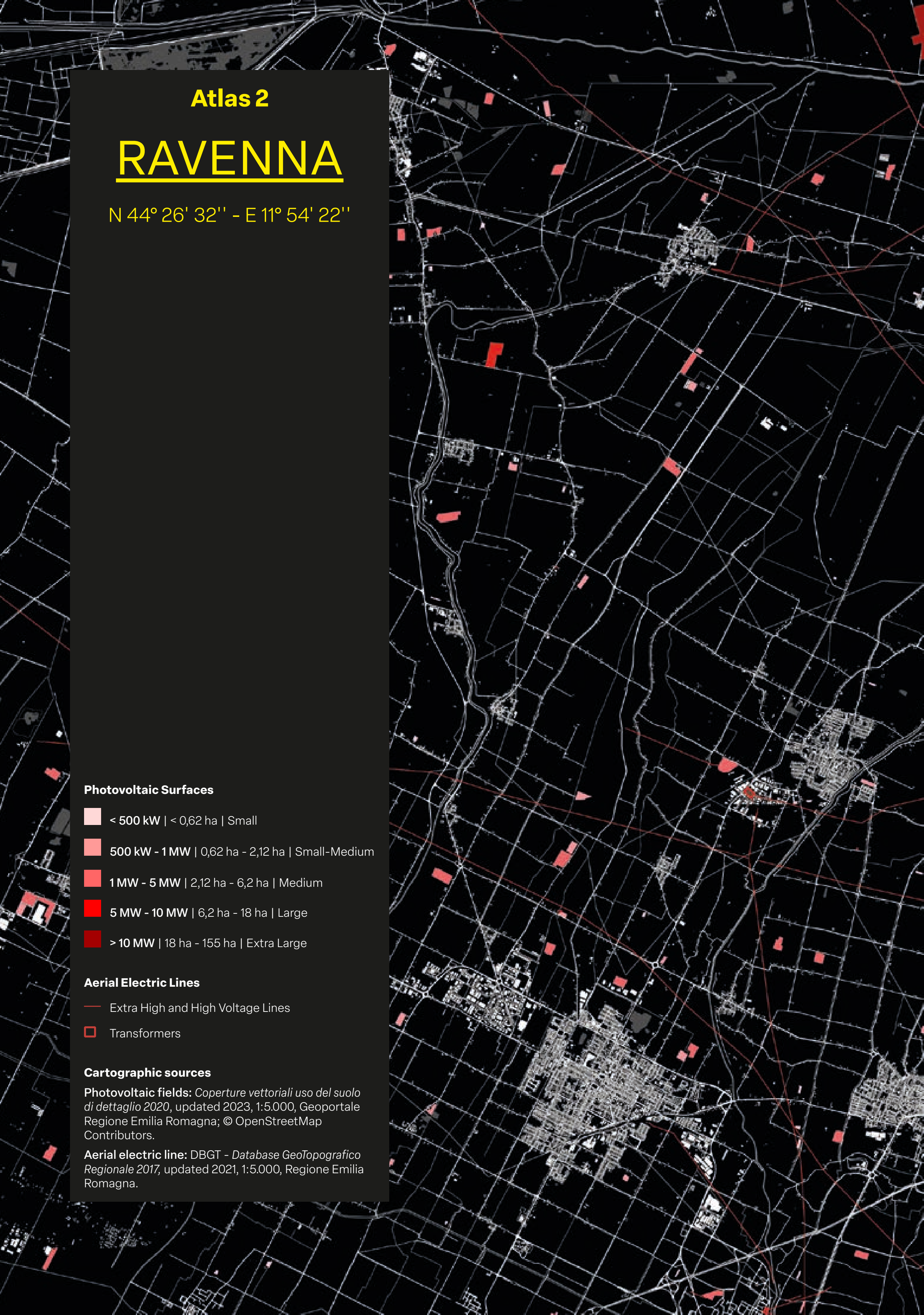




Atlas 2

RAVENNA

N 44° 26' 32'' - E 11° 54' 22''



Photovoltaic Surfaces

- **< 500 kW** | < 0,62 ha | Small
- **500 kW - 1 MW** | 0,62 ha - 2,12 ha | Small-Medium
- **1 MW - 5 MW** | 2,12 ha - 6,2 ha | Medium
- **5 MW - 10 MW** | 6,2 ha - 18 ha | Large
- **> 10 MW** | 18 ha - 155 ha | Extra Large

Aerial Electric Lines

- Extra High and High Voltage Lines
- Transformers

Cartographic sources

Photovoltaic fields: *Coperture vettoriali uso del suolo di dettaglio 2020*, updated 2023, 1:5.000, Geoportale Regione Emilia Romagna; © OpenStreetMap Contributors.

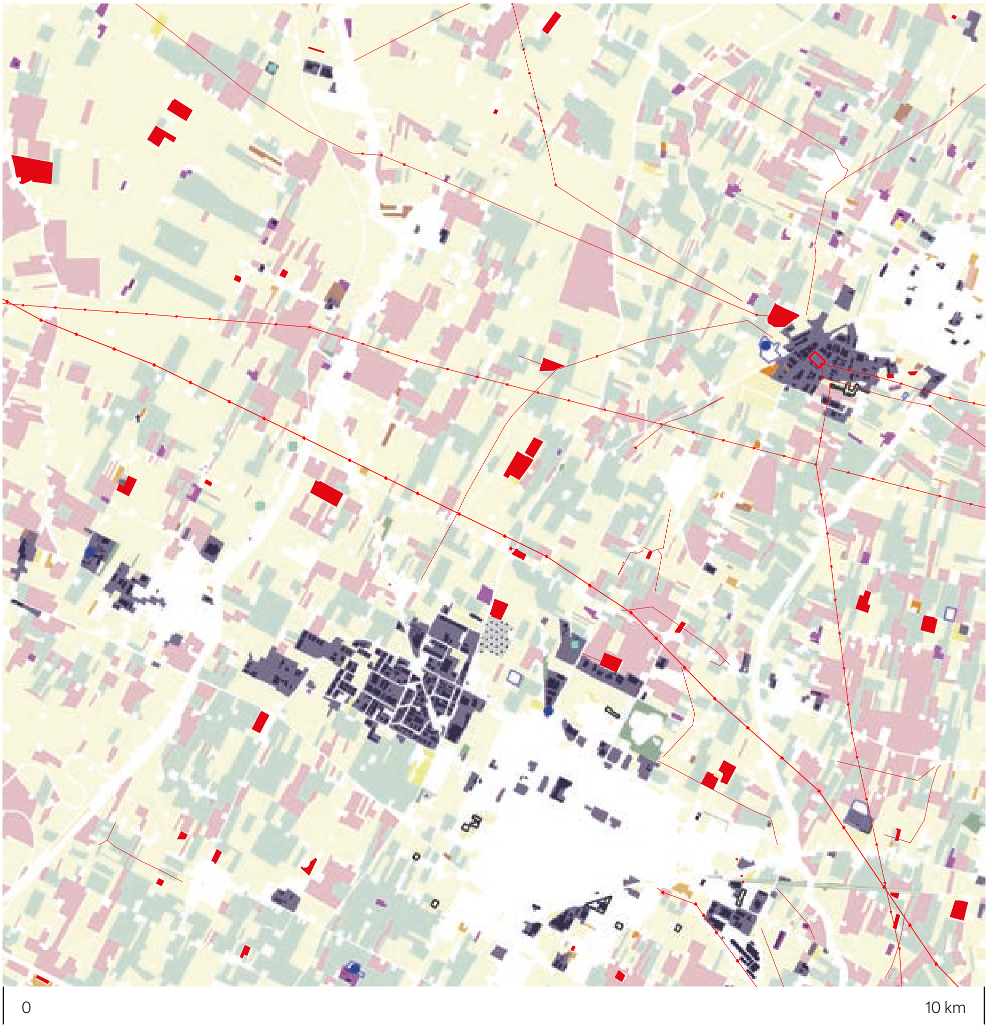
Aerial electric line: DBGT - *Database GeoTopografico Regionale 2017,* updated 2021, 1:5.000, Regione Emilia Romagna.

The grid of a productive territory

The province of Ravenna has a highly recognizable morphological and geometric feature, namely its foundation on the original Roman centuriation grid. This division of the flat territory into a square grid is still reflected today in the layout of modern agricultural fields, the entire urban and territorial structure, and the water canals. The Ravenna area has a high hydrogeological risk, plagued in recent years by extreme flooding, which is compounded by the presence of seismic hazard. Along the perimeter of the densely urbanized area, there are extensive areas featuring contemporary industrial complexes, manufacturing and production facilities, and large commercial spaces. Given the flat terrain, numerous ground-based photovoltaic fields, mainly small to medium-sized (around 1 MW of power generated), have been installed in a scattered and widespread manner in recent decades, especially during the three-year incentive period from 2009 to 2011. Few large-scale fields aro also present. Given the area's high level of infrastructure and the distribution of the electricity grid, the fields are often isolated from each other, and sometimes they are also partially integrated into the urban fabric. The presence of ground-based photovoltaic fields, combined with extensive areas of industrial buildings, has, in recent decades, altered the nature of the territory and the landscape, particularly concerning the relationship between the city and the countryside.

This increasingly fragile and undefined relationship makes it increasingly difficult to recognize historical and anthropological features, such as the historical pattern of centuriation, and elements of environmental enhancement, weakening ecosystems and the biodiversity of fauna, spontaneous flora, and cultivated plant elements.

ILARIA TONTI - RICCARDO RONZANI



Agricultural and productive system

Cartographic sources

Agricuture: *UDS_Coperture vettoriali uso del suolo di dettaglio 2020*, updated 2023, Regione Emilia Romagna.

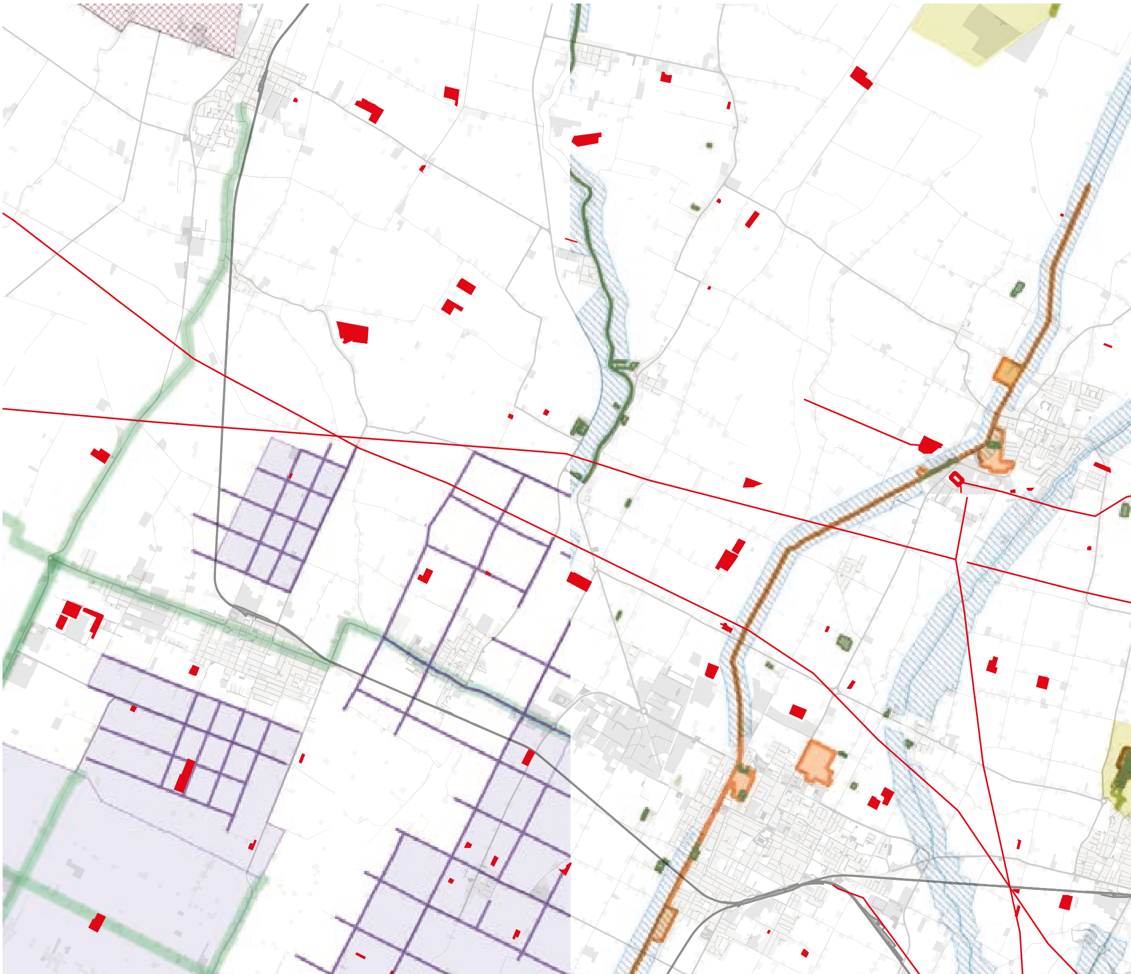
Production: *DBGT_Database GeoTopografico Regionale*, 2017, updated 2021, 1:5.000, Regione Emilia Romagna; *UDS _Carta dell'Uso del Suolo*, 2020, updated 2023, Regione Emilia Romagna; *Corine Land Cover*, 2018, 1:10.000, ISPRA; *Dati energia*, 2020, 1:5.000, ARPAE; © OpenStreetMap Contributors.

Agriculture

- Arable crops
- Grass and pasture areas
- Horticultural crops and greenhouses
- Vineyards
- Wooded areas
- Arboriculture, wood cultivation

Production

- Biomass-biogas plants
- Water treatment plants
- Industrial and manufacturing buildings
- Industrial, commercial, manufacturing areas
- Agro-zootechnical sites
- Agricultural productive sites
- Construction sites and excavation areas
- Landfills and quarry deposits
- Areas for energy distribution and production



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Anthropic constraints

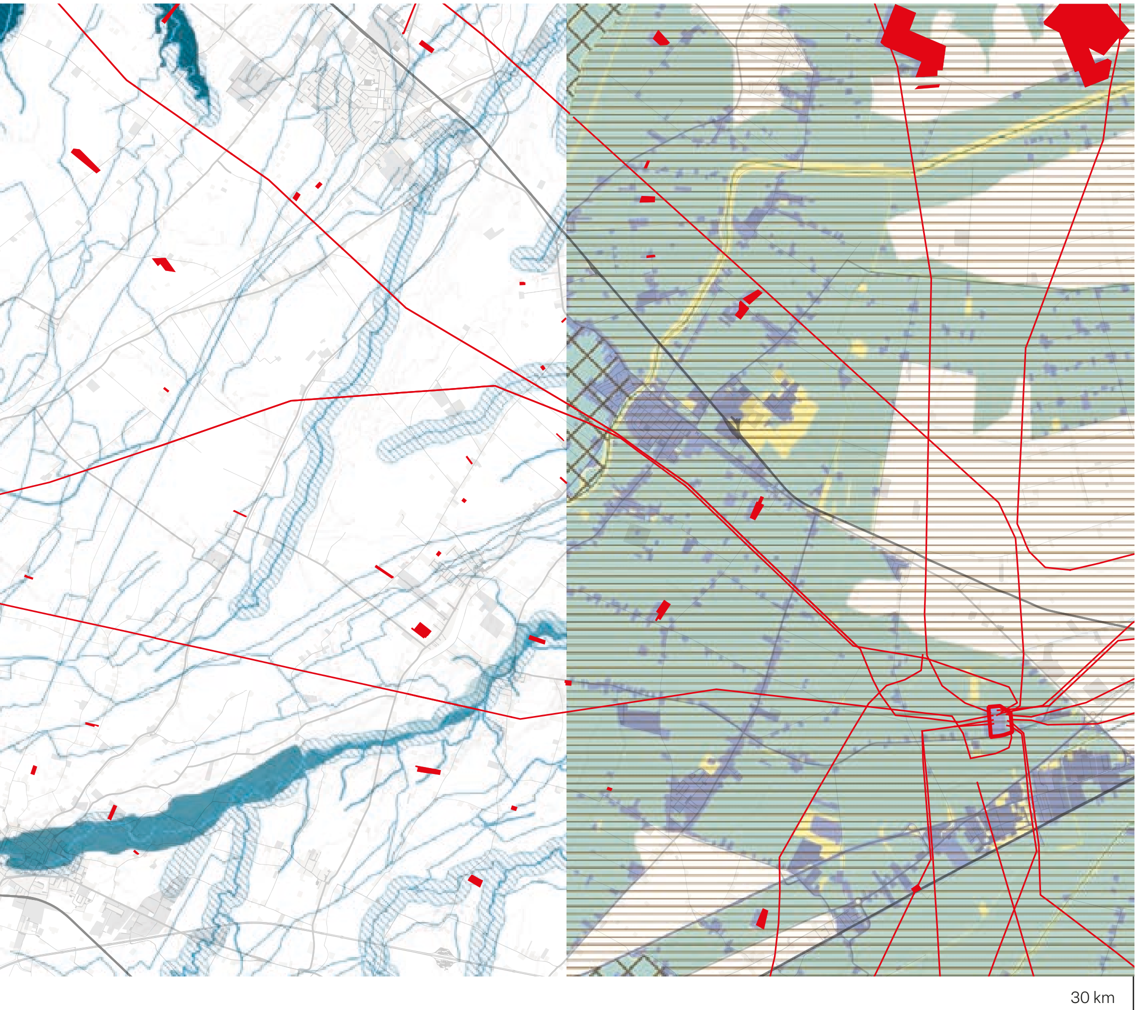
Environmental constraints

Cartographic sources

Constrains: *Rete Natura 2000 PdGPo 2021*, 2021, ADBPO; *Aree protette regionali*, 2019, 1:10.000, Portale minERva Emilia Romagna; *Aree tutelate legge Dlgs42/04 - art 142 comma 1 lett. b) e c)*, updated 2022-2025, 1:10.000, Portale minERva Emilia Romagna; *PTPR /PTCP - art.10 Sistema forestale e boschivo*, updated 2022, Portale minERva Emilia Romagna; *PTPR - Piano Territoriale Paesaggistico Regionale*, 2011, Portale minERva Emilia Romagna.

Cultural and settlement components
- Areas of historical and cultural interest
- Protected areas of the centuriation structure
- Protected areas of elements of centuriation
- Historical landscape roads

Protected areas
- Waterways protection areas (art. 17_PTPR)
- Forest and woodland system (PTCP_art. 10)
- Areas of landscape interest (art. 19_PTPR)
- Sites of nauralistic relevance / Natura 2000
- Ecological rebalancing areas (Regional Law 6/2005)



Risk factors

Multi risk factors

Cartographic sources

Multi risk factors: *Classi Rischio Aree Rischio idraulico Distretto Po 2020*, updated 2024, ADBPO; *Stabilimenti della Regione Emilia Romagna soggetti a Rischio Industriale D.l.vo 334/99 e s.m.*, updated 2025, ARPAE; *Classificazione sismica*, updated 2023, 1:2.000, Emilia Romagna.

Risk factors: *Aree Allagabili*, 2024, ADBPO; *Aree tutelate per legge Dlgs42/04* - art 142 comma 1 lett., b) e c), updated 2025, Portale minERva Emilia Romagna.

Rivers

Artificial irrigation canals

Hydraulic hazards

High

Medium

Hydrogeological requirements

Rivers and public waters buffer (150 m)

Hydraulic risk classes

R1

R2

R3

R4

Seismic classification

Class 2

Class 3

0 10 km

Photovoltaic system and implementation through time

Cartographic sources

Coperture vettoriali uso del suolo di dettaglio 2020, updated 2023, 1:5.000, Geoportale Emilia Romagna; *DBGT - Database GeoTopografico Regionale 2017*, updated 2021, 1:5.000, Geoportale Emilia Romagna; *Ortofoto RER 2023-24 RGB*, *Ortofoto AGEA 2011 RGB*, and *Ortofoto CGR 2018 RGB*, Geoportale Emilia Romagna; © OpenStreetMap Contributors; © Google Earth Pro [2009-2024].

- PV buildings
- Simple wire fences
- Simple wire fences with hedge
- Field accesses and underground cables
- Inside field gravel roads
- Transformers
- High-voltage electric lines (EHV and HV)
- Medium-voltage electric lines
- High-voltage pylons

Years of PV construction

- 2011
- 2014

PV panels typology

- Bi-axial PV
- Static PV
- Unsuitable areas
- Roads or buffer zone of unsuitable areas

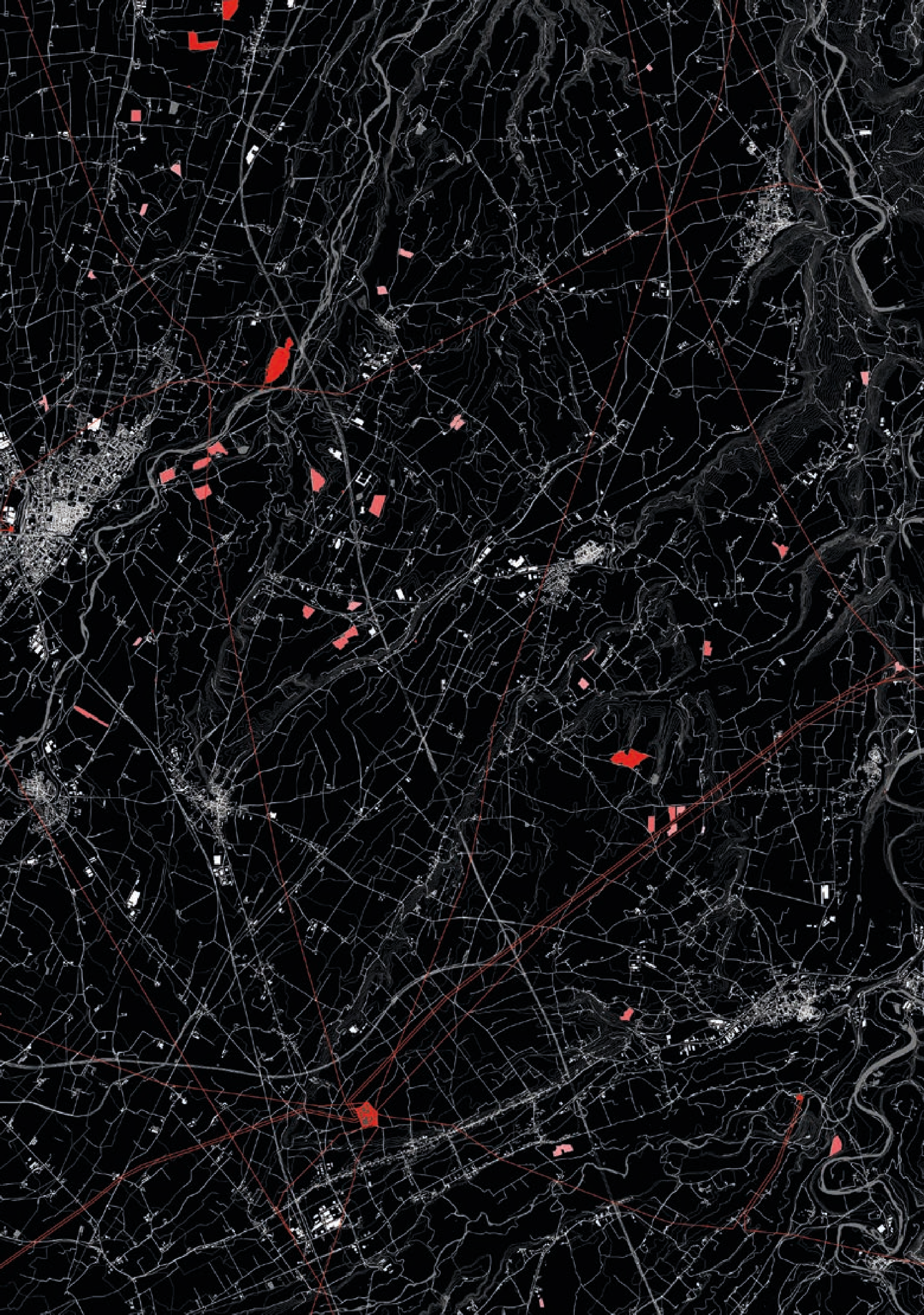
Atlas 3

CUNEO

N 44° 33' 28'' - E 7° 45' 12''

Cartographic sources

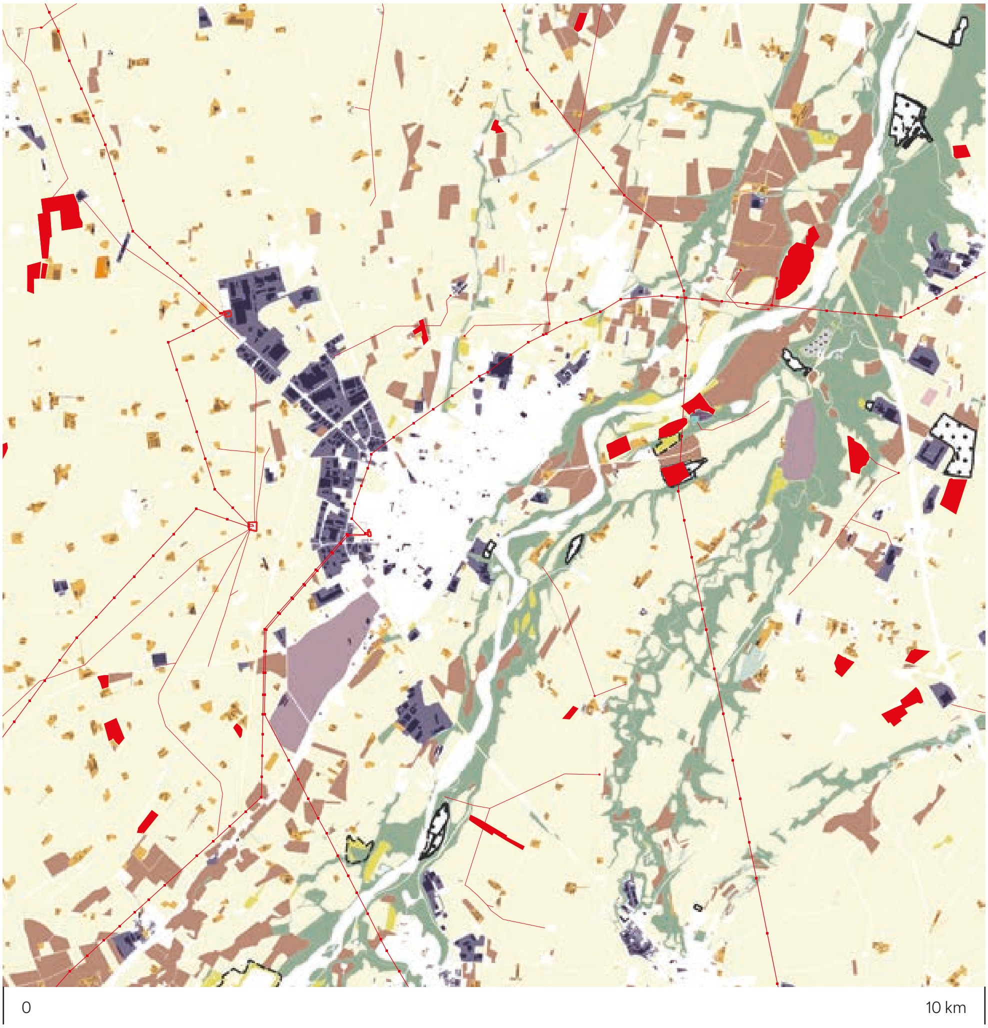
BDTRE - *Banca Dati Territoriale di Riferimento degli Enti*, 2024, 1:5.000; *Geoportale Regione Piemonte*; © OpenStreetMap Contributors; © Google Earth Pro [2023].



A vulnerable connection to the river

The Cuneo plain has historically been an agricultural hub based on extensive arable farming. In recent decades, this area has maintained its primary vocation, despite also hosting essential manufacturing centres. The Stura di Demonte river crosses the countryside of Cuneo. On its banks, between the right and left shores, there are significant altitude differences, above which urban settlements have developed on the ridges, including the municipality of Fossano. A substantial presence of wooded areas also characterizes the countryside. In addition to creating an ecosystem with high biodiversity and ecological interest, they also represent an essential testimony to the ancient ecosystems of the area. Within this predominantly agricultural and natural landscape, small to medium-sized portions of land have been set aside in recent decades to accommodate photovoltaic fields. Mixed ground-based photovoltaic technologies have been tested in this area: static photovoltaic panels, single-axis mobile trackers for the most recent ones, and dual-axis trackers for larger areas. Conceiving the energy infrastructure as temporary installations, portions of land near the river have been occupied, assuming a greater impact on the landscape, and with the presence of areas at high hydrogeological risk of river flooding.
The result is an area that, although still dedicated to agriculture and home to significant and recognizable natural ecosystems, is now impoverished in its relationship with the river that runs through it. Rather than being enhanced in ecological and landscape terms by its surroundings, this element is weakened by new production and energy plants, which, with careful planning, could be relocated.

ILARIA TONTI - RICCARDO RONZANI



Agricultural and productive system

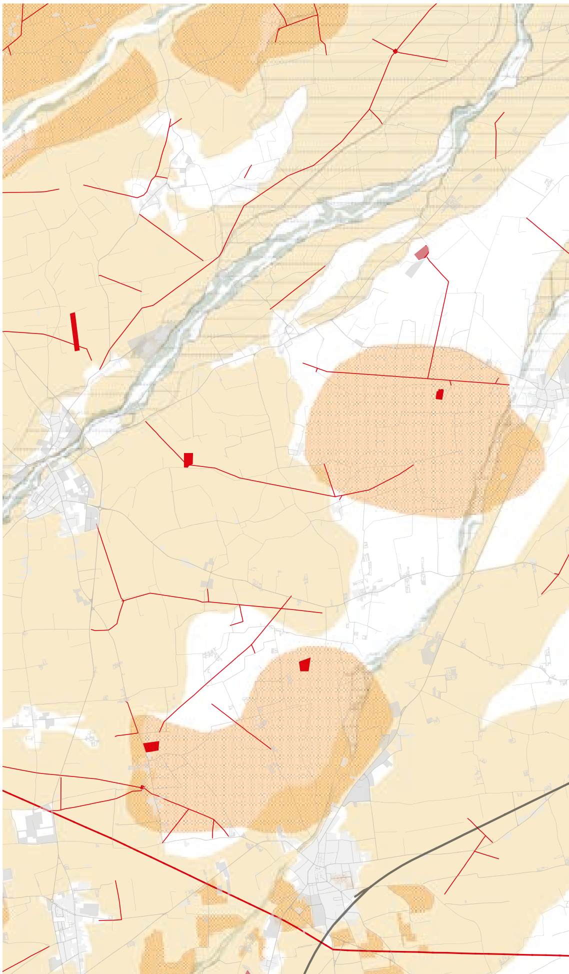
Cartographic sources

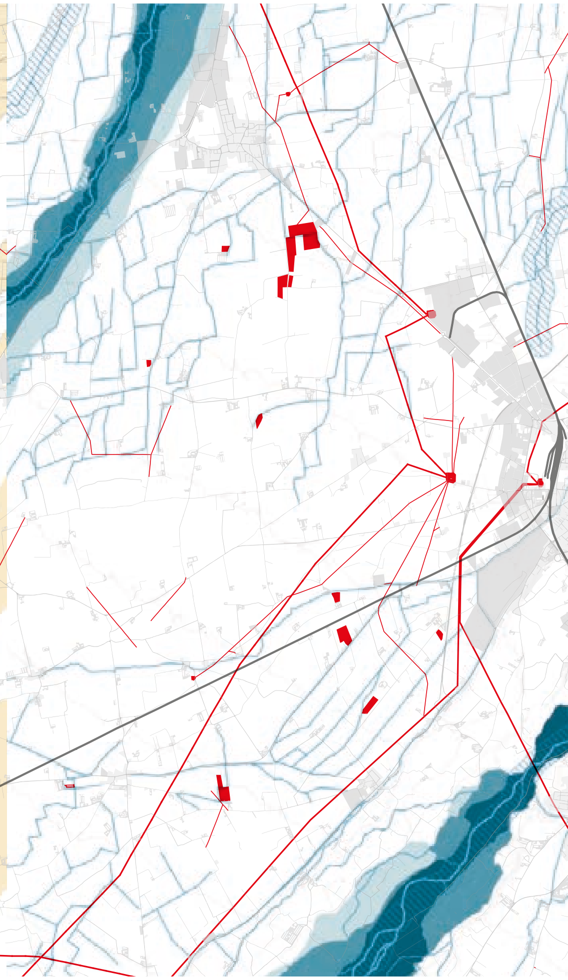
Agricuture: *BDTRE - Banca Dati Territoriale di Riferimento degli Enti*, 2024, 1:5.000, Geoportale Regione Piemonte; *Carta Forestale Regionale, Arboricoltura da legno*, updated 2016, Sistema Informativo Forestale Regionale (SIFOR).

Production: *BDTRE - Banca Dati Territoriale di Riferimento degli Enti*, 2024, 1:5.000, Geoportale Regione Piemonte; © OpenStreetMap Contributors.

Agriculture
- Arable crops
- Grass and pasture areas
- Horticultural crops and greenhouses
- Vineyards
- Wooded areas
- Arboriculture, wood cultivation

Production
- Water teatment plants
- Industrial/manifacturing buildings
- Rural buildings
- Industrial, commercial, manufacturing areas
- Military areas
- Agro-zootechnical sites
- Construction sites and excavation areas
- Landfills and quarry deposits
- Quarry, extraction areas
- Areas for energy distribution and production





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Agricultural quality

Risk factors

Cartographic sources

Agricultural quality: *Aree a vocazione tartufigena*, in PTR_Tavole della Conoscenza A, 1:50.000, 2024, Geoportale Regione Piemonte; *Piano Paesaggistico Regionale (PPR)*, 1:25.000, 2013, Geoportale Regione Piemonte.

Risk factors: *BDTRE - Banca Dati Territoriale di Riferimento degli Enti*, 2024, 1:5.000, Geoportale Regione Piemonte; *Aree Allagabili*, 2024, ADBPO, *Tav. P2.0 Beni Paesaggistici, lett. c)*, 1:25.000, updated 2024, Geoportale Regione Piemonte.

Perceptual identity components

Rural landscape systems

Natural and environmental components

Areas of high agricultural interest

Rivers

Canals

Hydraulic hazards

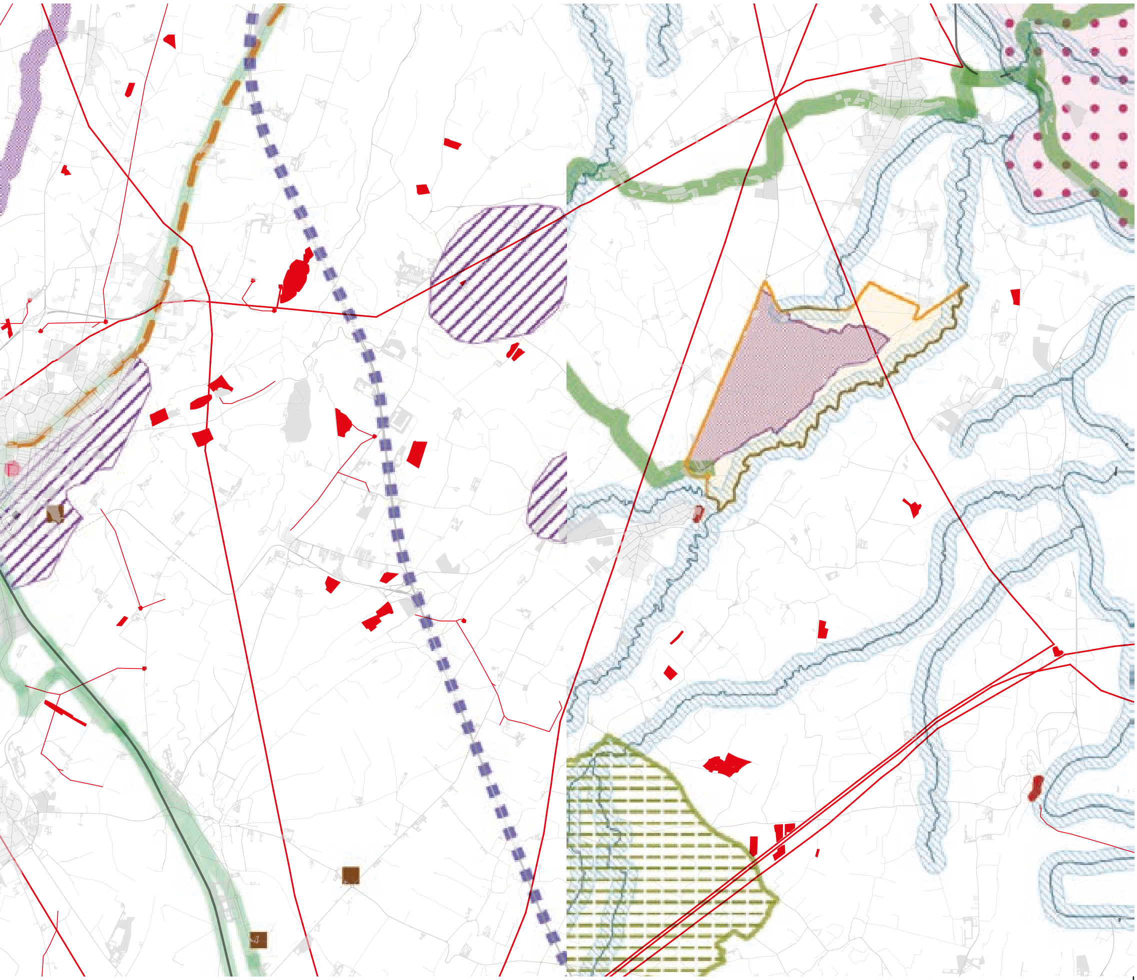
High

Medium

Low

Hydrogeological requirements

Rivers and public waters buffer (150 m)



30 km

Anthropic constraints

Environmental constraints

Cartographic sources

Ecological and antropic constrains: *Natura 2000*, updated 2022, Rete del Sistema Informativo Nazionale Ambientale - ISPRA; *Aree protette e siti della rete ecologica*, 1:10.000, 2024, Geoportale Regione Piemonte; *Piano Paesaggistico Regionale (PPR), Tav. P2.0 Beni Paesaggistici, Tav. P4.0 Componenti paesaggistiche, Tav. P5 Rete di connessione paesaggistica*, 1:25.000, 2013, Geoportale Regione Piemonte.

- Traditional settlements
- Historical landscape roads
- Panoramic viewpoints
- Historical industrial production areas
- Infrastructure to be regenerate
- Tour of interest to visitors

Protected areas

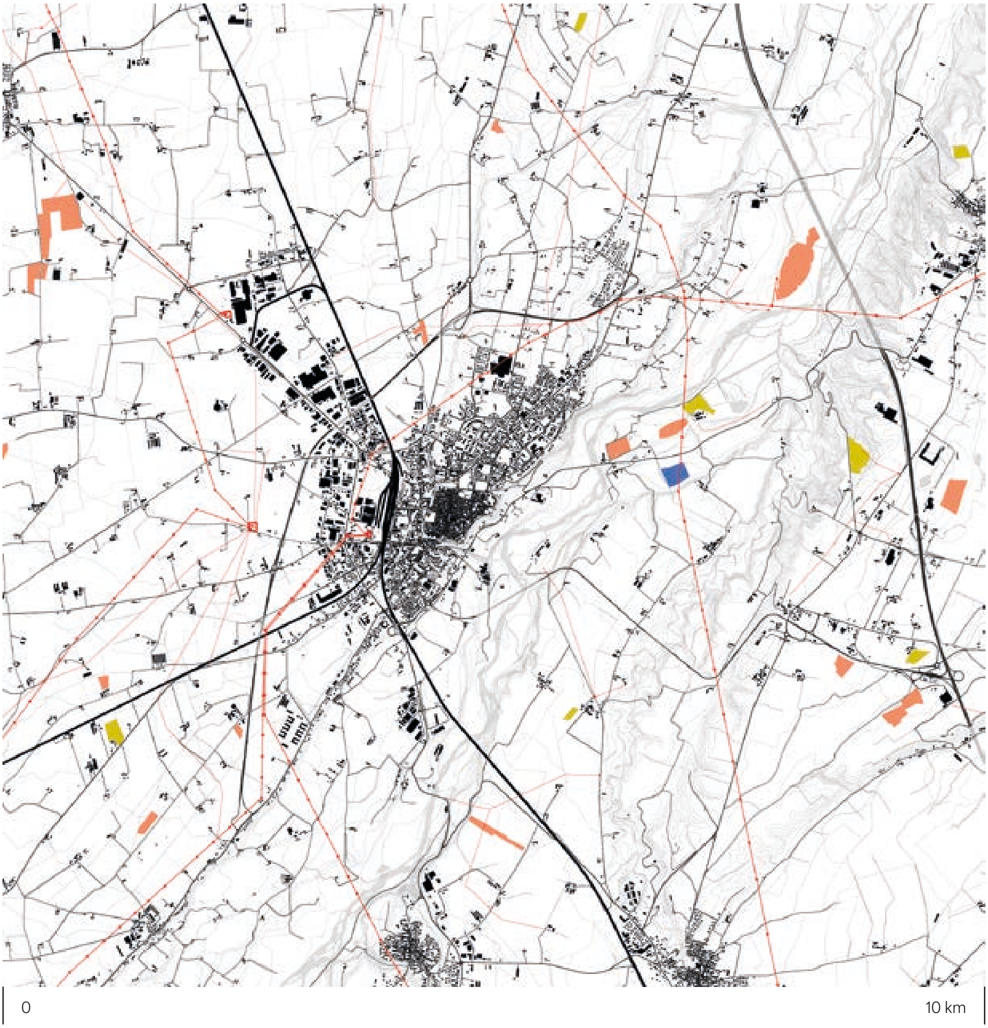
- Sites of naturalistic relevance
- Natural reserves
- Waterways protection areas (150 m)

Landscape connection network

- Regional Greenways

Landscape assets

- Landscape assets exDDMM 1/8(1985
- UNESCO sites - buffer zones for wine growing landscape



Photovoltaic system and implementation through time

Cartographic sources

BDTRE - Banca Dati Territoriale di Riferimento degli Enti, 2024, 1:5.000, Geoportale Regione Piemonte; *Ortofoto a colori anno 2012*, Geoportale Nazionale; *Ortofoto 2015 / 2018 / 2021 AGEA*, Geoportale Regione Piemonte; © OpenStreetMap Contributors; © Google Earth Pro [2023].

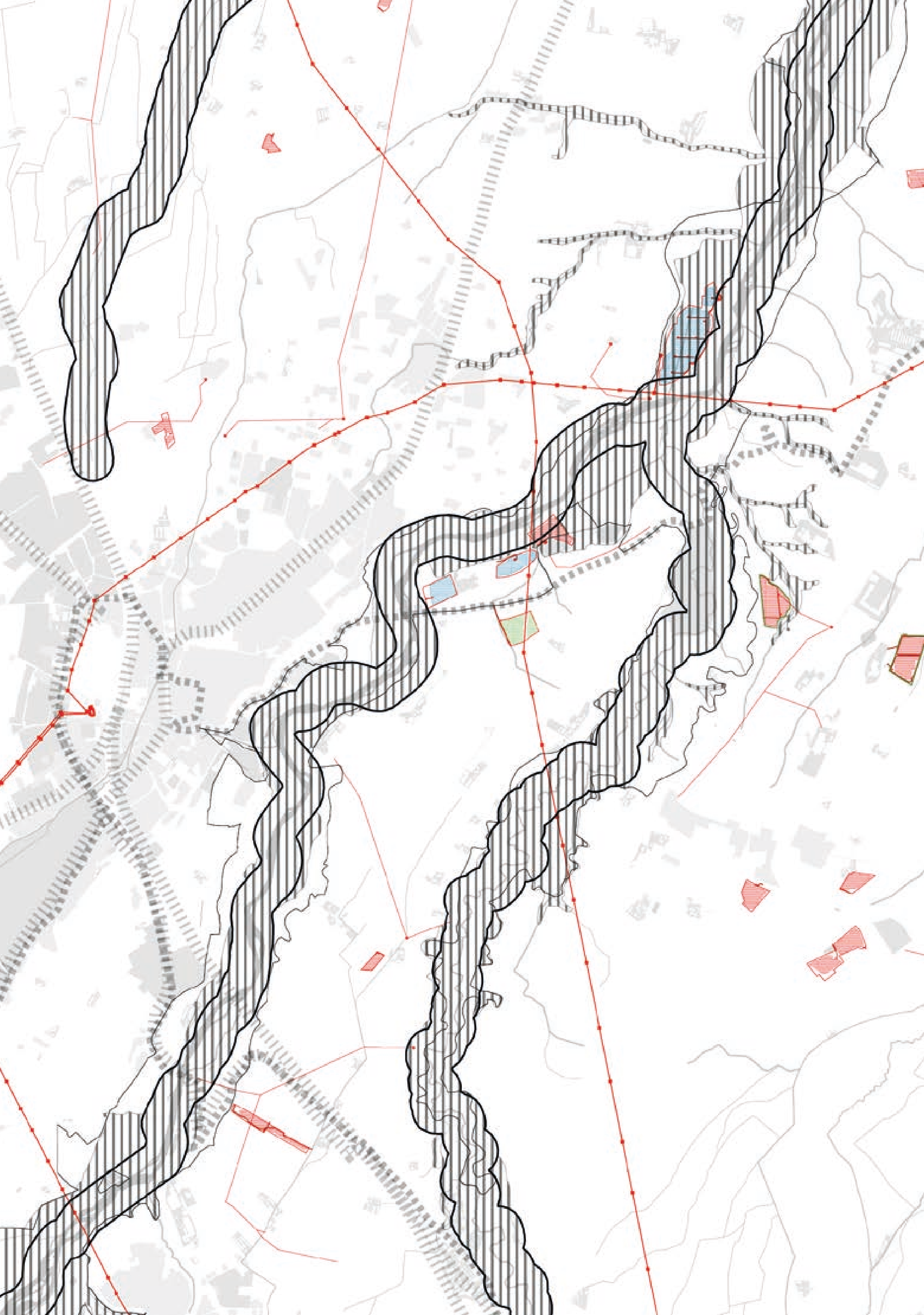
- PV buildings
- Simple wire fences
- Simple wire fences with hedge
- Field accesses and underground cables
- Inside field gravel roads
- Transformers
- High-voltage electric lines (EHV and HV)
- Medium-voltage electric lines
- High-voltage pylons

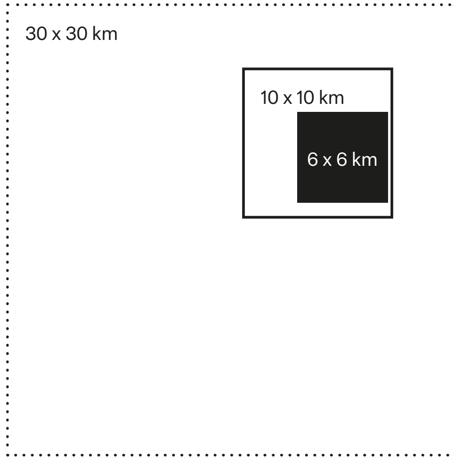
Years of PV construction

- 2011
- 2012
- 2023

PV panels typology

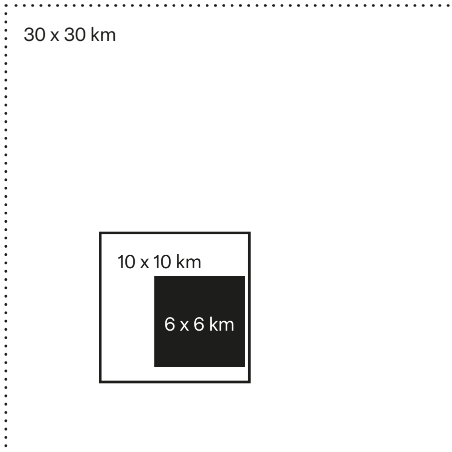
- Bi-axial PV
- Mono-axial PV
- Static PV
- Unsuitable areas
- Roads or buffer zone of unsuitable areas



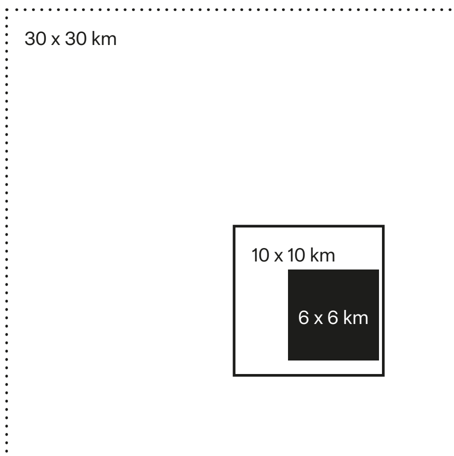


Atlas 3
N 44° 33' 28'' / E 7° 45' 12''

COMPARING
ATLASES



Atlas 2
N 44° 26' 32'' / E 11° 54' 22''



Atlas 1
N 40° 30' 50'' / E 17° 59' 15''

Photovoltaic system

Atlas 1

Atlas 2

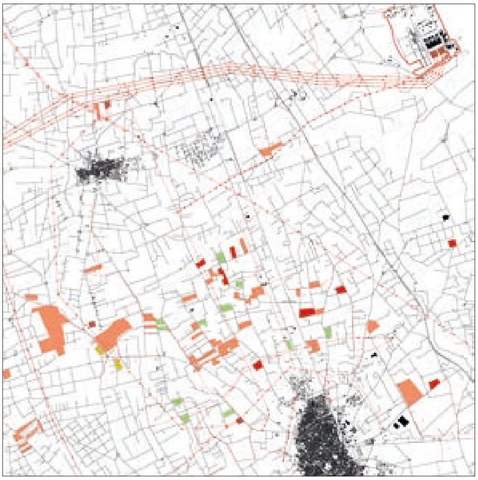
Atlas 3

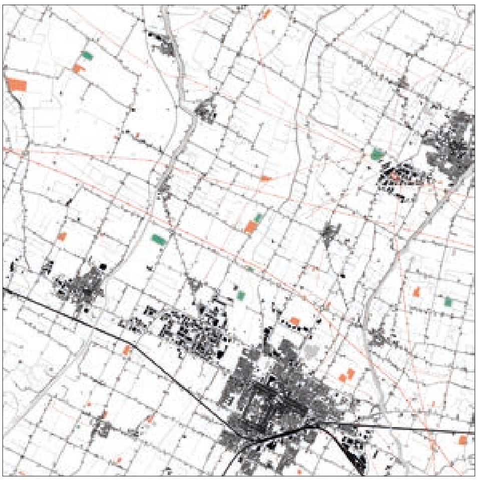
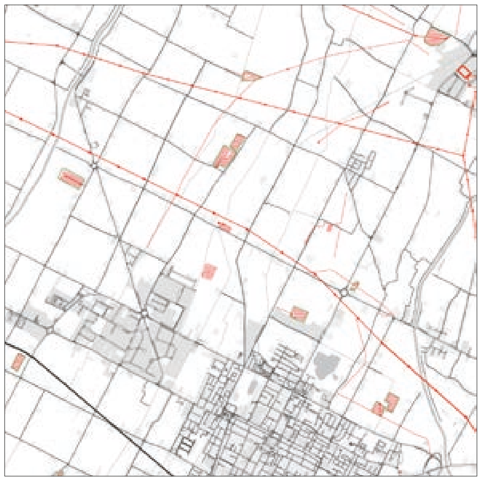
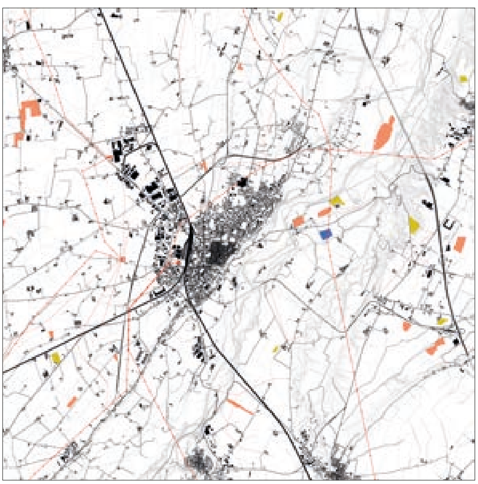
A comparison of the distribution models of photovoltaic fields in the three case studies reveals some common trends and some specific differences. Due to economic incentives and the simplification of bureaucratic processes, minor to medium-sized fields are spread throughout the territory, especially between 2010 and 2014. This trend, which is particularly visible and impactful in the case of Brindisi, has specific characteristics in the other two case studies. In the Cuneo area, small clusters of two or more photovoltaic fields reveal an attempt to optimize the infrastructure connecting to the electricity distribution network. In the Ravenna area, on the other hand, in a highly infrastructured territory, even before the installation of the fields themselves, isolated fields are common, often located far away from each other. Most of the photovoltaic fields installed are static, with a few bi-axial installations built between 2011 and 2012. This condition confirms the approaching end-of-life phase of these plants and highlights the need to address the challenges related to their decommissioning, revealing the urgency of developing new strategic and planning visions.

PV buildings
Simple wire fences
Simple wire fences with hedge
Field accesses and underground cables
Inside field gravel roads
Transformers
High-voltage electric lines (EHV and HV)
Medium-voltage electric lines
High-voltage pylons

Years of PV construction
2010
2011
2012
2013
2014
2023

PV panels typology
Bi-axial PV
Mono-axial PV
Static PV
Static and mono-axial PV




Hydrogeomorphology and infrastructure

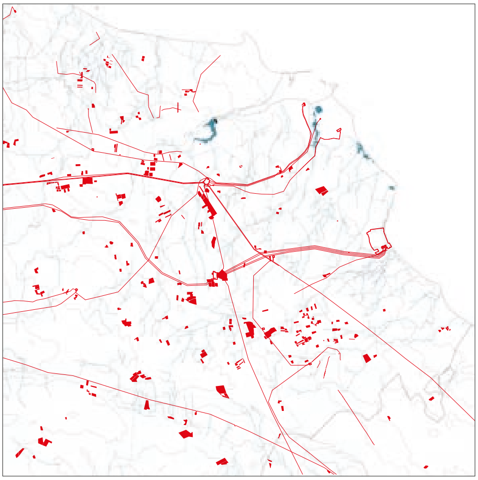
Atlas 1

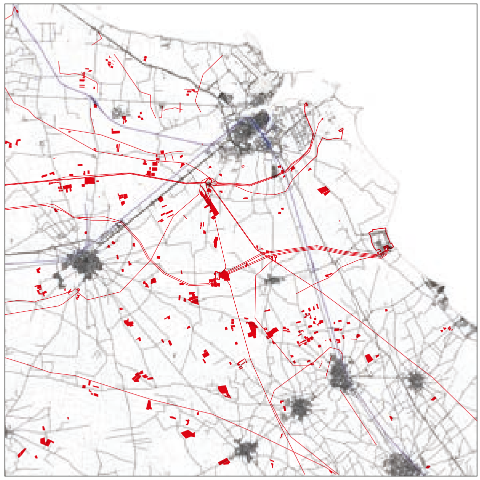
Atlas 2

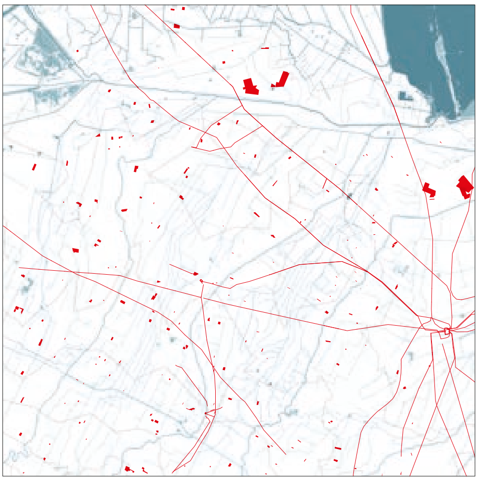
Atlas 3

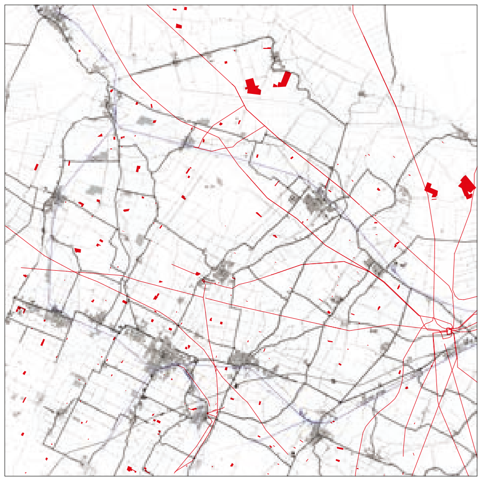
In examining the relationship between photovoltaic systems and local infrastructures, it is important to recognize the variety of elements involved – ranging from natural and artificial hydro-morphological features toroad networks and electricity distribution lines. In the case of Brindisi area, where the water canalization network is silent and almost unrecognizable in the landscape, the distribution of photovoltaic fields is based on the dense network of paved and dirt roads that fragment the agricultural countryside. In the case of Ravenna area, the dense network of Roman grid centuriation still dictates the rules for the distribution of photovoltaic fields. In this case, the rivers and artificial irrigation canals are separate elements, even if the presence is densely diffuse and articulated in all the plain. On the contrary, the presence of the Stura di Demonte river is an extremely important factor in the case of the Cuneo plain; some of the main photovoltaic fields in this area are located along the riverbanks, thus exploiting areas that would have been impossible to use in other ways.

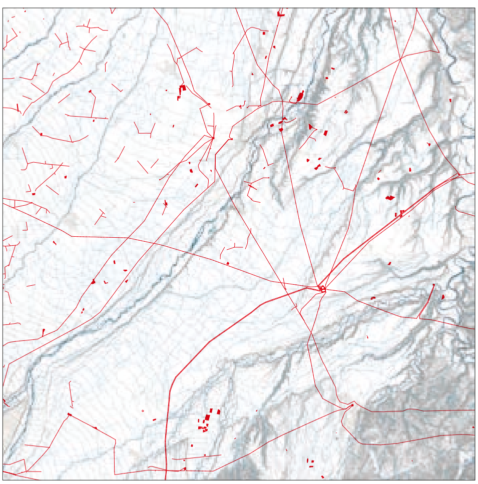
Contour lines
Water courses
Canals
Artificial irrigation canals
Water basins / lakes
Railways
Primary infrastructure networks
Secondary infrastructure networks
Buildings

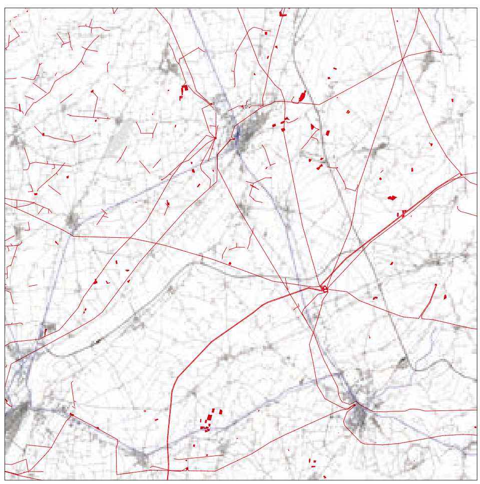












Agriculture and other productions

Atlas 1

Atlas 2

Atlas 3

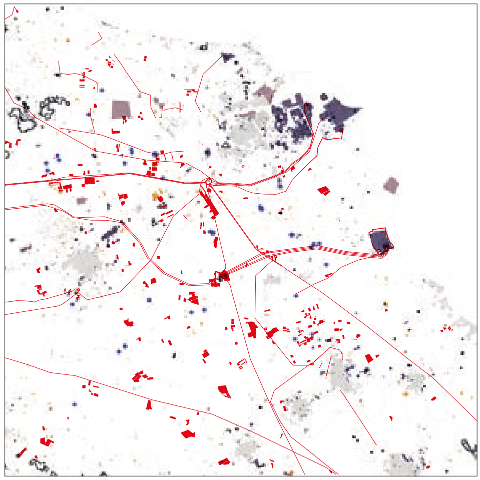
Although a predominantly agricultural production model characterizes all three areas, their differences are significant and evident. The extensive cultivation of olive trees is particularly evident in the Brindisi area, covering such a large area of the countryside that it takes on the characteristics of monoculture. The central industrial districts are located near the city of Brindisi. Industries are distributed evenly across the Ravenna plain, which is mainly dedicated to arable farming but also hosts a mosaic of different crops and fruit productions. The Cuneo area is almost entirely arable and characterised by extensive wooded areas and timber cultivations. The presence of steep slopes on the Pre-Alps, particularly visible, leads to the concentration of industrial and produtive activities near the various villages, and to a more widespread and fragmented development of agro-zootechnical sites.

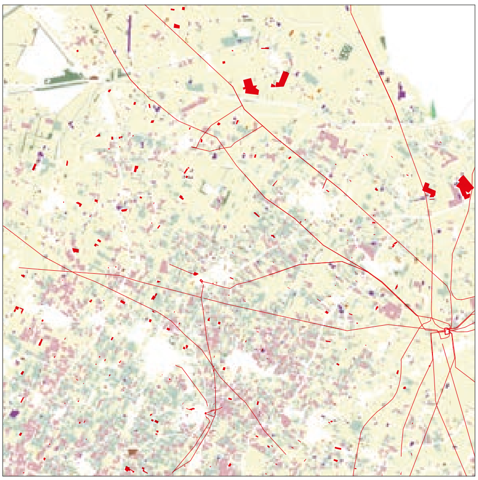
Agriculture

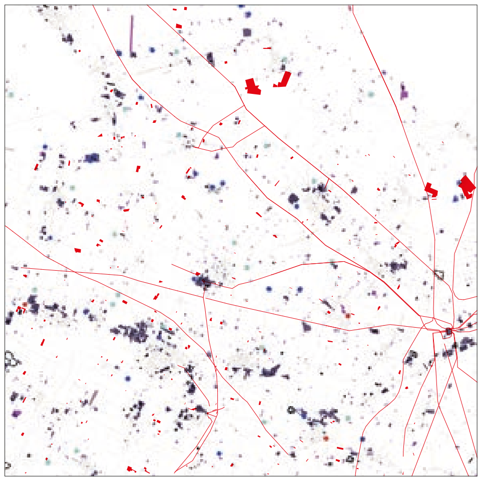
- Arable crops
- Grass and pasture areas
- Horticultural crops and greenhouses
- Fruit orchards
- Olive groves
- Vineyards
- Wooded areas
- Arboriculture, wood cultivations

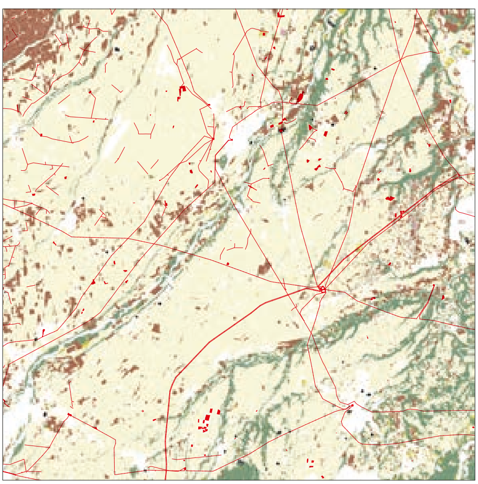
Production

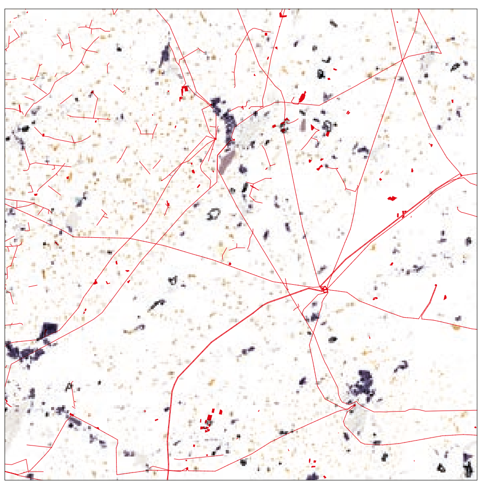
- Wind turbine towers
- Water teatment plants
- Industrial and manifacturing buildings
- Industrial, commercial, and manufacturing areas
- Military areas
- Agro-zootechnical sites
- Agricultural productive sites
- Construction sites and excavation areas
- Landfills and quarry deposits
- Quarry, extraction areas
- Areas for energy distribution and production



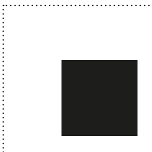




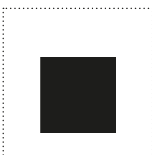




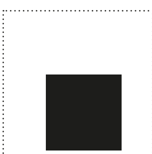
Risk factors



Atlas 1

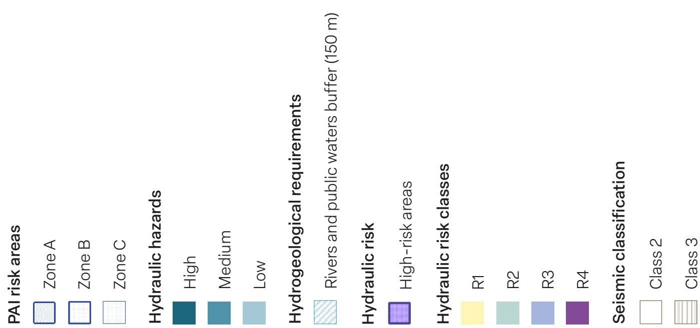


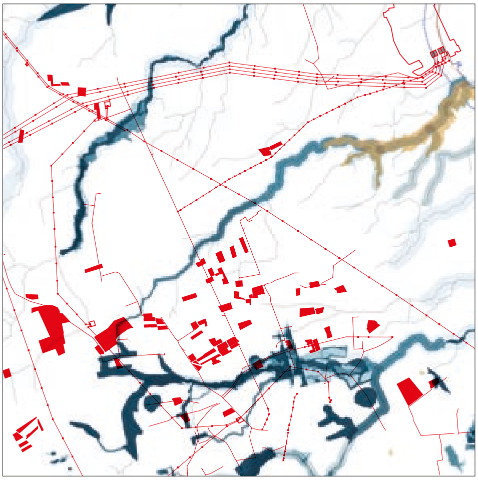
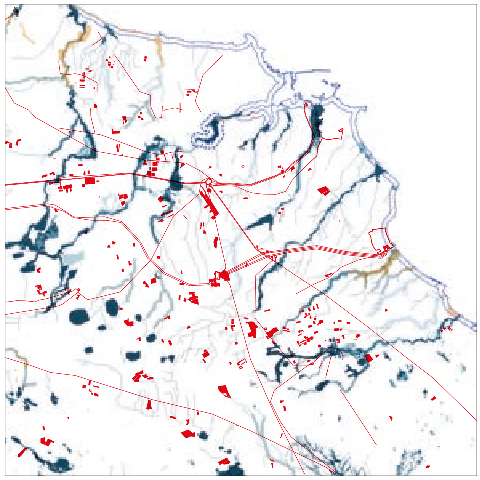
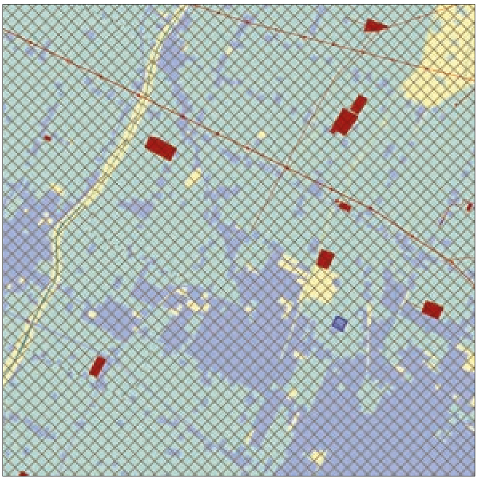
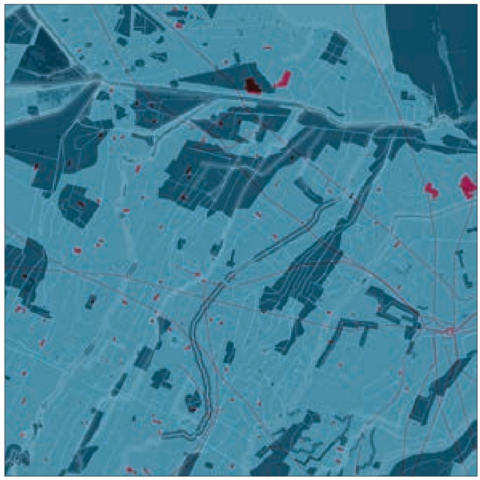
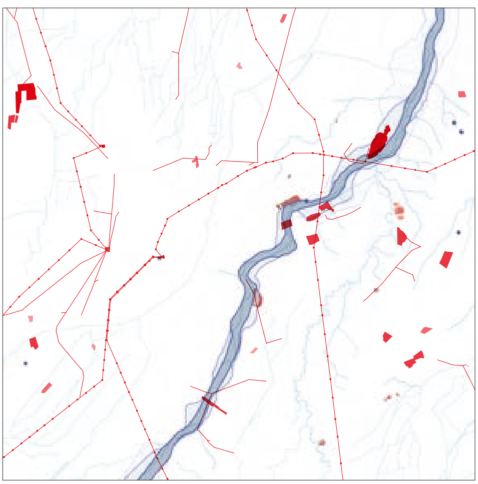
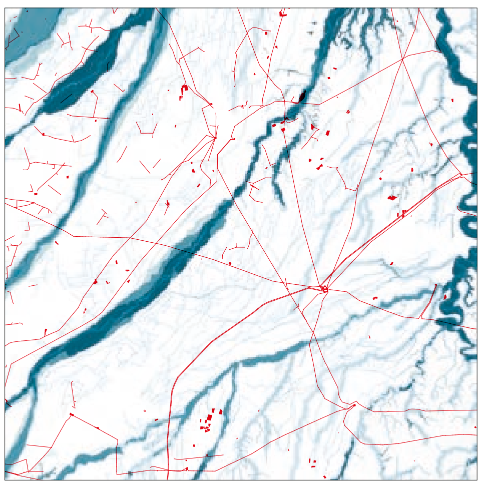
Atlas 2



Atlas 3

The risk factors are linked to natural systems, ecosystems, and the territory's specific geomorphological and hydrographic characteristics. While the Brindisi area, thanks to its characteristics – flat terrain, limited water bodies, rare heavy rainfall, etc. – is ideal for the widespread proliferation of photovoltaic fields, the other two case studies present different conditions. Particularly striking is the risk analysis of the Ravenna plain, where the flooding risk is evenly distributed and quite significant. This same risk affects the Cuneo area, but in this case, it is concentrated only along the main waterways. The high riverbanks that raise the entire southern Piemonte plain limit the risk to certain areas. The analysis of risks present in each territory is fundamental both in terms of imagining possible and more suitable futures for the fields in which photovoltaic plants are decommissioned, and in terms of planning where to locate new photovoltaic fields that can replace those of the previous generation.



Constrains

Atlas 1

Atlas 2

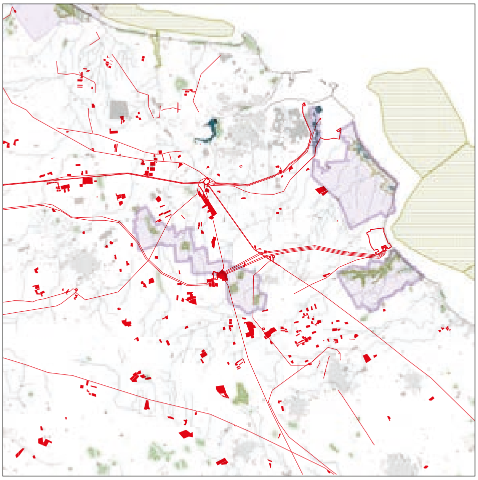
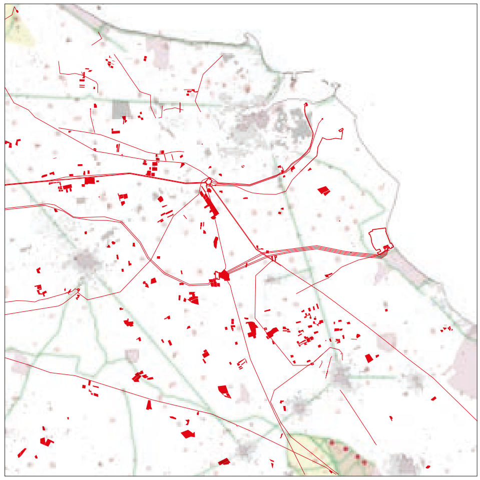
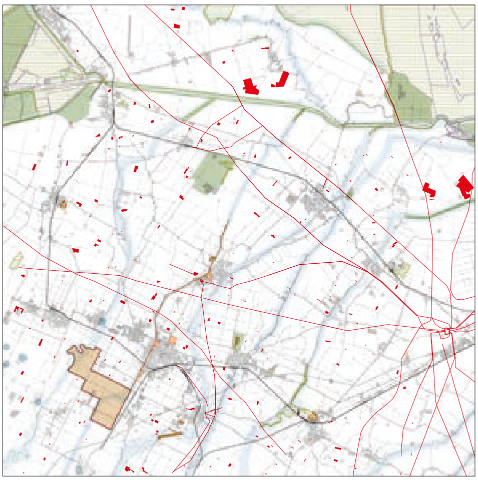
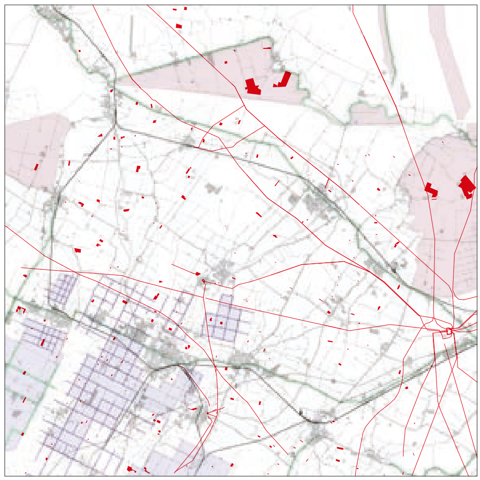
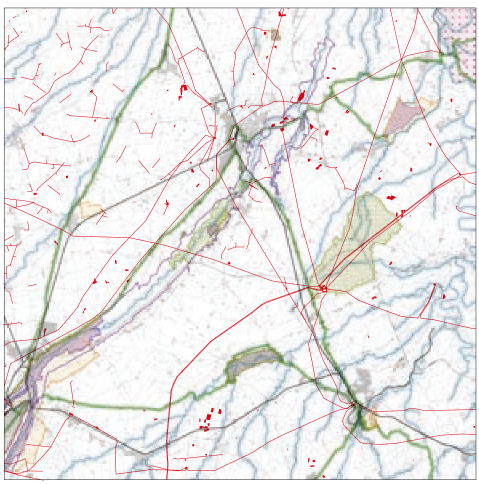
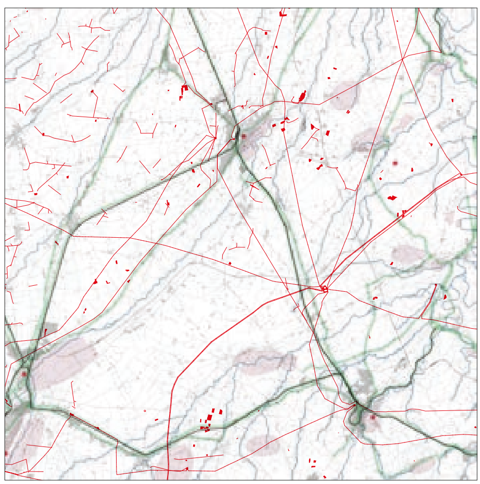
Atlas 3

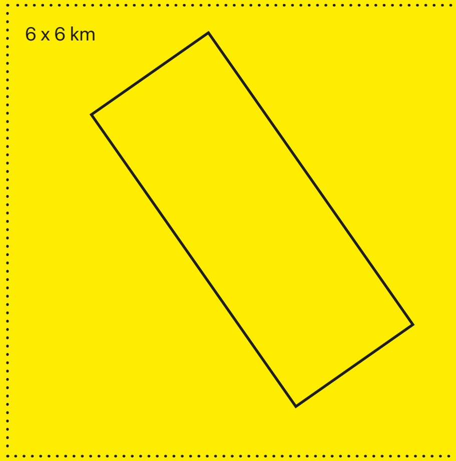
The overlap within the same design between the different types of land-protection has led to the development of three maps in the three cases, highlighting the presence of specific constraints and related potential.
Some areas are to be excluded for hosting photovoltaic fields to protect historical and archaeological assets located more precisely (as in the case of the Brindisi plain) or in larger areas (as in other cases). In some cases, the geometric structure organizes the territory itself that is directly protected, as in the case of the Pianura Padana, characterized by the Roman *centuratio*.
The ecological factor is one of the most important aspects to consider in all three cases. In addition to the protected environmental areas, such as parks and reserves particularly visible in all the three cases , landscape roads (roads characterized by historical and landscape interest) emerge and cross the territories and, if respected, can enable the ecological system to be networked.

Protected areas
- Sites of naturalistic relevance - ZPS-ZSC_Natura 2000
- Forest and areas of landscape interest
- Parks and natural reserves
- Ecological rebalancing areas
- Protected urban landscapes
- Waterways protection areas (150 m)
- Parks and natural reserves buffer (150 m)
- Forests buffer zones (100 m)

Landscape assets and networks
- Landscape assets ex DDMM 1/8/1985
- UNESCO sites - wine landscapes buffer zones
- Regional Greenways
- Rural landscapes

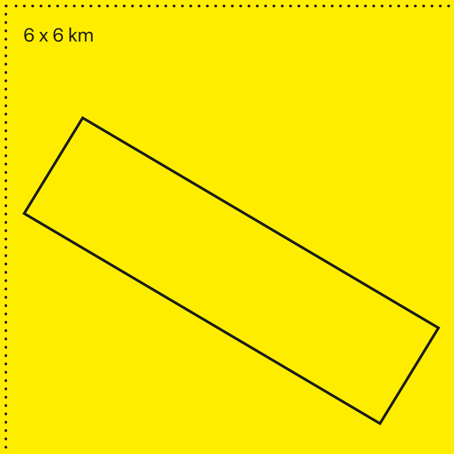
Cultural and settlements components
- Historical interest and traditional settlements
- Historical and cultural buffer zones
- Protected areas of the centuriation structure
- Protected areas of elements of centuriation
- Landscape historical roads
- Panoramic viewpoints

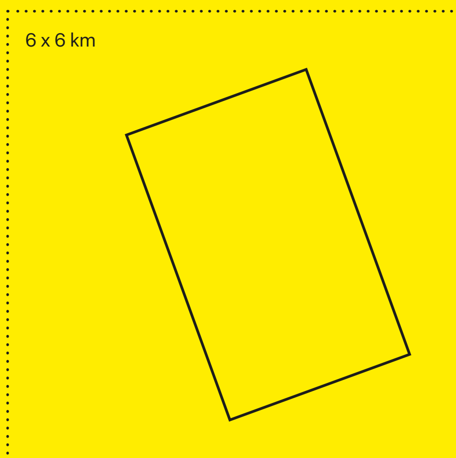


Atlas 3
N 44° 33' 28'' - E 7° 45' 12''

PROCESSES AND TRACES



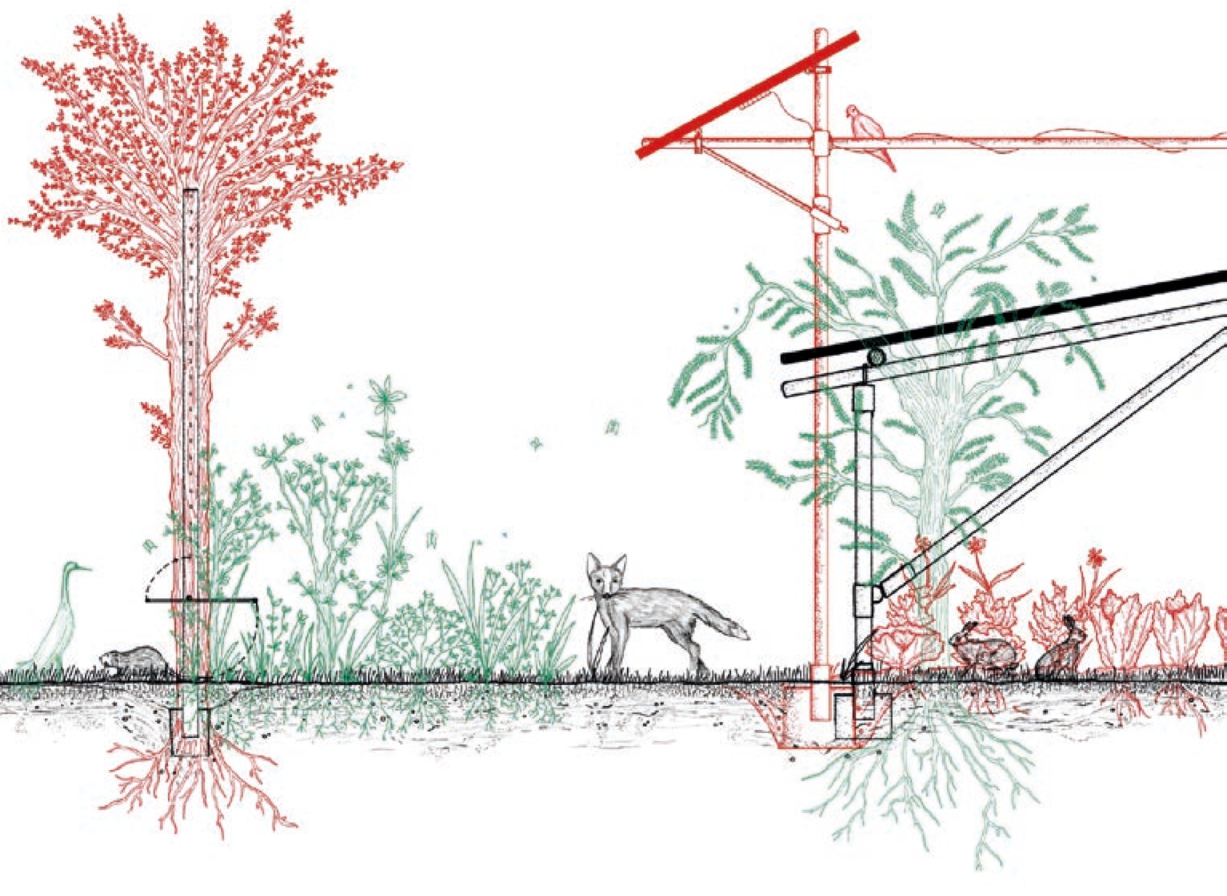
Atlas 2
N 44° 26' 32'' - E 11° 54' 22''



Atlas 1
N 40° 30' 50'' - E 17° 59' 15''

DESIGN THE DECOMMISSIONING

GIULIA CAZZANIGA - SARA ANNA SAPONE[1]



Decommissioning as a project of becoming

The concept of landscape, within the contemporary debate, is understood as an increasingly complex and layered system where the process is not merely part of its definition but constitutes the landscape itself. Landscape is a dynamic process and moves beyond static objects to represent the continuously evolving outcome of negotiations and relations among ecological, geological, and human factors, such as management and stewardship[2]. This understanding incorporates and intertwines the ecological and cultural spheres. "Nature" is rethought, building upon James Corner's theories[3], as an autonomous yet fundamental force that shapes the physical environment, within which design practice operates to induce further changes over time. This approach shifts the focus to phenomena like hydrology, soil structure, and succession, with design capitalizing on these dynamic systems. Conversely, drawing on the work of André Corboz, landscape is rooted in the material expression of the soil itself, functioning as a repository of knowledge, history, and cultural meanings inscribed and overwritten by different eras and agents[4]. This emphasizes that the ground is a palimpsest, a stratified surface where traces of past human intentions and natural events persist and inform ongoing change. More recently, research such as Timothy Mortons introduces the concept of "hyperobjects", entities that transcend local scale and traditional mapping[5], instead referring to global dynamics. Given this inherent fluidity, the project of landscape architecture must act in harmony with this ever-changing reality, rendering a static view of design as a finite solution obsolete.

This chapter, within the context of a broader exploration of energy-productive landscapes and their evolution, aims to reposition the decommissioning phase of a photovoltaic field. Decommission is viewed as more than the end-of-life (EOL), a technical or ecological requirement, but rather as a critical moment of design agency, a projective act that can redefine the meaning and role of the landscape within a productive system. In this sense, the end-of-life of the photovoltaic plant is viewed as a series of phases, a project in itself subject to ongoing mediation, always in the process of becoming

1 The two authors jointly conceived this chapter, defining its theoretical frame and outline. Giulia Cazzaniga authored the section *Decommissioning as a Project of Becoming*, Sara Anna Sapone authored the section *Design the decommission through scenarios of change*. The section *Qualitative description of three solar landscapes* was co-written by both.

2 «Regardless of how landscapes are studied, they are always formed by the interaction between humans and nature». Hilde Tobi, Adri van den Brink, *A process approach to research in Landscape Architecture,* in Adri van den Brink, Diedrich Burns, Hilde Tobi, Simon Bell, *Research in Landscape Architecture*, London-New York, Routledge, 2017, pp. 24-34.

3 James Corner (ed.), *Recovering Landscape. Essays in Contemporary Landscape Architecture*, New York, Princeton Architectural Press, 1999.

4 André Corboz, *The Land as Palimpsest*, in "Diogens", n. 121(31), pp. 12-34.

5 Timothy Morton, *Dark Ecology*, New York, Columbia University Press, 2014.

Previous page. Hand drawing by Simone Baccaglini, 2025.

something possible, never fully accomplished. In addressing this, landscape architecture could play a role considering the potential of design to «set up the conditions for life to evolve, utilizing natural processes like an open-ended, dynamic medium to achieve resilient, adaptable, and self-organizing environments»[6].

In the common understanding of photovoltaic solar plant decommissioning, three main strategies are generally recognized[7]. One approach is Total Decommissioning, which refers to the complete removal of the plant, ancillary structures, and the infrastructures that make it accessible, intending to return the land to its original condition. Items such as machinery and plant components are removed and made available for reuse within the company or on the secondary market. Alternatively, Revamping entails a partial and rotational decommissioning of the photovoltaic plant, which, divided into sectors, involves targeted removal and replacement of components based on a hierarchical order. All structures are progressively upgraded and continuously upgraded during this process. The size and appearance of the newly replaced parts may vary due to ongoing technological advances. This cycle is repeated over time, also encouraging internal reuse and integration of components alongside new ones. The third one is the Transition to a new productive typology, where partial, total, or no decommissioning of the photovoltaic system may occur to create recreational or educational spaces. Components can be reused, sold, or repurposed for different uses, land changes, or other programs. This EOL model offers alternative business opportunities and fosters better connection between the facility and its surrounding area.

Building on these technical definitions, our aim is to investigate these three operational strategies through landscape architecture projects. To achieve this, the first step was to shift from an acknowledgment and representation of data as a deductive system of quantitative references to an interpretation and reorganization of that data. This enables a transition to a qualitative expression of main characteristics, such as tendencies toward particular traits or behaviors. These "tendencies" are already present in the ground, air,

6 James Corner, *Lifescape–Fresh Kills Parkland in Topos*, in "The International Review of Landscape", 2005. pp. 14-21.

7 Among the various books on the topic we referred to the position expressed in Heidi Kolbeck-Urlacher, *Decommissioning Solar Energy Systems Resource Guide*, Lyons, Center for Rural Affairs, 2022. It explicitly lists the options as «reuse, refurbishment, or repowering» versus «fully discontinuing operations and decommissioning the project», which includes «recycling and disposal».

water, and elements that compose the landscape, and through design practice, they can be unveiled to inspire new possibilities for the project. Inspired also by Pierre Bélanger's theories, which strongly advocate for an outlook where design data and representations are not neutral or objective, but are fundamentally interpretations shaped by designers' intentions and political/ideological contexts[8], we adopt a design-driven research approach that pursues unconventional solutions for an uncharted issue. With the majority of solar fields constructed at the turn of the century – and an average lifespan of thirty years – there is currently a lack of built solutions and researches addressing photovoltaic decommissioning from a landscape architecture standpoint.
By radicalizing design concepts, such as the total decommissioning or the revamping, we intend to stir up hypotheses and potential answers regarding the transformation of the productive landscape that have not yet been fully focused on or recognized as established architectural strategies. This approach necessitates intentionally setting aside immediate social factors and conventional feasibility constraints to prioritize the full exploration of systemic and territorial possibilities.

Qualitative description of three solar landscapes

Considering as the starting point the morphological reorganization suggested by the Politecnico di Torino research team, we read the characteristics of three territorial contexts. The envisioned project-driven approach necessitates the use of specific lenses – transversal tools designed to read different landscape typologies, ensuring the vision is both site-specific and capable of finding common "ground" across case studies. From a landscape architectural perspective, these lenses address questions of form, scale, and continuity[9]. Specifically, we read the territory through its Rural-Urban Development Relationship, given our focus on productive landscapes and the interaction between human and non-human systems. Secondly, we investigate the specific Spatial Relations that have shaped these lands, involving the morphology of the region, its hydrological and infrastructure networks, and the proximity to the urban environment. Furthermore, the Energy Distribution

8 Pierre Bélanger, *Is Landscape Infrastructure?*, in Gareth Doherty, Charles Waldheim (eds.), *Is landscape...? Essays on the Identity of Landscape*, London, Routledge, 2015, pp. 190-212.

9 This frame relates to the theoretical precedents expressed in the text by Sara Protasoni in this volume.

Next page. The representation of the three landscapes. From data to interpretation.

Grid is an essential lens as it constitutes the main feature and objective of the research-to place the future energy productive landscape at the center of the reflection. Finally, observing Biodiversity and Ecological systems contribute to a broader reflection on the territory, intended not as a juxtaposition of different elements but as a complex living body.

To fully explore the complexity of energy-productive landscapes, three distinct context are described[10] – San Pietro Vernotico, Lugo, and Fossano – each characterized by the integration of large-scale photovoltaic energy production into established rural systems. By describing the specific historical settlement patterns, dominant agricultural practices, and key ecological features, we establish a framework for understanding how the tension between past agrarian use and present energy demands shapes the contemporary landscape and could change once decommission occurs.

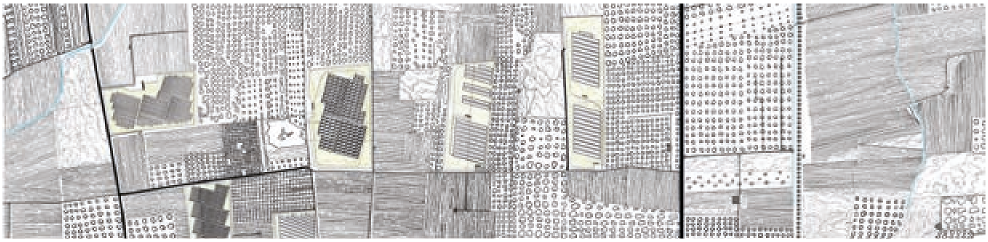
Design through Scenarios of Changes

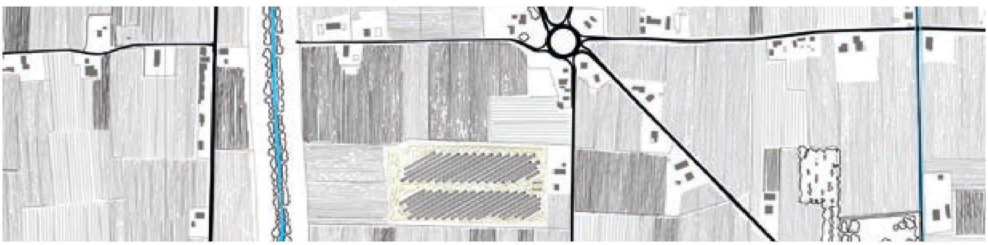
Building on the understanding of the specificity of the three territorial contexts, our design approach involves creating Scenarios of Change[11]. This entails analyzing the current conditions, reading the "tendency"[12] of each site, and developing a theoretical proposal with a specific spatial layout, focusing on rethinking and reorganizing elements within a new relational framework. We select one particular future, a critical case, to test our research perspective and evaluate the site's potential for decommissioning. Although each site – San Pietro Vernotico, Lugo, or Fossano – has multiple possible futures, we identify the most probable one based on our assessment of local conditions. By exploring extreme options, we present the most radical alternatives, configurations that challenge conventional methods without necessarily considering their feasibility. These are not final design solutions but rather exploratory trajectories employing unconventional approaches. They may even radicalize ideological or conceptual positions to stimulate new questions about decommissioning, especially for issues that are not yet fully addressed or integrated into existing relational systems. By these

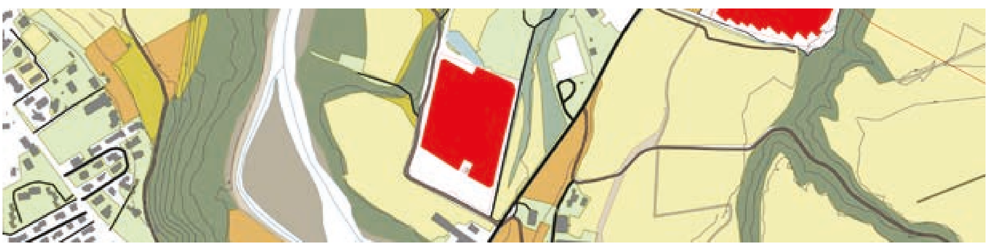
10 An extended description of the three landscapes is provided in the following pages.

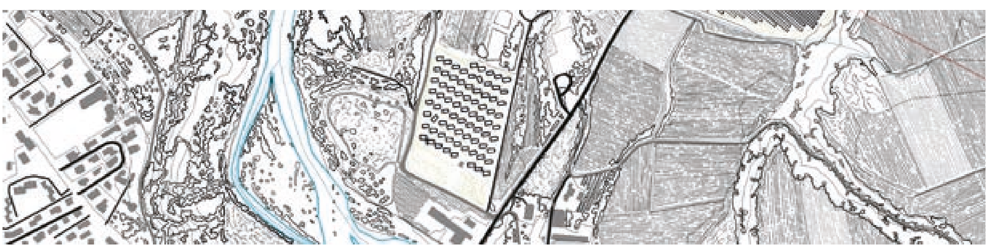
11 «Developing scenarios of change and then projecting the possible landscape outcomes. He identified a series of decision points (or discursive moments as he called them) which appeared to be particularly important in shaping the way that the different futures were chosen». Adri van den Brink, Diedrich Burns, Hilde Tobi, Simon Bell, *Research in Landscape Architecture*, in *Research in Landscape Architecture*, New York, Routledge, 2017, p. 109.

12 Concept of *tendency* in design expressed in Julian Raxworthy, *Novelty in the Entropic Landscape: Landscape Architecture, Gardening and Change*, Ph.D. Thesis, Santa Lucia, University of Queensland Library, 2013.









three distinct scenarios, we aim to explore a taxonomy of potential afterlives for energy infrastructure, moving beyond simple removal to frame decommissioning as an opportunity for site-specific resignification.

The first approach focuses on the countryside of Brindisi, close to San Pietro Vernotico, in the energy-intensive south, historically tied to olive cultivation. Thus, we envision a scenario of productive reprogramming, where the dismantling of solar fields becomes an opportunity to restore abandoned or weakened olive landscapes, capitalizing on the energy distribution infrastructure already in place. Rather than a return to pre-existing conditions, this scenario explores how decommissioned sites can serve as platforms for new agro-cultural economies – such as oil production, food networks, or landscape tourism – linking identity, ecology, and infrastructure. It suggests that the afterlife of energy fields can support not only biodiversity, but also social and economic regeneration, linking energy production to the appreciation of a composite landscape.
A second model is explored in Lugo, Ravenna province, through a Transitional Scenario toward Agrivoltaics. In this territory, where the centuriation grid and historical Piantata Padana – a traditional agroforestry system of vine and mulberry rows – still marks the landscape, we explore a transitional scenario toward agrivoltaics. Here, photovoltaic panels are not removed but repositioned and redesigned to accommodate a hybrid production model that merges renewable energy with small-scale, culturally resonant agricultural practices. The scenario reflects on how landscape form and spatial patterns – such as the rhythm of rows, the alternating texture of orchards and crops, and the logic of irrigation – can be reinterpreted through contemporary agrivoltaics strategies. Rather than erasing the energy infrastructure, this project seeks to suture it into the productive and cultural history of the territory, affirming landscape as a medium of continuity and invention.
Finally, in Fossano, a territory characterized by dispersed settlement, cereal monocultures, and ecological fragmentation in the province of Cuneo, we propose a scenario of total decommissioning. Here, the dismantling

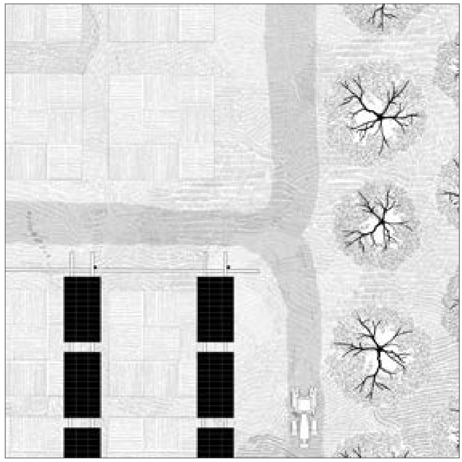
of photovoltaic panels gives way to a long-term ecological succession process – a form of re-wilding that acknowledges the degraded condition of the agroecosystem while restoring continuity between fluvial corridors and fragmented habitats. Drawing inspiration from the site's existing riparian systems and the presence of the Foresta Fossile – a rare, fossilized forest along the Stura di Demonte river – we reimagine the energy field as a catalyst for habitat regeneration and landscape memory. Rather than returning to intensive agriculture, the area is allowed to evolve as an open-ended ecological matrix, fostering biodiversity and mitigating hydrological risks.

Through these three scenarios, we argue that the future of decommissioned photovoltaic landscapes depends on a shift from mitigation to design. Decommissioning must be conceived not merely as an end, but as a threshold, a transformative moment that mobilizes the agency of landscape architecture to reimagine the forms and functions of post-energy territories. Ultimately, our aim is to challenge the notion that energy infrastructures are inert technical objects with fixed lifespans. Instead, we see them as territorial figures-spatial configurations that are embedded in, and transformative of, the larger landscape.

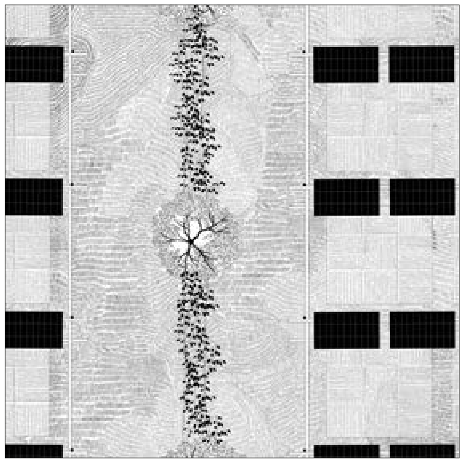
Project matrix. Schemes to illustrate boundaries, technical structures, and biodiversity in their evolution, adaptation, and changes on site.

Diagrams by Marco Agosti, 2025.

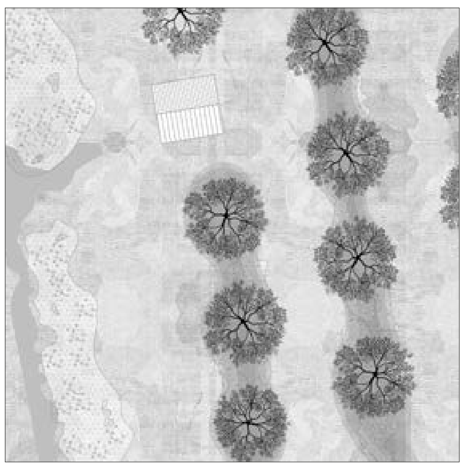
San Pietro Vernotico →



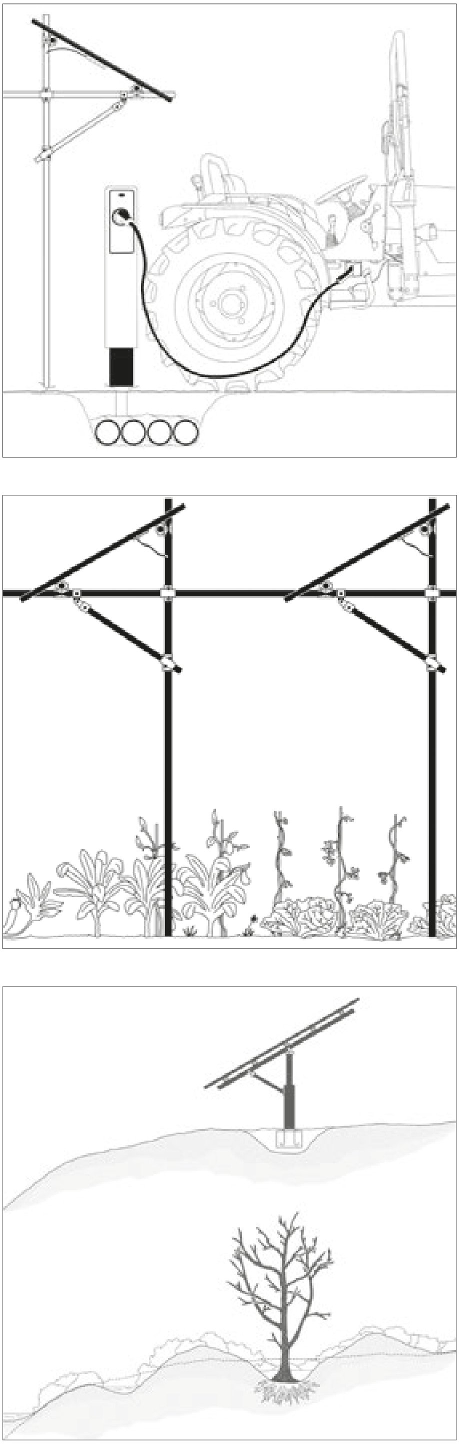
Lugo →



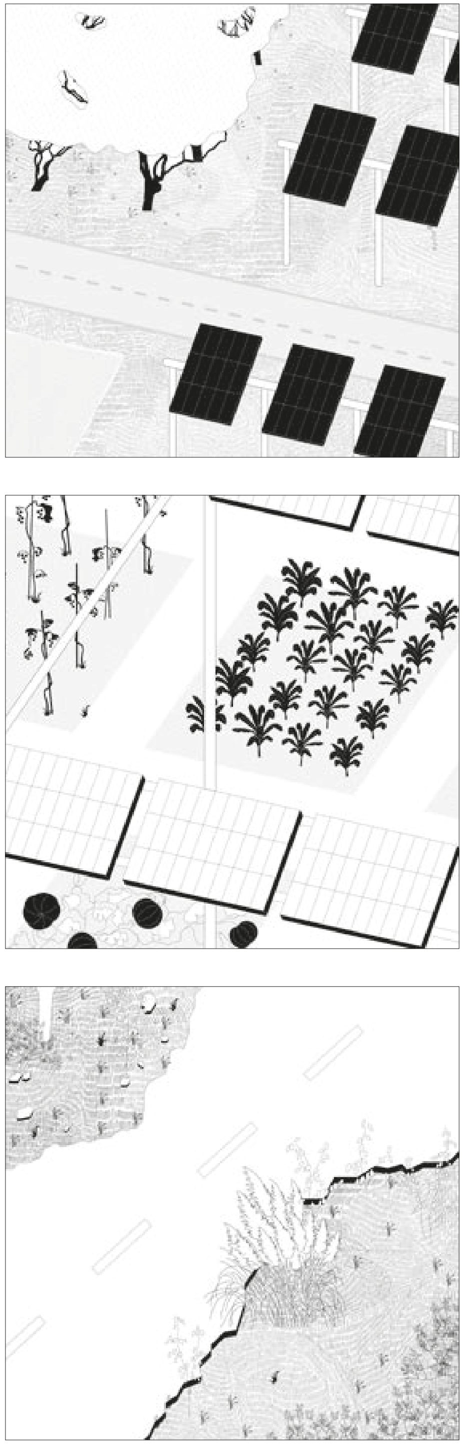
Fossano →



Boundaries



Structures



Biodiversity


N 40° 30' 50'' - E 17° 59' 15''


SAN PIETRO VERNOTICO

Fields and infrastructures

San Pietro Vernotico, in the northern Salento area of Puglia region, is a plainland characterized by wide open landscapes strongly shaped by agricultural production, fragmented by water management and mobility infrastructures. This infrastructured landscape initially supported regional food productivity but impoverished biodiversity. Subsequently, it became fertile ground for renewable energy production due to large available surfaces from decaying monocultures and favorable mediterranean weather. A key question now concerns the reuse of energy infrastructures nearing the end of their lifecycle, potentially to power new systems like precision agriculture and electric mobility, while improving local biodiversity.

Urban-Rural Development
The Puglia region is widely occupied by agricultural production, with 65% of its territory dedicated to agricultural fields. The area around San Pietro Vernotico belongs to the Brindisi plain, a flatland originally devoted to pastures and later dominated by crops, mostly of vines and olive groves, suited to the Mediterranean climate. The field layout is rooted in centuries of productive uses, tracing back to Roman centuriation systems. However, the cultivation does not strictly follow the Roman grid, featuring irregular planting schemes and varying density, mainly consisting of monocultural patches. The rural landscape is perceived as open, with few vertical elements, but its quality is evaluated as low to no ecological value also due to the prevalence of monocultures.

Spatial Relations
The regional landscape matrix is strongly defined by agricultural operations, including soil reclamation, field divisions, and different crops. There is a prevalence of medium-sized plots, regularly laid out by local roads and irrigation canals perpendicular to the coastline. These agricultural canals have significantly shaped farming practices and settlement growth, especially in the coastal

Next page. The conditions on the test site: borders, structures and biodiversity. Photos from San Pietro Vernotico by Sara Anna Sapone. 2025.

area, which is also influenced by marine ecology. Water channels are particularly present in this part of Puglia due to the sandy and clayey substrate and lack of natural inclination, requiring artificial channels to stabilize agricultural lands. The shape of San Pietro Vernotico and its surrounding fields are strongly influenced by the reclamation canals, characterized by an east-west directionality.

Energy Distribution Grid

Puglia region is one of Italy's top photovoltaic energy producers, with widespread solar fields presence. The region has the highest average area size per plant in Italy (36kW), with the majority being ground-mounted photovoltaic systems. Following European incentives starting in 2010, the region rapidly saw an increase in solar fields, converting unused agricultural lands for energy production. This resulted in a diffuse system of solar farms, fragmented and fenced off from the surrounding rural landscape. The potential exists for agrivoltaics to support local flora and improve connectivity, leveraging the heavily infrastructured territory. San Pietro Vernotico is near several energy processing facilities in the Brindisi province. The Centrale Termoelettrica Enel Federico II in Cerano, the closest large powerplant, is connected to the national high-tension network. Originally coal-fired, it was converted to a gas-fired station in 2021 to reduce pollution. The electric network also links to the Terna powerplant in Brindisi, part of the national high-tension network.

Biodiversity and Ecological Systems

The flatland surrounding San Pietro Vernotico, covered by large-scale monocultures, offers limited ecological variety and is defined in planning tools as having low-to-no ecological relevance. The substitution of traditional mixed-use cultivation with monocultures (olives and viticulture) further lowered biodiversity. Potential biodiversity along the multiple water channels has been hindered by the disorganized construction of secondary roads and urban settlements. Areas of ecological interest are concentrated on the coastal side and along the main water canals, such as the Siedi channel, which is surrounded by the Cerano woodland natural reserve. A vegetational gradient exists from the coast inland, shifting from holm oak and aleppo pines near the coast to sessile oaks, cerris, or hygrophilous plants like field elms. Other ecologically rich areas include the woodlands of Santa Teresa and Bosco dei Lucci, which host relict populations of mediterranean cork oak (*Quercus suber*). These areas support passeriformes, nocturnal birds of prey, small mammals, and reptiles. The highest biodiversity is found in the Cerano Natural Park and coastal areas, while in inner areas, it is mostly relegated to uncultivated edges and abandoned fields. Current planning suggests rethinking agrarian production to increment quality and potentially link it to tourism, which could push for a different relation with energy production needs, reusing existing infrastructure.

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N 44° 26' 32'' - E 11° 54' 22''


LUGO

Layered productive landscape

Lugo, in Italy's Emilia Romagna region, is a richly stratified and intensely managed rural landscape shaped by centuries of agriculture, water management, and infrastructural transformation. This flat, geometrically structured territory is now a critical case study for adapting post-agricultural landscapes to new functions like photovoltaic energy generation.

Urban-Rural Development
Emilia Romagna is one of Italy's most productive agricultural regions, with over 50% of its land cultivated. Lugo, in the Romagna plain, has been a model of rural intensification and agrarian efficiency. However, this inner plain isn't environmentally protected and is widely perceived as having low or negligible ecological value, often approached primarily as a space for the extraction of food, fiber, and now, energy. The territorial layout is still defined by the legacy of the Roman centuriation system, a rational orthogonal grid of roads and fields. Historically, this facilitated the Piantata Padana, a structured agroforestry system combining rows of mulberries and vines with herbaceous crops in geometrically organized plots. Today, much of this vegetative complexity and vertical layering has been lost. Traditional elements like tree-lined roads, hemp retting ponds (*maceri*), and drainage ditches have largely been filled in or converted to simple cropland. The centuriated layout remains legible, now hosting vast fields of monocultures – wheat, maize, rice, sorghum, soybeans, and sugar beets – outside urbanized areas. Lugo is marked by peri-urban sprawl, where low-density development coexists with high-intensity agriculture. While productive use is dominant, new occupations – industrial, logistic, and energetic – are reshaping the landscape's identity.

Next page. The conditions on the test site: borders, structures and biodiversity. Photos from Lugo. Simone Baccaglini, 2025.

Spatial Relations
The defining feature of Lugo's spatial organization is its regularity. The northeast-southwest orientation, inherited from Roman centuriation, structures farming and infrastructural development,

with each centuria (around 712 meters per side) still shaping the modular logic of land division. Beyond geometry, the space is deeply influenced by centuries of hydraulic engineering, with extensive drainage and reclamation systems transforming marshes into cultivable land from the Middle Ages through the Renaissance. The hydrological network has two main orientations: an east-west drainage axis parallel to the Po River and a north-south system of tributaries converging toward the Reno River. These overlapping flows create a multi-scalar web of canals, embankments, and ditches for efficient water management on the flat terrain. In the lower Romagna plain, the riverine character is more pronounced; meandering riverbeds, abandoned oxbows, floodable plains (*golene*), and river islands coexist with fields and tree plantations, often with poplar groves occupying former fluvial landscapes, reinforcing a hybrid space that is artificial, natural, productive, and geomorphic. The persistent centuriation and historical water management patterns imbue the area with a strong sense of continuity. These same patterns are now being adapted for new functions, particularly the spatially regular installation of photovoltaic fields, reprogramming historical spatial templates for emerging infrastructural uses.

Energy Distribution Grid

Lugo is significantly integrated into the regional and national energy grid, hosting key infrastructural nodes like the Lugo RFI substation and the TERNA substation in nearby Alfonsine, forming part of a broader energy corridor. This reflects a trend where rural landscapes are redefined as spaces for energy production and distribution. The morphological clarity and accessibility of the centuriated landscape, combined with flat topography, low ecological sensitivity, and large sun exposure, make it particularly well-suited for the deployment of photovoltaic systems. The regularity of the land division simplifies the planning and alignment of solar panels, but this shift raises questions about multifunctionality and identity.

Biodiversity and Ecological Systems

Despite its visual openness and vegetative cover, Lugo's landscape currently offers limited ecological value. The simplification of the agricultural matrix and the eradication of semi-natural elements have caused significant habitat loss and reduced biodiversity. The former diverse mosaic of trees, vines, water bodies, and hedgerows is now a monocultural expanse with few ecological niches. Spontaneous vegetation is largely confined to marginal spaces like canal edges, field borders, and isolated uncultivated fragments. River corridors provide the most meaningful ecological continuity, acting as semi-natural axes in an otherwise poor environment, but they face pressure from intensive land use and infrastructural expansion.

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N 44° 33' 28'' - E 7° 45' 12''

FOSSANO

Rural and riverine landscape

Fossano, in the province of Cuneo, southern Piemonte, illustrates the tension between productive rural economies, infrastructural modernization, and ecological fragmentation. Anchored in cereal cultivation and intensive livestock farming, the territory reflects historical agrarian layering and challenges posed by high-pressure systems. Despite a regionally diversified land use (50% agricultural, 37% forest, 15.5% pastures), Fossano's plain is predominantly monocultures and large-scale animal husbandry. This results in a simplified agroecosystem with high water and energy demands, limited biodiversity, and growing pressure on soil and aquifer quality.

Urban-Rural Development
Piemonte has a legacy of social and political fragmentation, with territorial cohesion historically driven by industrial development. The Cuneo province features a complex network of isolated rural structures – historical farms (*grange* and *cascine*), towers, *tetti* – emerged through centuries of agrarian adaptation. Agriculture is the dominant land use (over 50%) in the Fossano area, with pastures notably accounting for roughly one-third of the utilized agricultural area, supporting a diverse agro-pastoral system that has resisted homogenizing pressures. The agricultural parcels are relatively small, characterized by undulating surfaces formed by gravelly alluvial deposits and a deep-water table. Historically, the rural landscape was viewed as a cultural extension of the garden and villa tradition, where the agricultural field was both an economic asset and an aesthetic object. Today, this complexity is challenged by land-use intensification and infrastructural development. The prevalence of maize and forage anchors Fossano's landscape in a deep agronomic identity. Scattered development combined with infrastructural modernizations suggests a hybrid territoriality where productive, residential, and infrastructural functions interlace.

Next page. The conditions on site, structure, and biodiversity. Photos from Fossano by Marco Agosti, 2025.

Spatial Relations
Fossano's landscape is shaped by geomorphology, water systems, and historic land divisions. The topography features gently rolling hills with powerful alluvial soils and deep aquifers, supporting a diversified agriculture. A dense network of irrigation canals, dating back to the 14th century, forms a fine-grained hydrological lattice that structures the territory. The historical settlement pattern is markedly dispersed, featuring isolated rural nodes anchored to agricultural production, like early grange complexes and later large cascinali surrounded by roads and canals. The legacy of this morphology is visible in toponyms and remnants like towers and isolated farmsteads. The Stura di Demonte river is a key element, acting as a powerful natural discontinuity. Its deep, steeply incised bed carves through the terrain, bordered by pioneer vegetation and narrow cobbled riverbanks. Riparian zones alternate between natural poplar-willow assemblages and managed poplar plantations. The infrastructural crossings of the Stura define the landscape's morphology and symbolic reading; the 19th-century railway bridge symbolizes early industrial modernization, while the contemporary A6 motorway bridge is a landmark of commercial connectivity and mobility. These two bridges act as both functional structures and cultural references.

Energy Distribution Grid
Fossano is strategically located within an energy corridor between two TERNA energy hubs (north toward Turin, south along the A33 highway). The nearby installation of an *E-Distribuzione* substation indicates ongoing efforts to modernize and densify local electricity infrastructure. This trend reflects the growing centrality of rural landscapes in Italy's energy transition. While not yet widespread, its open parcels, deep water table, and relatively low building density make it a plausible candidate for future solar development.

Biodiversity and Ecological Systems
Fossano's biodiversity is significant, even without official high-value recognition. The fluvial corridors, especially the Stura river, host valuable riparian habitats with pioneer vegetation and native species like black poplar and willow. These narrow ecological bands introduce heterogeneity, acting as reservoirs of spontaneous life in the cultivated landscape. The Foresta Fossile along the Stura is a site of exceptional paleobotanical and ecological significance, reinforcing the Stura corridor's value as a multifunctional system. Biodiversity faces critical pressures, primarily from the high density of intensive livestock farming. Manure spreading leads to nitrate and pathogen infiltration into groundwater, threatening aquifer health due to the local soils' poor natural filtering capacity. The dominance of maize monoculture also exacerbates ecological degradation, homogenizing the landscape and demanding substantial water and energy inputs that are unsustainable on gravel-rich soils. Ecological connectivity is weak, especially in cereal-dominated zones, with a low density of linear ecological

elements. The most valuable corridors (riverine systems) lack connective pathways, and their riparian vegetation is often degraded. Potential for regeneration exists through revitalizing hedgerows, restoring riparian buffers, and reconnecting fluvial corridors to enhance landscape permeability and biodiversity. Integrating dual-purpose land uses, such as agrovoltaic systems, offers a way to reconcile ecological restoration with energy transition goals.

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Cuneo / Fossano
N 44° 33' 28'' - E 7° 45' 12''

N E W
P E R S P E C T I V E S

Ravenna / Lugo
N 44° 26' 32'' - E 11° 54' 22''

Brindisi / San Pietro Vernotico
N 40° 30' 50'' - E 17° 59' 15''

DESIGNING SOLARSCAPES

A RADICAL APPROACH

ELENA VIGLIOCCO

«You can even look at a piece of a puzzle for three days straight, believing you know everything about its configuration and its colour, without having made the slightest progress: all that matters is the possibility of connecting that piece to other pieces […]; only the recomposed pieces will take on a legible character, will acquire a meaning: isolated, a piece of a puzzle means nothing; it is simply an impossible question, an opaque challenge»

George Perec, *La vie mode d'emploi*, 1978[1]

Through design, the third framework of the research critically reflects on the change underway and the characteristics of a new, sustainable productive solarscape. Starting from the idea that the unplanned sprawl of small and medium photovoltaic fields on the ground compromises the ecological quality and the perceived landscape, based on the observation of the state-of-the-art distribution of photovoltaic fields within the three case studies examined, the opportunity connected to the decommissioning and/or revamping of photovoltaic fields on the ground allows to reconfigure the landscapes compromised by these fields. After examining, identifying, and breaking down the elements that make up the landscapes investigated and identifying a taxonomy of recurring and non-recurring elements, the research identifies three alternative intervention strategies based on the redistribution and relocation of photovoltaic fields on the ground to redesign the landscape and increase the ecological and perceived landscape quality. Each strategy provides for decommissioning at least a part of the existing photovoltaic fields and their relocation to another area identified as suitable to increase the overall quality of the examined landscapes. The strategies are the starting point for developing specific solutions for decommissioning individual photovoltaic fields that can be redesigned according to the opportunities offered on a case-by-case basis.

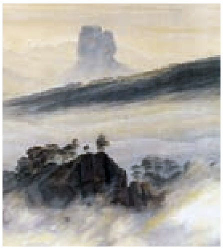
A radical approach

In Diderot and D'Alembert's Encyclopedia, "landscape" or *paysage* is a term originating in France that indicates a landscape painting, presented as a «*genre de peinture qui représente les campagnes e les objets qui s'y rencontrent*»[2]. With Romanticism, landscape painting became the highest and most popular expression of the figurative arts, surpassing historical, character, and allegorical genres. For Alexander von Humboldt (1808), landscape was the overall impression of a place[3], while, referring to Karl Popper's theory of the three worlds (1978), landscape belongs to "world 2" – that of conscious experience – and "world 3" – the world of social constructs – rather than to "world 1"

1 George Perec, *La Vie mode d'emploi*, Paris, Hachette, 1978. Trad. it. La vita istruzioni per l'uso, Bergamo, BUR, 2011, p. 205. Translation by the author.

2 Denis Diderot, Jean Baptiste Le Rond D'Alambert, *Enciclopedie, ou Dictionnaire raisonné des sciences, des arts et des métiers, par une société de gens de lettres*, vol. 12, 1769, p. 169. Source: https://www.byterfly.eu/islandora/object/libria%3A112296#mode/2up [last access August 2025].

3 Alexander von Humboldt, *Ansichten der Natur*, 1808. Trad. it. Franco Farinelli (ed.), *Quadri della natura*, Florence, La Nuova Italia, 1999. In this book, written after a long journey in South America, the connection between the idea of landscape and landscape painting is strong.



Caspar David Friedrich, *Der Wanderer über dem Nebelmeer*, 1818. Detail. Source: https://commons.wikimedia.org/wiki/File:Caspar_David_Friedrich_-_Wanderer_above_the_sea_of_fog.jpg

– the world of objects and physical states[4]. The idea of landscape originates from, and remains closely linked to, that mode of perception that finds its reference in landscape painting. It consists of selecting and rationalising the various elements captured by the gaze, transforming them into a defined view, considered a meaningful unit.

The same year as Popper's theory, Perec wrote *La Vie mode d'emploi* (1978), which narrates the lives of some characters who live in a building in rue Simon-Crubellier 11 in Paris. The book's protagonist is Percival Bartlebooth, who lives on the first floor. Caspar David Friedrich's Romantic masterpiece, *Der Wanderer über dem Nebelmeer* (1818), probably inspired the character of Bartlebooth, who dedicates his life to fulfilling a single project. Perec imagines a man whose fortune was equal only to his indifference to what fortune generally allows and whose desire was to grasp, describe, and exhaust a fragment of the world, not its totality. Three phases organise Bartlebooth's program. In 1925, this bored millionaire asked painter Serge Valène to give him one lesson a day for ten years so he could master the art of watercolour. After, Bartelbooth planned to travel the world for the next 20 years (from 1935 to 1955), sending a watercolour of a seascape (in the format 65 x 50 or 50 x 65 cm) on Whatman paper to the craftsman Gaspard Winckler every two weeks. Winckler would transform the watercolour into a 750-piece puzzle every two weeks and store it in a special box. In total, 500 puzzles would be completed. From 1955 to 1975, Bartelbooth would reassemble a puzzle every two weeks following the arrival order, knowing only the place's name and the watercolour's arrival date. Once the watercolour was reassembled, Bartelbooth would send the completed watercolour back to where it had been painted to be immersed in a solvent solution from which nothing but a virgin, intact sheet would emerge.
The puzzles Bartlebooth are truly enigmas for at least two reasons. The first is that the pieces are unique. The puzzle isn't made up of standardised pieces, but rather pieces that Winkler cut out according to his imagination[5]. The second is that, to put them together, he can only

4 Karl R. Popper, *Three Worlds*, 1978. Source: https://tannerlectures.org/wp-content/uploads/sites/105/2024/07/popper80.pdf [last access August 2025]. Trad. it. I *tre mondi. Corpi, opinioni e oggetti del pensiero*, Bologna, Il Mulino, 2012.

5 Winkler's art refers to the first jigsaw puzzles, invented around 1760 by the English cartographer John Spilsbury. Initially, they were geographically themed by painting the subject on a thin wooden board, which was then cut into small pieces that followed the borders of countries. Their purpose was primarily educational.

remember the landscape he saw and painted many years before. Does Bartlebooth succeed in his intent? Does he manage to capture and reassemble the fragments of the world he spent 20 years painting and 20 years reassembling? No. He fails because his project had an unknown factor he hadn't planned: Winkler. The craftsman, cutting the pieces according to his project, plays a role Bartlebooth hadn't considered[6].

What does the failure of Bartlebooth's project teach? First, it teaches that multiple players interact even in a small world fragment. Each player sees and perceives what he can of that world fragment, which may not correspond to what another player sees and perceives. Second, it teaches that time blurs and softens forms in memory. That what we seem to grasp today may not necessarily be valid tomorrow. The certainties that Bartlebooth seeks and thinks he can control are illusions. Not only is a small piece of the world the result of sedimentations, sometimes explicit and sometimes latent, which have stratified over time, but also the eye of the observer is always different, intentional, and allows only the formulation of temporary programs. Furthermore, while Bartlebooth's ambition is limited to understanding a piece of the world, Winkler's is to reprogram that same piece by developing a project that is revealed only in its end. And it is precisely the metaphor of Winkler's work that inspires the third framework of the research[7].

Three design actions and Two design levels

Considering that the research outcomes aim to improve the places we live in, both from an ecological and a perceptive point of view, this section seeks to answer two main questions. First, because the Country must increase its solar power to be more independent from abroad and to reduce CO2 emissions, do current solarscapes at the end of life conceal design opportunities that are not yet revealed? Second, what new opportunities could there be for decommissioned solar fields?
After having recognised and organised the elements that, like puzzle pieces, organise and structure the three solarscapes investigated, by bringing together the

6 Bartlebooth dies with the last piece of the last puzzle in his hand. The missing piece shape was X. Unfortunately, the one he held was shaped like a W – Winkler's W.

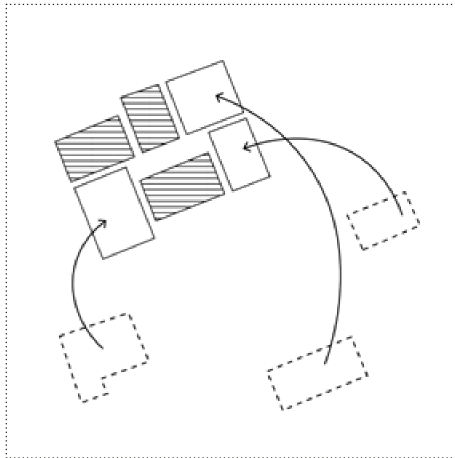
7 The metaphor that has undoubtedly been most studied in architecture is that of the *Collage City* of Colin Rowe and Fred Koetter published in 1978. The aspect that the collage metaphor fails to resolve is uncertainty. In *La Vie mode d'emploi*, Perec reveals the illusion of control inherent in any design determinism. This is the most intriguing aspect of the research, which proposes a protocol rather than a method, by remaining open-ended in its findings.

three examined palimpsests, the research continued identifying the shared latent design opportunities that can answer the two questions above.

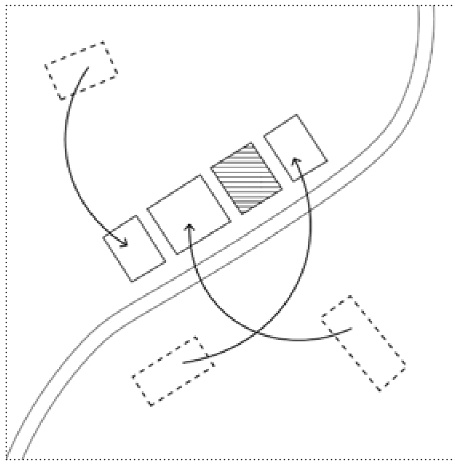
The research has observed that the solar fields installed with incentives are being renewed or (a few) abandoned but not dismantled. So, the research assumes solar production plants are like any other industrial production because the productive trend does not assume decommissioning as an effective opportunity in the short term. Also, because small and medium solar fields on the ground fragment the systems' ecology and increase serial and standardised landscapes, reducing porosity – in term of accessibility –, the research considers that the unplanned sprawl of solar fields affects the ecological quality and the perceived landscape.

Furthermore, the research observed three crucial elements, recurrently present in the three contexts examined, which could become new interpretative keys for the solarscape redesign.

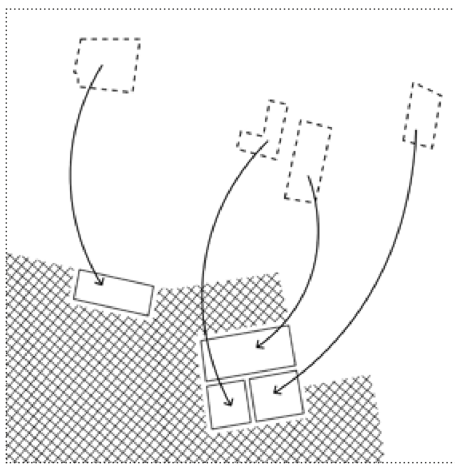
The first is the suburban location of ground-based photovoltaic fields. Small and medium solar fields are always near a street to facilitate accessibility and near the electricity distribution network, but they are far from any inhabited site. From this layout, the opportunity to densify these latent clusters emerges. The first action that the research identifies consists of clustering in the landscape. The principle is to build clusters for electricity production by working on the saturation of the current production areas – DA1. In the case of end-of-life solar fields, the opportunity lies in identifying areas where densification can provide greater production opportunities and interaction with the countryside to build positive relations. The idea is to accentuate the presence of solar fields where they already exist, saturating and densifying them in the landscape, building real production settlements that should be, at the same time, porous and various. The more extensive and dense the clusters are, the more porosity and variability will be essential. Thus, while clustering in the landscape confirms the revamping of some solar fields and the



DA1 – Clustering in the landscape



DA2 - Pairing with infrastructures



DA3 - Filling urban margins

design of a new productive solar cluster integrated in the landscape, other solar fields can be reprogrammed for new uses, whether agricultural or otherwise.

The second is the high anthropization of the countryside, characterised by infrastructures related to mobility and irrigation. At the same time, natural features (e.g., waterways and torrents) structure the ecological system of the three examined contexts. The extensive presence of infrastructures that network the landscape, along which ground-based photovoltaic fields are already installed, raises the idea that these infrastructures could structure and draw the future layout of solarscapes. In this case, the principle is to pair solar plants to infrastructure – DA2 –, designing a morphological layout that depends on the network. The logic proposed here is opportunistic. First, infrastructures such as roads, railways, and irrigation canals are resilient structures, meaning their presence is functional for a public utility. Second, the electricity grid already pairs with infrastructure systems for mobility, and it is no coincidence that ground-based photovoltaic systems tend to be located near roads that ensure accessibility to the power distribution network. On the contrary, natural infrastructures are a threat to solar landscapes. For example, waterways should be avoided unless there are significant differences in elevation due to the associated hydrogeological risk, which, however, guarantees lower land acquisition costs. The goal of this action is to redesign a landscape in which photovoltaic fields are placed to become part of the infrastructural system that designs the territory, moving away from the idea of integration with the productive agricultural landscape. Even in this case, while pairing to infrastructure confirms the revamping of some solar fields, other solar fields can be decommissioned and reprogrammed for different uses, also re-naturalisation in case of hydrographic risk.

The third are the jagged edges of urban settlements or production centres between residential areas and the countryside. These voids are a relevant resource. The more jagged and porous the edges of settlements, the more interesting their use. The principle consists of assimilating the photovoltaic fields to urban artefacts capable of redrawing the edges of the settlements. The goal in this case is to enhance the image of production centres or residential areas, reinforcing the urban-rural duality. Filling the margins correspond to the third actions that leads to the third morphological category – DA3. Ground-based photovoltaic fields could create productive synergies depending on specific opportunities. In the case of residential urban settings, solar fields could become the productive cornerstone of an energy community that also uses them as accessible urban parks. Conversely, in the case of industrial developments, solar fields could also saturate the flat roofs of buildings or parking lots, reconfiguring and innovating non-sustainable industrial areas. Compared to the two previous actions, it is challenging to find photovoltaic fields that can be confirmed in the location because, as already mentioned, they tend to be in open countryside. However, using these often residual but infrastructured areas could allow the decommissioning of the more remote photovoltaic fields, which could be reused for other purposes.

Each Design Action can be merged with the others, tailoring solutions to different contexts. For this reason, the research does not identify a method that presupposes a defined result, but a work protocol structured on two Design Levels. Following the first analysis level, which identifies and names the macro-elements of the landscape puzzle, the first Design Level aims at designing the most efficient new solarscape. The first design step identifies, case by case, which pieces of the puzzle to replace, which to recycle, and which to renovate. Assuming a look that includes the overall palimpsest, the first Design Level imagines a potential project for each context, starting from the idea that the landscape's components can be rearranged according to a different order, the goal of which, however, is to improve the overall quality of the inhabited context through augmenting ecological porosity and variable landscapes. This level constructs a new vision that, to achieve its medium- and long-term programmatic intent, excludes ownership structures to focus on the possibilities that

individual contexts can offer to the renovation of their solarscapes. The research is aware of the limitations this entails, but, at the same time, is aware that it is the only way to produce a strong vision of a landscape that renews itself over time.
After identifying which fields to confirm and renew, and which to decommission, the second Design Level focuses on identifying specific opportunities for those in decommissioning. Depending on the opportunities each solar field offers in terms of location, level of infrastructure, opportunities for renaturation or reintegration for agricultural use, the second Design Level focuses on mending these sprawled solar fields that are currently isolated and impermeable clusters. The research has identified different intensities of electric production decommissioning. The less intense decommissioning will allow the renovation of the area as a rechargeable site for electric agricultural machines. Because the areas are well accessible and connected to the electric network, thanks to the previous solar plant, these areas could support agriculture 4.0. In contrast, the most intense decommissioning provides the total removal of all the technical devices of the solar plant to renaturalize the area for ecological purposes. The choice of one decommissioning intensity over another depends on the context in which the decision is taken. The variety of opportunities opens many scenarios and opportunities that only a comprehensive and detailed project can address.

Below, for each context, the research develops a transformative scenario that has been organised in the two Design Levels above. The aim is to develop a potential vision for each context to reframe the narrative on solarscapes. The proposed solutions are open, transformative scenarios. This means they should be considered possible, but not the only workable, options.

Conclusion

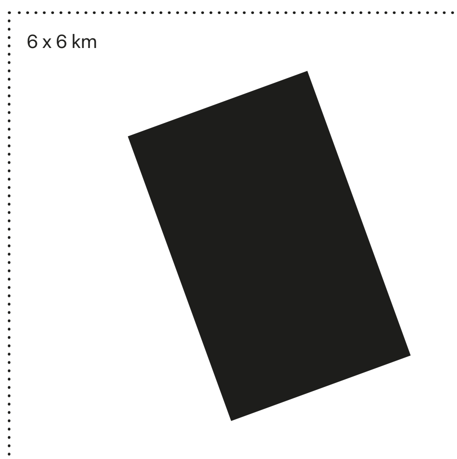
«Despite appearances, this is not a solitary game: every gesture the puzzle player makes has been performed before him by its creator; every piece he picks up and picks up again, examines, caresses, every combination he tries and tries again, every groping, intuition, hope, all his discouragements, have already been decided, calculated, and studied by the other»[8].

The reuse, revamping and decommissioning approach has a deep impact on design, and implies comprehension of past rationalities, their deconstruction and reconstruction, to expand their reinterpretation. The focus of the research is on solar morphologies, on forms as the output of collective construction and social rules. They address conflicting goals or express shared values, developing functional solutions for the organization of the countryside. The research finds, recognises, and designs a new structure assuming the landscape as a palimpsest, documented through presences and absences, but also a place that expresses common commitments and responsibilities in time.
Though not exhaustive, the representation of possible new solarscapes is an effort of imagination. A dynamic representation might have helped to convey the idea of continuous modification, but it would not have added greater conceptual clarity. Design offers stronger footholds by working on adaptation. Proposals are extracted from the contexts to structure future solarscapes without imposing hierarchies, instead articulating spaces and their roles, to increase the readability, accessibility, and ecological functioning.
The "radicalism" of the research design proposal lies in its non-selectivity and non-deterministic approach. In each context, a potential constellation of relations connects existing and new elements, developing spatial structures to reinforce solarscapes.

8 George Perec, *La Vie mode d'emploi*, Paris, Hachette, 1978. Trad. it. *La vita istruzioni per l'uso*, Bergamo, BUR, 2011, p. 9. Translation by the author.

Brindisi
San Pietro Vernotico

N E W
P E R S P E C T I V E S


6 x 6 km

Innovating productive landscape

Riccardo Ronzani

The construction of large infrastructure projects in the landscape has often caused feelings of scepticism, if not outright rejection[1], to the point of generating the belief that the productive landscape built by man has become divorced from the concept of nature and is ruining landscape quality[2].
In architecture, productive morphologies have been an essential key to understand natural landscapes modified by humans. They constitute a fundamental part of the iconic and cultural landscapes created by humans throughout history[3], or they can become the design key for planning new ways of dwelling the territory[4]. When it comes to renewable energy, which has been implemented urgently and on a massive scale in recent years, this relationship seems to break down[5]. Technical elements, such as photovoltaic panels or wind turbines, must necessarily be separated from the concept of beauty.
Is it possible to mend this rift and create a new order between productive infrastructure and the natural landscape, integrating energy production activities within agrarian landscapes?
This question finds a practical application in the development of a new design proposal for the solar energy landscapes of southern Italy, an iconic symbol of the Mediterranean landscape. One of the protagonists of this type of landscape is the olive-growing landscape of Salento, in Puglia. In light of these considerations, the project developed for the area around the village of San Pietro Vernotico has as its primary objective the reconstruction of the link between agricultural morphologies and those defined by renewable energy production infrastructures.
According to the concept of stratification of natural environments and human actions within the landscape[6], the Salento landscape has been altered in recent years by two main features and two events.

1 Preface by John Ruskin in Robert Somervell, *A Protest against the Extension of Railways in the Lake District*, London, Simpkin, 1876. And José Palma-Oliveira, *A New Theory for the Explanation of the NIMBY Effect*, in M.P. Cottam, D.W. Harvey, R.P. Pape, J. Tait (eds.), *Foresight and precaution: Proceedings of ESREL 2000*, Rotterdam, A.A. Balkema, 2000.

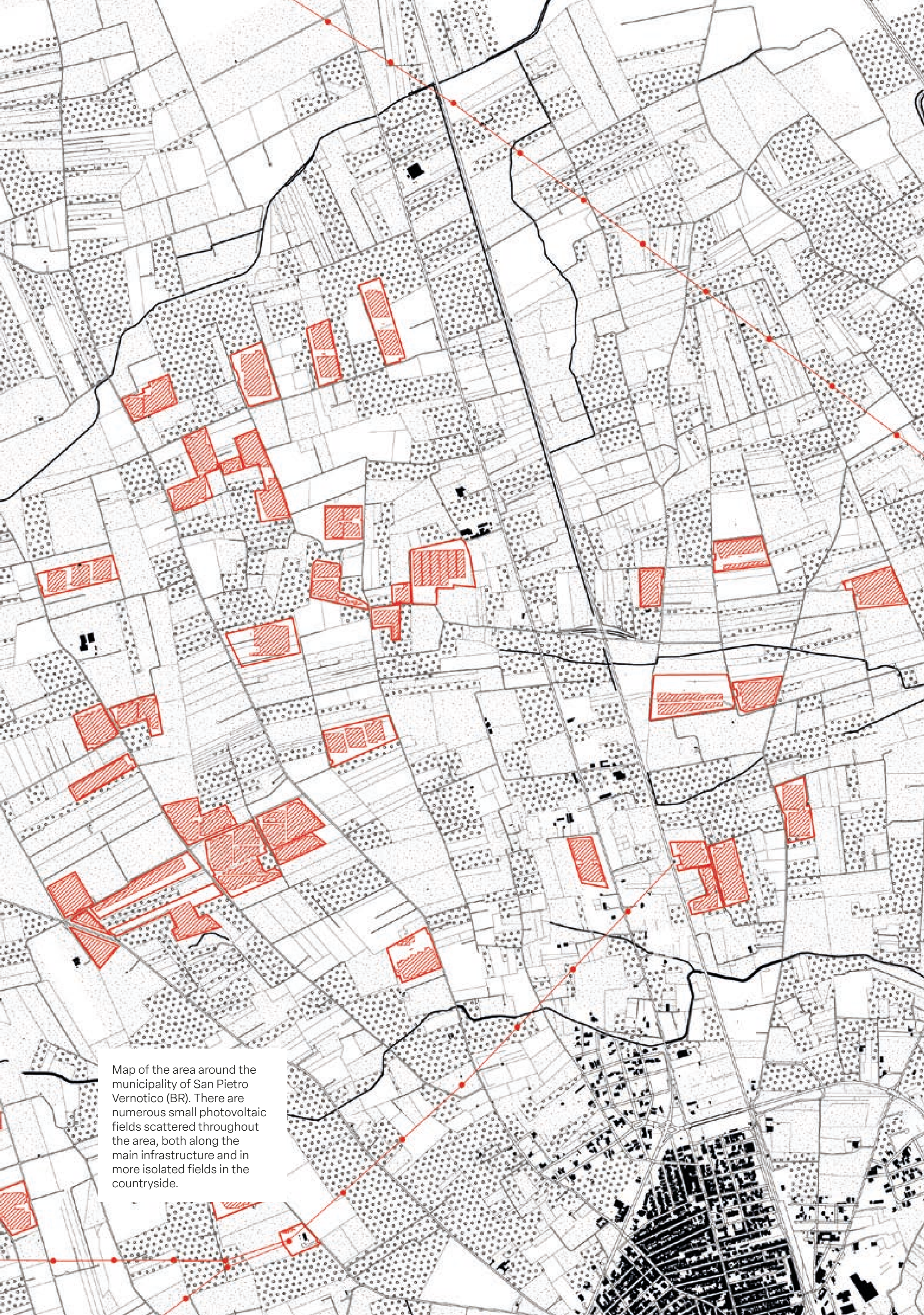
2 Salvatore Settis, *Paesaggio Costituzione cemento. La battaglia per l'ambiente contro il degrado civile*, Turin, Einaudi, 2010.

3 Emilio Sereni, *Storia Del Paesaggio Agrario Italiano*, 2nd ed., Rome, Laterza 1974.

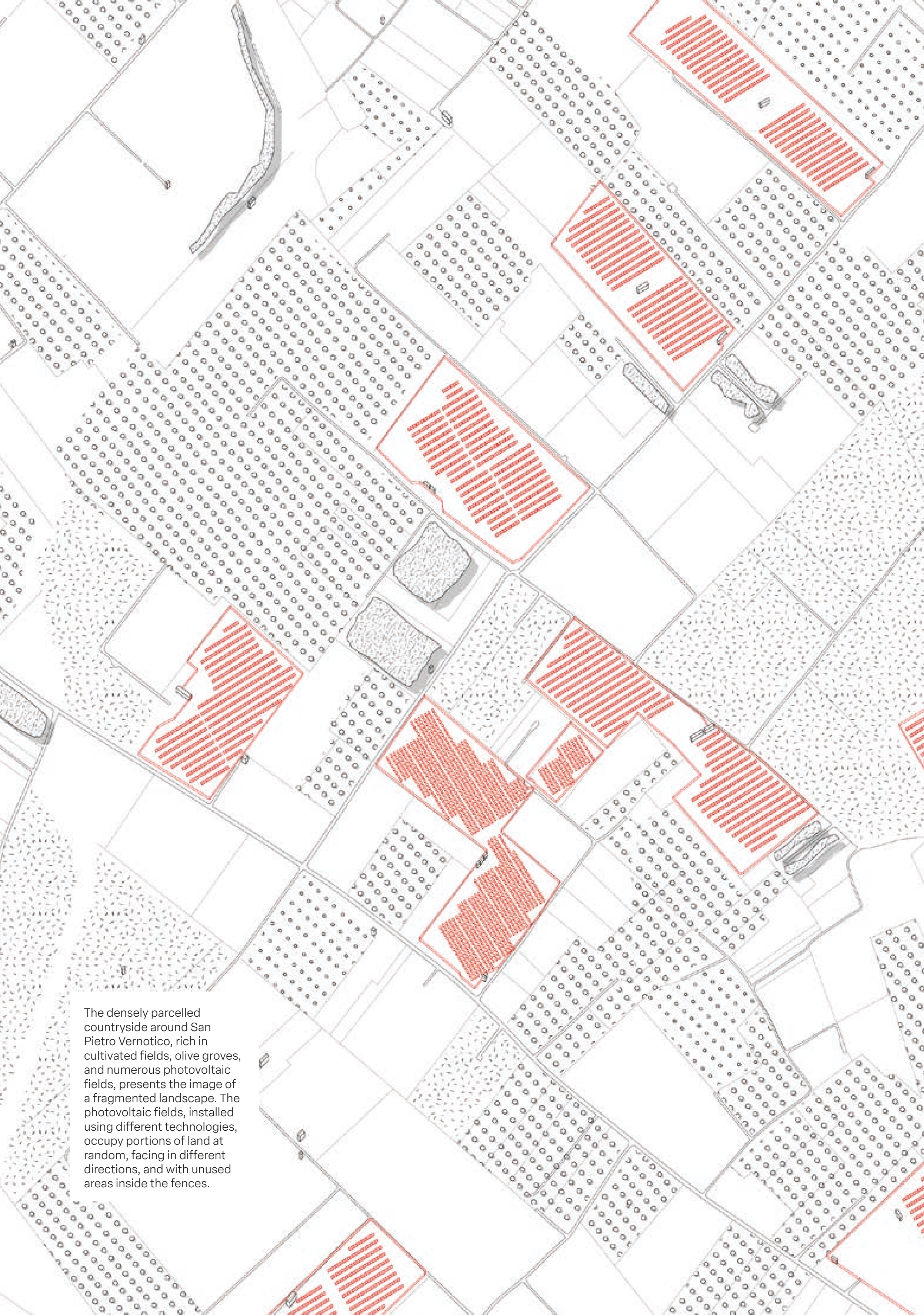
4 Among the others, we can mention the Brodacre City, described in Frank Lloyd Wright, *The Disappearing City,* New York, Payson, 1932.

5 Among the others, Katriina Soini, Eija Pouta, Maija Salmiovirta, Marja Uusitalo, Tapani Kivinen, *Local residents' perceptions of energy landscape: the case of transmission lines*, in "Land Use Policy", vol. 28, issue 1, 2011, pp. 294-305.

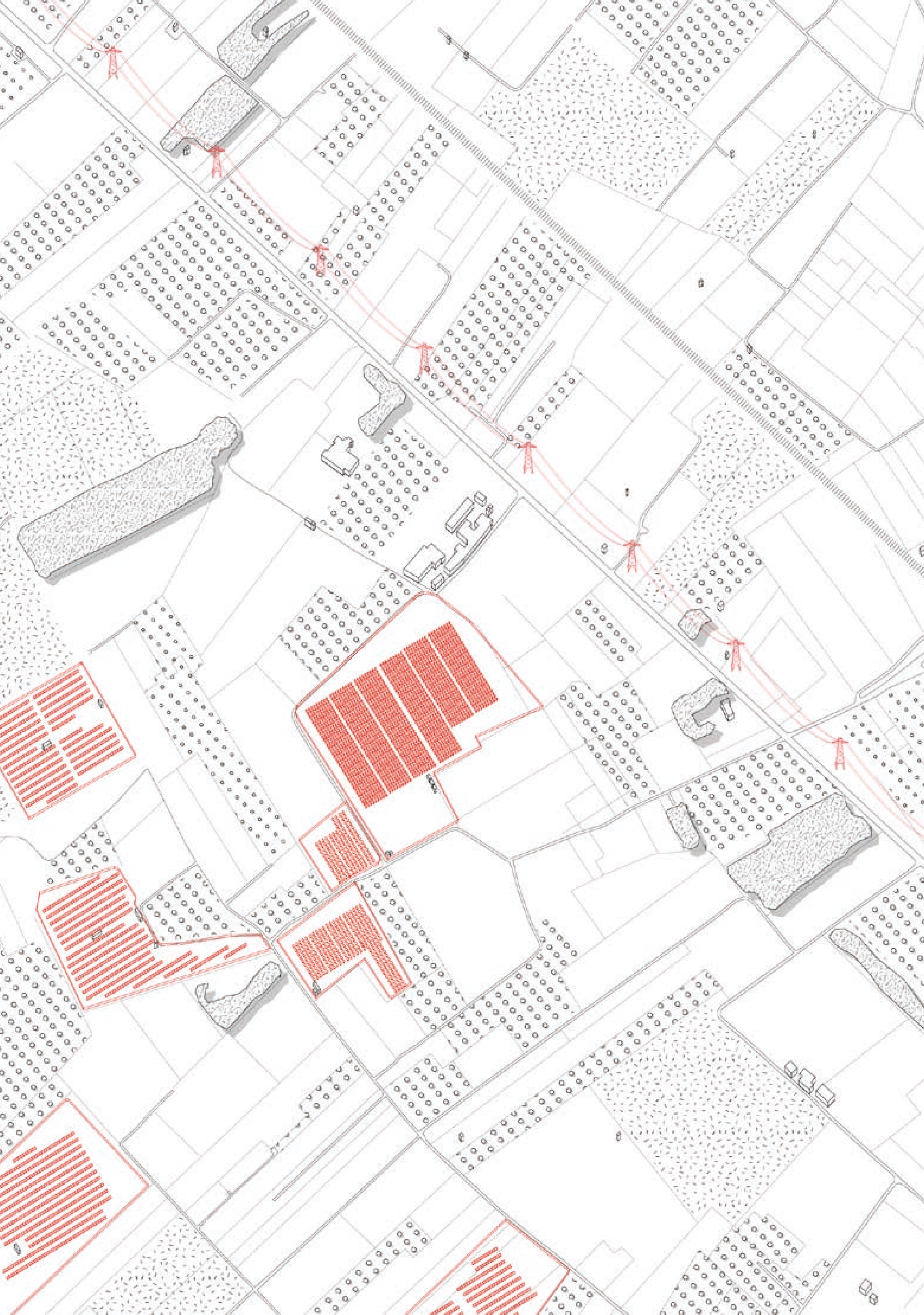
6 Among the others, Denis Cosgrove, *Social Formation and Symbolic Landscape*, Beckerham, Croom Helm Ltd, 1984, and Eugenio Turri, *Il paesaggio come teatro. Dal territorio vissuto al territorio rappresentato*, Venice, Marsilio Editore, 1998.



Map of the area around the municipality of San Pietro Vernotico (BR). There are numerous small photovoltaic fields scattered throughout the area, both along the main infrastructure and in more isolated fields in the countryside.



The densely parcelled countryside around San Pietro Vernotico, rich in cultivated fields, olive groves, and numerous photovoltaic fields, presents the image of a fragmented landscape. The photovoltaic fields, installed using different technologies, occupy portions of land at random, facing in different directions, and with unused areas inside the fences.

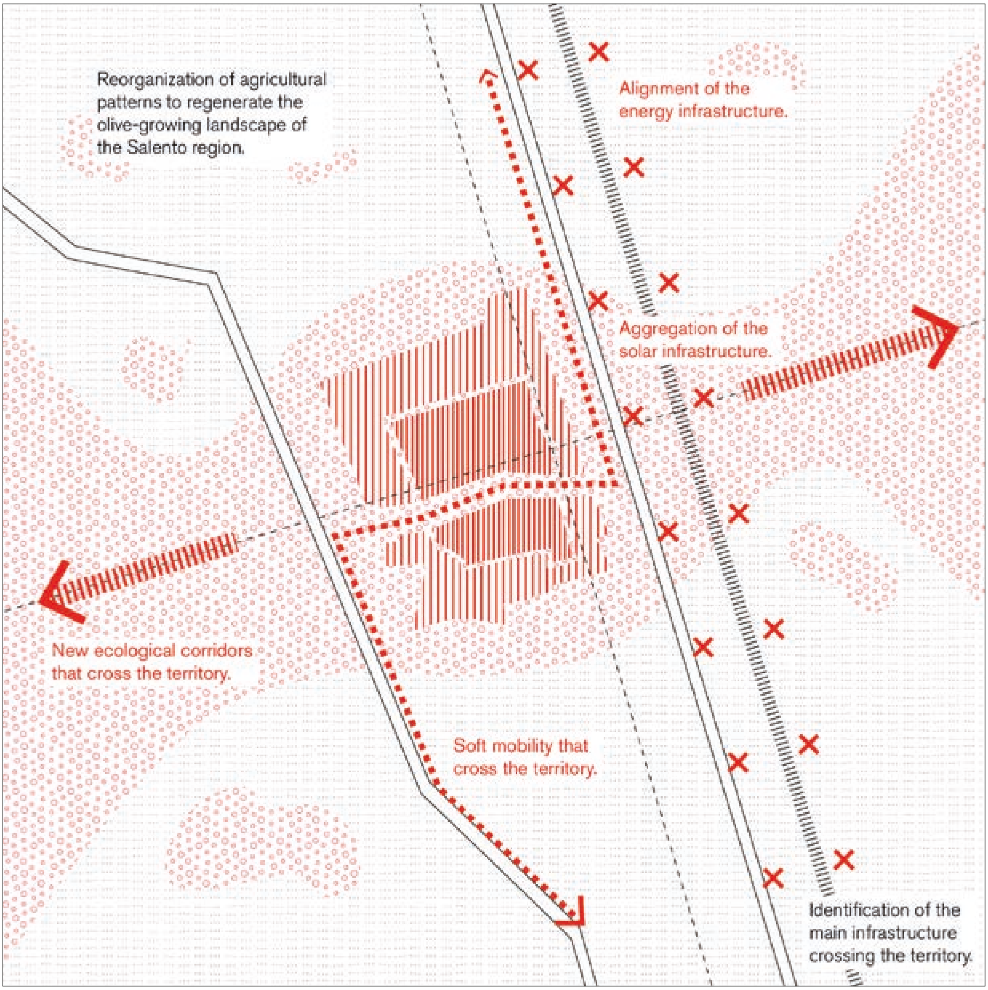


The first characteristic is the iconic olive tree cultivation, which is deeply rooted in the territory (since ancient times, when it was dedicated to the production of lamp oil)[7] and has grown to such an extent that it can be considered, in some respects, a monoculture. The second characteristic is the extremely widespread and fragmented parcelling of the agricultural landscape, consisting of a combination of different fields enclosed within a labyrinthine network of roads.
The two events, which have developed independently over the last few decades, are, on the one hand, the installation of numerous small to medium-sized photovoltaic fields that are now approaching decommissioning, and, on the other hand, the advancing proliferation of the *Xylella fastidiosa* bacterium[8], which has led to the death of millions of olive trees in the South of the Puglia region, with the consequent collapse of a thousand-year-old production tradition.
The resulting landscape is defined by an area strictly dedicated to agricultural activity, which is divided and fragmented in such a chaotic manner that it is difficult to recognise the relationships between the different parts, the relationship with urban centres, or the hierarchies of the elements. The presence of small photovoltaic fields scattered throughout the area has increased the overall level of disorder. Today, their decommissioning transcends the challenge of the already ambitious energy transition to embrace the opportunity to completely redesign this landscape, in terms of its energy, agricultural, and natural components.
In this type of territory, the design strategies for relocating new plants following the decommissioning of old ones offer interesting solutions that would lead to the creation of new landscapes. In fact, the territory has such a dense and rich geometric texture that it provides numerous morphological solutions for the distribution of photovoltaic fields or other energy infrastructure. The consideration that guides the design choice between the various possibilities is not exclusively linked to the energy infrastructure that will be installed, but also and above all to the type of productive landscape (energy and agricultural landscape) that will be redesigned[9].
The project action adopted within such a fragmented context is the concentration of photovoltaic activity in a specific area of the territory. Within an extensive production system (such as agriculture and olive growing) in which old photovoltaic fields are scattered and widespread, the consolidation of the new photovoltaic system into a single area within the territory allows for a reduction in the number of fences that interrupt the territorial and landscape continuity, a decrease in energy transport infrastructure, and a more coherent image of the agricultural landscape.
The design choice is to concentrate the fields in a location enclosed between the main infrastructure, to avoid direct visual contact between the roads and the solar fields, in a place where there was already a concentration of old solar fields, which, at the end of their life, could be involved in revamping projects and thus become part of the new layout.

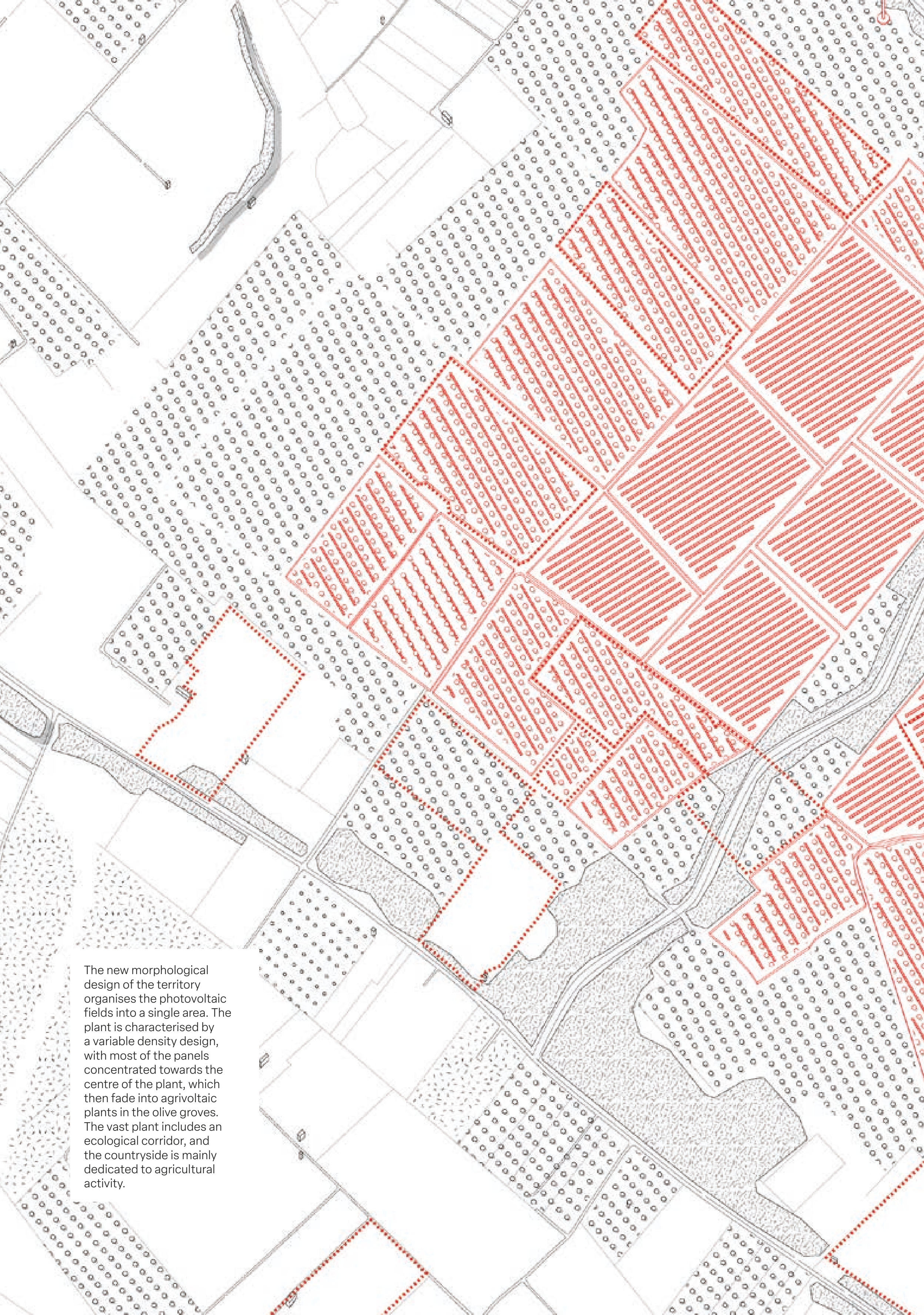
7 Paolo Mellano, Elena Vigliocco, Elena Guidetti, Riccardo Ronzani, *Co-productive Energy Landscape Project: Borgo Monteruga*, in "Ardeth", vol. 13, 2024, pp. 81-95.

8 Daniele Rielli, *Il fuoco invisibile. Storia umana di un disastro naturale*, Milan, Rizzoli, 2023.

9 Dirk Sijmons, *Landscape and Energy. Designing Transition*, Rotterdam, nai010 Publishers, 2014; Bertrand Folléa, *L'Archipel Des Métamorphoses. La Transition Par Le Paysage. La Necessité Du Paysage*, Marseille, Editions Parenthèses, 2019; Sylvain Allemand, Aureline Doureau, Bertrand Folléa, *Paysages et Energies. Une Mise En Perspective Historique*, Parigi, Hermann Editeurs, 2021; Sven Stremke, Dirk Oudes, Paolo Picchi, *Power of Landscape: Novel Narratives to Engage with the Energy Transition*, Rotterdam, nai010 Publishers, 2022.



The main components and effects of the project can be summarised in a diagrammatic map showing the centralisation of the photovoltaic system and the alignment of wind turbines along the main infrastructure, in order to dedicate the countryside to agricultural activity. The project pays great attention to the issue of maintaining ecological balance and biodiversity.

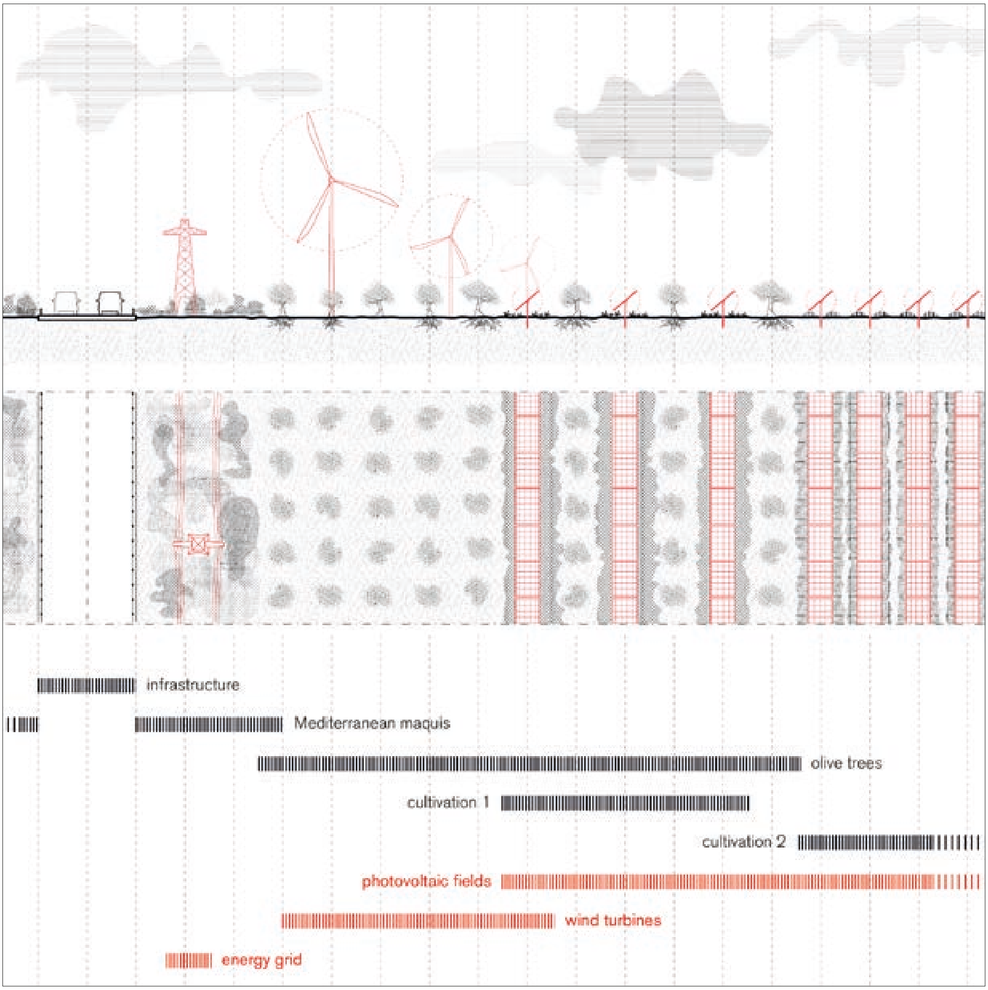


The new morphological design of the territory organises the photovoltaic fields into a single area. The plant is characterised by a variable density design, with most of the panels concentrated towards the centre of the plant, which then fade into agrivoltaic plants in the olive groves. The vast plant includes an ecological corridor, and the countryside is mainly dedicated to agricultural activity.

The project for the new photovoltaic fields has been developed in conjunction with the redesign of the surrounding agricultural fields, particularly the redistribution of new olive groves, which aims to restore the image of the Salento landscape. To integrate the two production techniques, a distribution is envisaged that gradually varies the density of the panels (which thin out from the inside towards the outside) and the olive trees (which thin out from the outside towards the inside). To do this, agrivoltaic techniques are being explored, which aim to integrate the coexistence of solar panels and olive trees on the same land. The presence of a new field reduces the feeling of fragmentation of the landscape, without, however, altering the texture and geometry of the territory. The new rows of solar panels stretch across the fields like a new type of agricultural technique, blending into the farmland until they become indistinguishable from the rows of olive trees once again.

The design solution is more complex and multifaceted than has been described so far, because it does not aim solely to replace part of agricultural production with energy production, but rather to create new types of landscapes that are also capable of generating synergies between the two productive activities and with the ecosystems that host them. The presence of an ecological corridor enables local fauna to cross this portion of the territory, thereby preventing the intervention from cutting off a large portion of the territory and excluding it from the natural ecosystem's geography. This measure also allows people to cross the area (for example, through forms of slow mobility such as a cycle path) and experience this landscape daily, rather than the tendency to want to hide them. The presence of strips of spontaneous Mediterranean vegetation along the edges also increases the biodiversity of flora and fauna. This biodiversity can also be increased by the presence of different arable crops that can be integrated into agrivoltaic techniques and positioned under photovoltaic panels, which provide shade and channel rainwater to the benefit of the crops themselves. In this way, photovoltaic panels become an integral part of agricultural production techniques, generating win-win mechanisms and relationships that can benefit agriculture, which is increasingly vulnerable to the risks induced by climate change. Through all these measures, the seemingly uniform landscape becomes one that retains its constituent and iconic characteristics while also being extremely rich in variation.

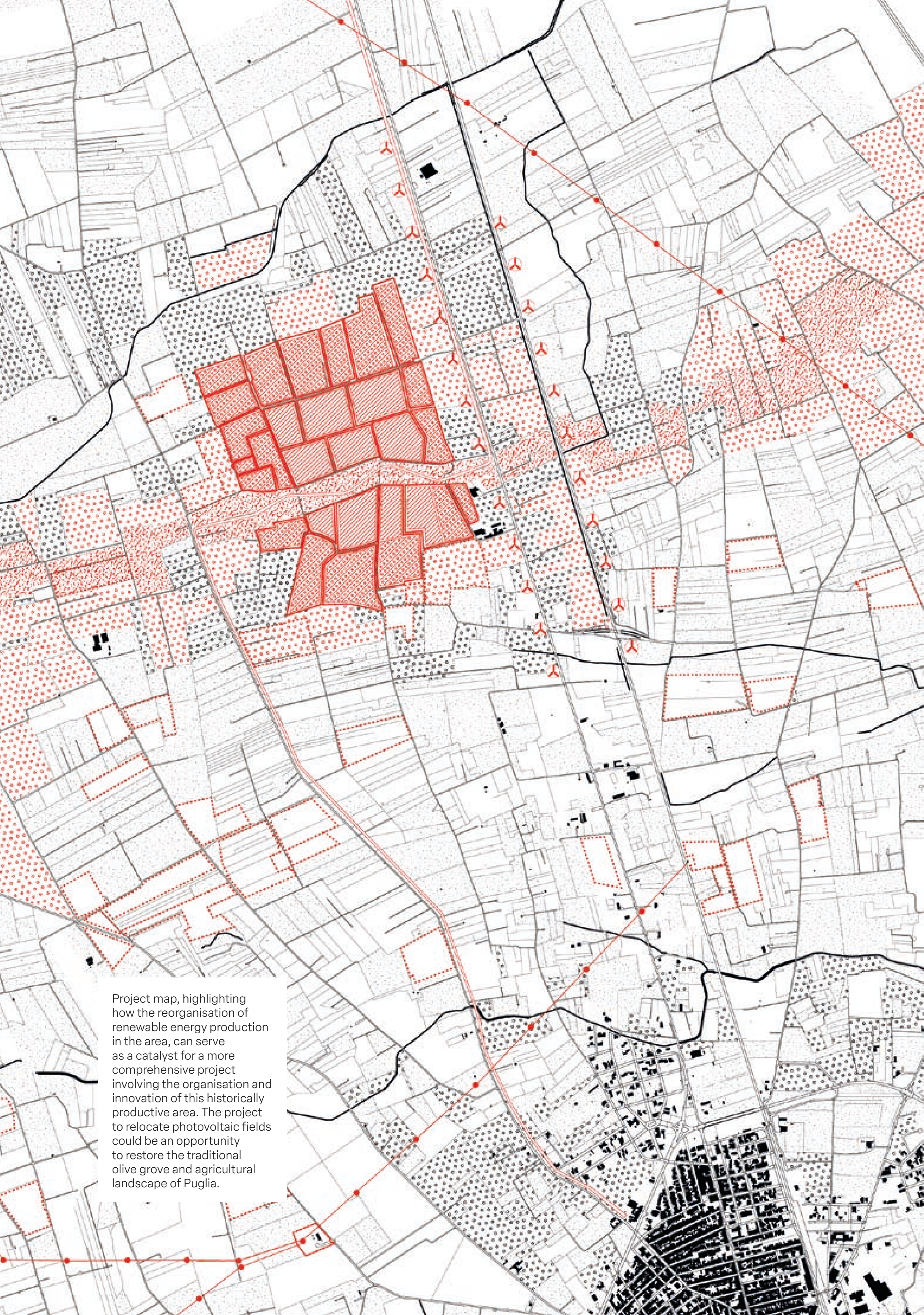
The project includes other energy production strategies, such as wind turbines, which are particularly suited to the climatic characteristics of the Salento region. These are not randomly placed throughout the territory for the sole purpose of maximising the profits of individual investors but are instead aligned with major road infrastructure to form a linear landmark which, with the passing of cars and the rotation of the wind turbines, seems to give physicality to the impact and movement of man through the natural landscape.



The project has a dual purpose. On the one hand, it simplifies the overall territorial layout by reducing landscape fragmentation. On the other, it includes numerous elements of variation in natural and technological features, in order to create a landscape that, while coherent and harmonious, is never homogeneous or monocultural. The inclusion of different energy production technologies, the movement of technical elements, and the variation of crops in agrivoltaic practice are all elements that allow for this variability.

The project, therefore, proposes a new strategic vision for the design of energy infrastructure, accompanied by a new architectural image of the Salento landscape. The proposed project does not merely involve the construction of energy infrastructure, but rather the design of a new type of innovative and widespread productive territory, where natural resources derived from the sun, are used to produce energy and food, and where the use of land, a limited and precious resource, activates win-win processes between production and landscape quality.

The project demonstrates not only that energy production is compatible with agricultural production, but that it can become an integral part of it. In this way, it is possible to avoid the tendency to hide energy production plants because they are considered "something else" compared to nature, but instead to see in them the same potential that the agricultural tradition has had to generate landscapes rich in cultural values and recognition.
The planned energy landscape is not just a landscape transformed by the impact of the energy transition and the effects of its decommissioning. On the contrary, it is a landscape that is potentially in constant transformation, and it undergoes transformation in response to changes in production needs.
The energy landscape is a new kind of production that is significantly impacting the landscape and also offers the opportunity to innovate the concept of a productive landscape itself.



Project map, highlighting how the reorganisation of renewable energy production in the area, can serve as a catalyst for a more comprehensive project involving the organisation and innovation of this historically productive area. The project to relocate photovoltaic fields could be an opportunity to restore the traditional olive grove and agricultural landscape of Puglia.

Reprogramming the Energy Landscapes

SARA ANNA SAPONE

Reprogramming is understood as the idea of taking what is already there and reconfiguring it, considering the memory of the place and its current representation to read its "tendency"[1], the future potentially there but not yet expressed. Among the many possible attitudes towards solar fields decommission[2], building on the notion of reprogramming the existing solar fields, it is interpreted as the possibility of introducing hybridity[3] between different functions. In this frame, following the Politecnico di Torino research unit work on morphological reconfiguration and selection of fields to reorganise elsewhere, it is imagined a future where the technical infrastructure is integrated with the environmental one, mediating between the agrarian and energy production needs and existing infrastructures of mobility, food and energy supply. The proposed scenario of change[4] looks at this place as a "technological park", a system of fields with different functions complementary to one another, related to energy production and distribution, towards slow and vehicular mobility systems and the integration between ecological systems and agricultural production. A link between the technological, environmental and social dimensions[5]. Here, the thought experiment is to evaluate a mix of actions. Reconfiguring the existing fields transitioning towards agrivoltaics, modifying their layout and surroundings' relation, entailing different borders and the possibility of renaturation . The implementation of different goals for energy production, distributing it locally and connecting the site to the energy grid to power vehicles. The establishment of a different relation to the existing mobility system, integrating a slow mobility system with resting points and viewpoints engaging with the energy infrastructure and the natural features, to change the perception of solar fields and reconfigure the site as part of a larger landscape.

The infrastructured landscape of the Brindisi plain
The area analysed is near San Pietro Vernotico, located in the energy-intensive south and historically tied to olive and grape

1 Julian Raxworthy, cit., 2013.

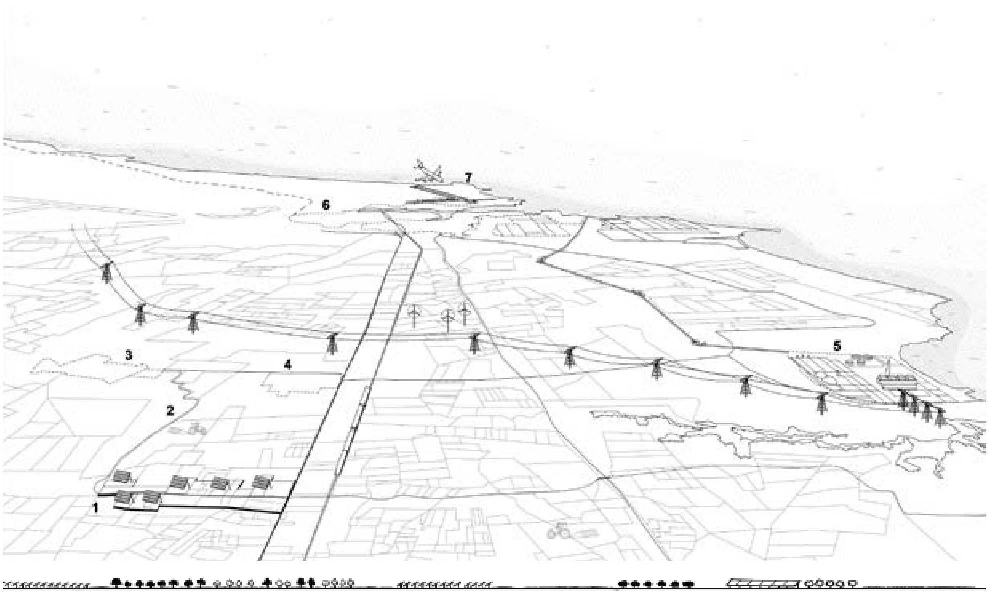
2 Decommissioning comprises the practices for managing solar fields once they reach the end of their operativity, usually of 30 years.

3 «How creative practices of ecology and landscape architecture construct alternative forms of relationship and hybridization between people, place, material, and Earth».

James Corner, *Ecology and Landscape as Agents of Creativity*, in "Ciudad Y Paisaje III", 1997, p. 279.

4 Notion derived from the research framework in terms of landscape architecture.

5 «Thus, the reclaiming of sites might be measured in three ways: first, in terms of the retrieval of memory and the cultural enrichment of place and time; second, in terms of social program and utility, as new uses and activities are developed; and, third, in terms of ecological diversification and succession». In James Corner, cit., 1999, p. 13.



Relationship between the site an the wider territorial infrastructures of energy, mobility and ecology.

Hand drawing by Marco Agosti, 2025.

Legenda: 1. Project Site; 2. Cycle path connecting the rural and energy landscape; 3. Tuturano; 4. Tuturano Station; 5. Federico II power plant; 6. Brindisi; 7. Brindisi Airport; 8. Sequence of solar fields.

cultivation. This region can be framed as an infrastructured landscape[6], a plainland fragmented into different fields following agrarian needs, with water channels cutting through the land in medium-sized parcels. Later, due to technological advancements and economic reasons, this parcellation converged towards monocultural conditions, further deteriorating the region's biodiversity[7].

In such territory, there is a widespread presence of infrastructures that manage power, both literally carrying the energy produced but also metaphorically determining the way the territory is used, with physical effects on it due to the repetition of the technical devices it needs to survive (cabling, electric poles, power plants and so on). The city of San Pietro Vernotico is close to several energy processing facilities, located in the Brindisi province and along the coastline. The Centrale Termoelettrica Enel Federico II in Cerano is the closest energy powerplant, the second biggest thermal power station in Italy, and it is connected to the national grid with a high-tension network at 380kV. These infrastructures and their pylons interrupt the otherwise flat expanse of the surrounding landscape, alongside the wind turbines scattered across the fields. It is relevant, facing the transformation of such territories, to

6 Pierre Bélanger, *Landscape Infrastructure. Urbanism beyond Engineering*, Ph.D. Thesis, Wageningen, Wageningen University, 2013. https://edepot.wur.nl/256226 [last access October 2025].

7 Information found in the regional planning document, *La Provincia di Brindisi, Piano Paesaggistico Territoriale Regione Puglia*. https:/ pugliacon.regione.puglia.it/ web/sit-puglia-paesaggio/9.- la-piana-brindisina [last access October 2025].

question the needs of their infrastructures, perceived as inevitable and needed, and for this reason, enabled to fragment lands with their repetition and grids through the support of instrumental reasons. Such infrastructures are not neutral nor permanent[8] due to the inherent nature of technological advancement. This applies even more so to solar fields, mostly created following economic incentives and not integrated with the land with a future vision in mind, even though their expected life cycle is approximately thirty years[9].

If we consider the analysed site, economic incentives[10] triggered in the years between 2010 and 2013, a widespread diffusion of ground-based solar fields occurred. The territories of the Brindisi plain were an ideal ground, because of their flat conformation and high solar radiation. However, this meant a high soil consumption, sacrificing a high percentage of agricultural fields and hindering agricultural productivity[11]. Before, the management of the fields was dictated by seasonal changes and vegetational growth, with crops composed of a grid-like succession of mostly vines or olive trees. With the shift towards energy production, the borders became more rigid, with metal wires, and the field management dependent on the sun and the technical needs of panels and their materials' timeline. This applies also to the project's transect, where between 2010 and 2013 several photovoltaic systems were constructed, mainly as static photovoltaic, taking over a formerly agrarian ground dedicated to olive groves and grape cultivation.

In the decommission of such solar fields, built in the first decade of the century and likely to be rethought, upgraded or dismantled around 2025-2030, how can we steer a transition to a different configuration? If the technological upgrade frees up some portions of the site, how can we take advantage of this additional space? In addressing such questions lies a potential chance to address the region's heterogeneous agricultural landscape, first composed with fields of different functions and sizes in time, homogenised by monofunctional agrarian production and later for energy production. Envisaging a scenario for 2040, the transect is reimagined as an integral part of the surrounding fields and infrastructures.

Designing a technological park, between energy and food production

Looking at the afterlife of this energy infrastructure, it is envisioned a productive regeneration. In this frame, the project of landscape can propose the transformation of site-specific micro-systems that can have macro-effects, producing new relationships on a wider territorial scale, with a fluid configuration for the site[12], reacting to the uncertainties of ecological development and the unknowns of the passage of time. Change and adaptation often occur at the fringe, at the borders between different systems, challenging uniformity since diversity may better face the future unknowns. Locally tailored solutions are meant as a reaction to

8 «The historic lack of engagement of infrastructure, as territory of design, surprisingly stems from the banality that ironically masks its technological complexity. (…) However neutral it appears, the constellation of infrastructural equipment - from sewers and sidewalks to airports and power plants - forms a technological apparatus-natural hardware that compose the urban world. Buried in its banal repetition, infrastructure is instrumental as a "tool and technique of power"». Pierre Bélanger, cit., 2016, pp. 197-199. access October 2025].

9 See on the average solar field life-span Patrizia Corrias, Umberto Ciorba, Bruna Felici, *Il fine vita del fotovoltaico in Italia implicazioni socio-economiche ed ambientali*, Rome, ENEA, 2021.

10 Economic incentives like the DM 6/8/2010 (Terzo Conto Energia), which became operative between 2011 and 2013. The introduction of these measures made it convenient to create extensive solar fields since it focused on controlling the integration of energy production with existing buildings. Source: www.gse.it/documenti_site/Documenti%20GSE/Società%20trasparente/Sovvenzioni,%20contributi [last access October 2025].

11 In Puglia, 160,000 hectares of land (19,989 hectares in the province of Brindisi alone) are occupied by photovoltaic systems, resulting in the disappearance of one in three agricultural lands in the last 5 years. Source: https://lecce.coldiretti.it/news/consumo-suolo-mangiati-in-puglia-6-130-ettari-da-pannelli-fotovoltaici-a-terra-il-dato-piu-alto-ditalia-34/ [last access October 2025].

12 «In contraposition to the hard, fixed infrastructures, this interpretation provides the room for the design of softer, looser ecological systems, where the design of micro- interventions has macro-effects, producing new relations across systems of trade, exchange, conveyance, mobility and communications». Pierre Bélanger, cit., 2016, p. 218.

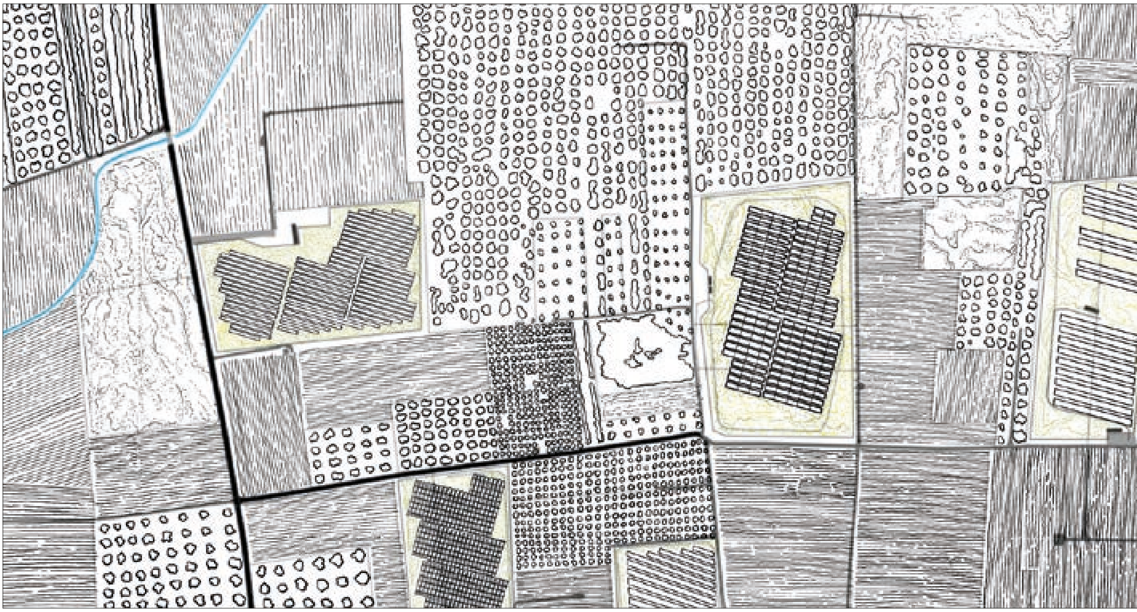
context-specific conditions, instead of uniform networks, both in terms of energy management and function-wise[13].
Rather than a return to pre-existing conditions, this scenario explores how decommissioned sites can serve as platforms for new agro-cultural economies – such as oil production, food networks, or landscape tourism – linking identity, ecology, and vehicular infrastructure. It suggests that the afterlife of energy fields can support not only biodiversity, but also social and economic regeneration grounded in place-specific conditions.
In this frame, it is challenged the *status quo* of the site, imagining the decommission of its solar fields towards a multifunctional landscape, through the transformation of existing infrastructures to relate the production of energy to local needs, linked to agrarian production and local mobility systems. Going beyond the monofunctionalism[14] characterising the region's agrarian systems, the fields assume different characteristics, reacting to local conditions to provide different functions and interact differently with their surroundings. It references the notion of Agroecology[15], promoting the reconciliation between agriculture, local communities and environments. Agrivoltaics, when correctly conceived, can be seen as an application within this frame, connecting food and energy production whilst representing a societal interest. The overall idea is to look at solar energy production, rethinking its local role, combining its infrastructure, which can provide energy locally to serve local mobility and agricultural machinery, and agrarian productivity (mostly olives and grapes) whilst enhancing biodiversity, introducing green edges, grassland underneath panels and diversifying the local flora. To do so, the energy production type is rediscussed, upgrading the static photovoltaic to an agrivoltaics system. This could be feasible considering the regional incentives for the implementation of agrivoltaics[16] and seeing the site's previous agrarian use, entailing suitable soil in this sense.
The first step to conceive the transition of this site to this configuration would be to evaluate the decommissioning status, looking at the timeline and technical needs to revamp. Since all fields were built concurrently, their future must be imagined not in isolation, but as a series of complementary functions. Decommission here is not understood as a singular solution, but a composition of different interventions that either upgrade the existing infrastructure, integrate it with new grids and shift its purpose or accept its redundancy and transform it into something different. The former energy production use would call for an evaluation of current soil compaction due to photovoltaic installation and plans to remediate it where needed. Following, considering the current layout, a required technical action would be to evaluate the existing infrastructure, with the possibility to reuse and upgrade parts of it or remove some portion to increase the poles' height and distance, to allow the passage of tractors and animals grazing underneath. The boundary of the site can be reshaped, becoming less rigid either because the energy production is removed or the system is mixed with agriculture

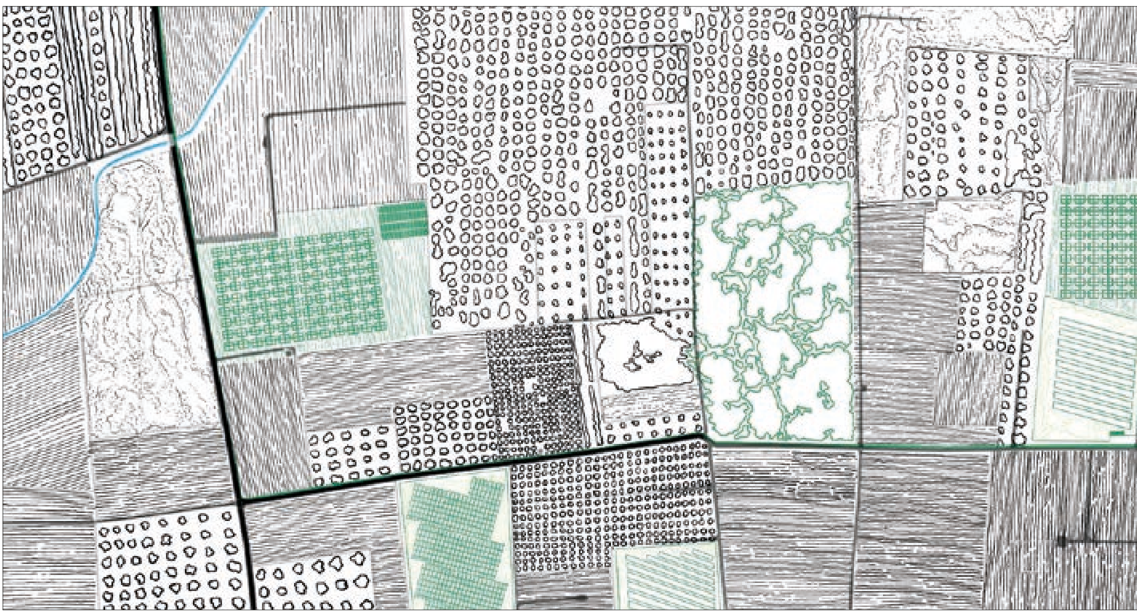
13 «As ecologists, for instance, know quite well, more adaptation occurs around the boundaries of different spatial patterns than in their more uniformly consolidated centers. In an unexpected disturbance, a diverse cluster often responds better than a larger monoculture». Malcom, McCullough, *Downtime on the Microgrid: Architecture, Electricity, and Smart City Islands*, Cambridge, The MIT Press, 2020, p. 3.

14 Sven Stremke, Dirk Oudes, Paolo Picchi, cit., 2022.

15 Agroecology is intended as the application of ecological principles and societal concern to design and manage agricultural systems. For its principles see www.fao.org/agroecology/overview/en [last access October 2025].

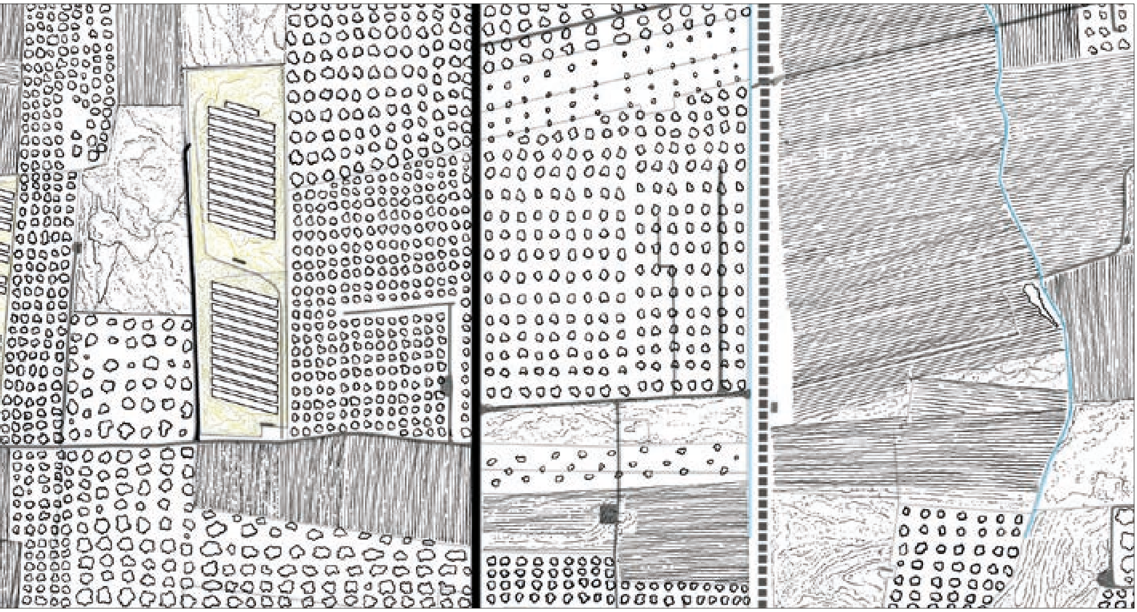
16 Coldiretti, the national farmers' association, expressed harsh critiques about the soil consumption and the shift [continue] brought about by the introduction of solar fields. They supported instead the option of limiting soil consumption and boosting food production by adopting agrivoltaics technologies, following the ministerial decree DM 10 Settembre 2010. See: https://brindisi.coldiretti.it/news/agrivoltaico-al-via-nuovo-bando-per-energia-green-16-rinnovabili-nasce-nei-campi/ [last access October 2025].

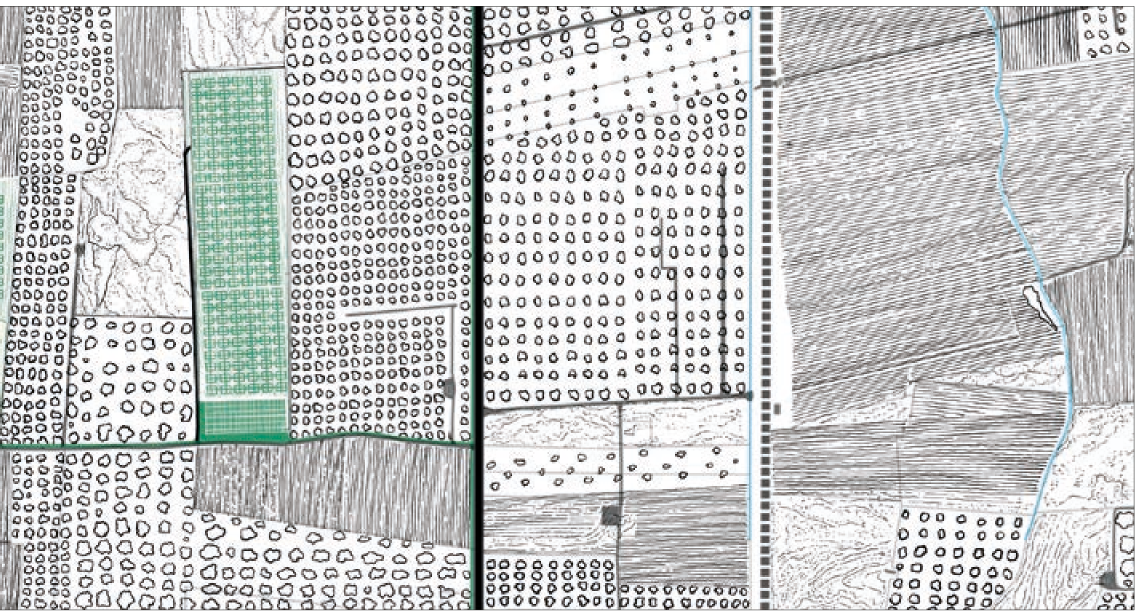




Above. Infrastructures and energy in between fields. Conditions in the landscape today, highlighting its key features.

Hand drawing by Simone Baccaglini, 2025.





Below. Reprogramming the existing solar field between energy and food production, renaturation and slow mobility.

Hand drawing by Simone Baccaglini, 2025.

and the machinery needs to pass through the fields. It is possible to design a new layout using the former paths present on site to minimise further soil disturbance. This may also become an opportunity to remove in some portion the technical infrastructure, redundant if the efficiency is increased, to add abandoned or weakened olive and vineyard landscapes, and to increase the lacking biodiversity in the area. To address this, native species can be introduced at the border to attract pollinators and local fauna. Ultimately, the energy production powered by the agrivoltaics fields could feed into the powering of agrarian machinery or precision agriculture devices, as well as private vehicles like electric cars and e-bikes, entailing a diversified revenue for the field owner. During the decommission phase, it is possible to assess the grid interconnection capacity, to evaluate the need of energy for an electric vehicle charging hub and a potential storage unit, positioned in proximity to the main vehicular connection for easy access. This area is functional, but can also be characterised in terms of design, with a project of the canopy and parking sensitive to the site, offering also a resting opportunity that brings people closer to the field to enjoy this technical landscape. This would introduce a multiplicity in usage, between energy production, pasture opportunity and agrarian productivity.

This reprogramming can also concern a shift in the relation with a wider territorial system. The site is connected to several infrastructures of mobility such as a state highway, provincial roads and railways, with site is in the middle on a nameless country road[17]. This infrastructural network offers a chance to connect it with a different mobility system, not yet as present in the region, linked to slow mobility with cycling routes.

At the moment, very few paths exist, usually passing through the low-traffic roads. Using these existing platforms, there is the potential to establish a connection between San Pietro Vernotico and the Cerano woodland, a natural reserve spanning from the coastline to inner areas, that displays a vegetational gradient shifting from Holm oak and Aleppo Pines on the coastal side to sessile oaks and cerris or hygrophilous plants like field elms. Implementing a different system for slow mobility could comprehend the site, integrating the solar landscape in a sequence of landscape characterising the region, offering a sequence in the landscape from the maritime environments to the open fields of olive groves and vineyards. A reference in this sense could be the Linear Park of Caltagirone, by studio NOWA, that reconnected through a slow mobility path and a few actions[18] existing buildings and structures lost in the landscape. Or the Freshkills parks, by Field Operations, where a park was created on a former landfill, displaying changing environments and a system of infrastructures for renewable energy production (solar, wind and methane power), also aimed towards education[19]. In this sense, the reprogramming of solar fields could entail a possibility for outreach and a shift in the understanding of solar fields as a part of the landscape that can be enjoyed.

17 The site is close to the Adriatic state highway (Strada statale SS16) and a provincial road (Strada provinciale 83); it is also close by the Adriatica railway, with the site in the middle between the train station of San Pietro Vernotico and Tuturano, with Brindisi as the next stop going north and Lecce as the terminal station southwards.

18 AA.VV., *10X10/3. 100 Architects, 10 Critics*, London, PHAIDON, 2009, pp. 257-259.

19 James Corner, *Lifescape–Fresh Kills Parkland*, in "Topos: The International Review of Landscape Architecture and Urban Design", n. 50, 2005, pp. 14-21.

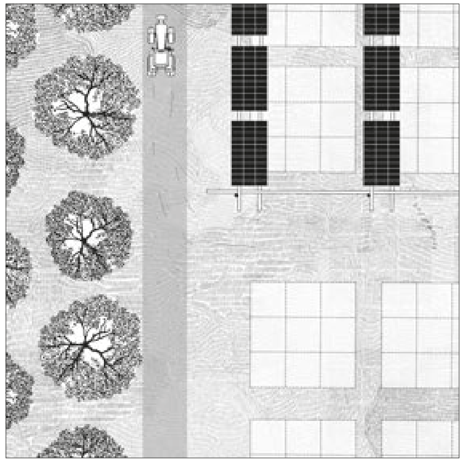
Schemes to illustrate boundaries, technical structures, and biodiversity in their evolution, adaptation, and changes on site.

Diagrams by Marco Agosti, 2025.

1. Boundaries_ redefine the relationship between the solar field and its surrounding, by removing rigid fences. This allows the passage of agricultural machinery and integrates the site into the wider landscape sequence, thanks to the slow mobility system.

2. Structures_reconfigure the existing energy infrastructure to provide energy locally to the mobility system and agrarian machinery

3. Biodiversity_ Enhance the site's biodiversity, revisiting the connection to its surroundings and increasing the presence of vegetation, both in between the energy infrastructure and in its place. This involves either introducting productive nature, as agrarian crops or as native plants along the borders, or the renaturation of fields, introducing local floar after removing the technical structures.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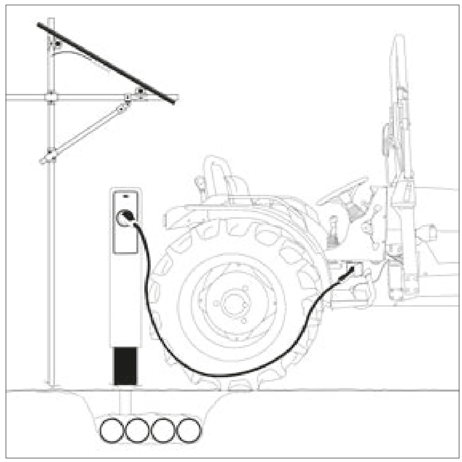
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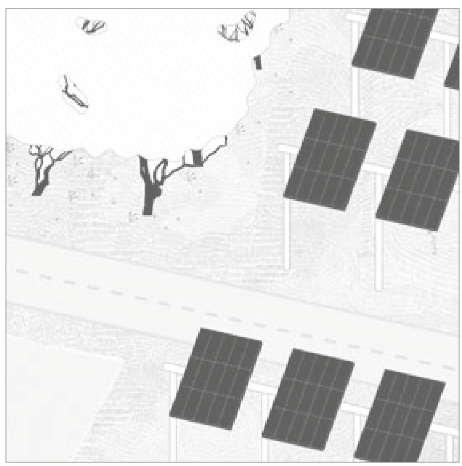
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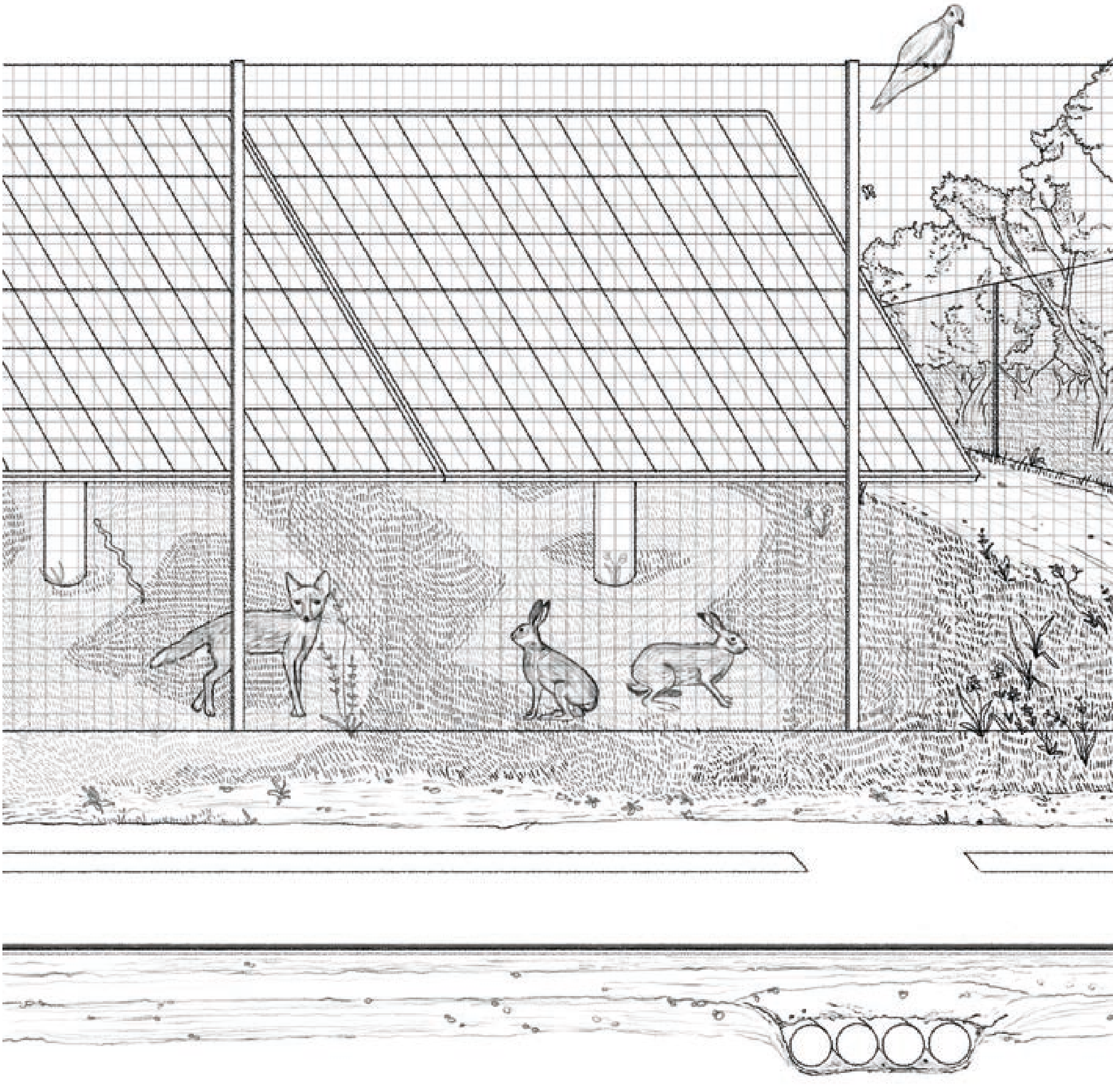
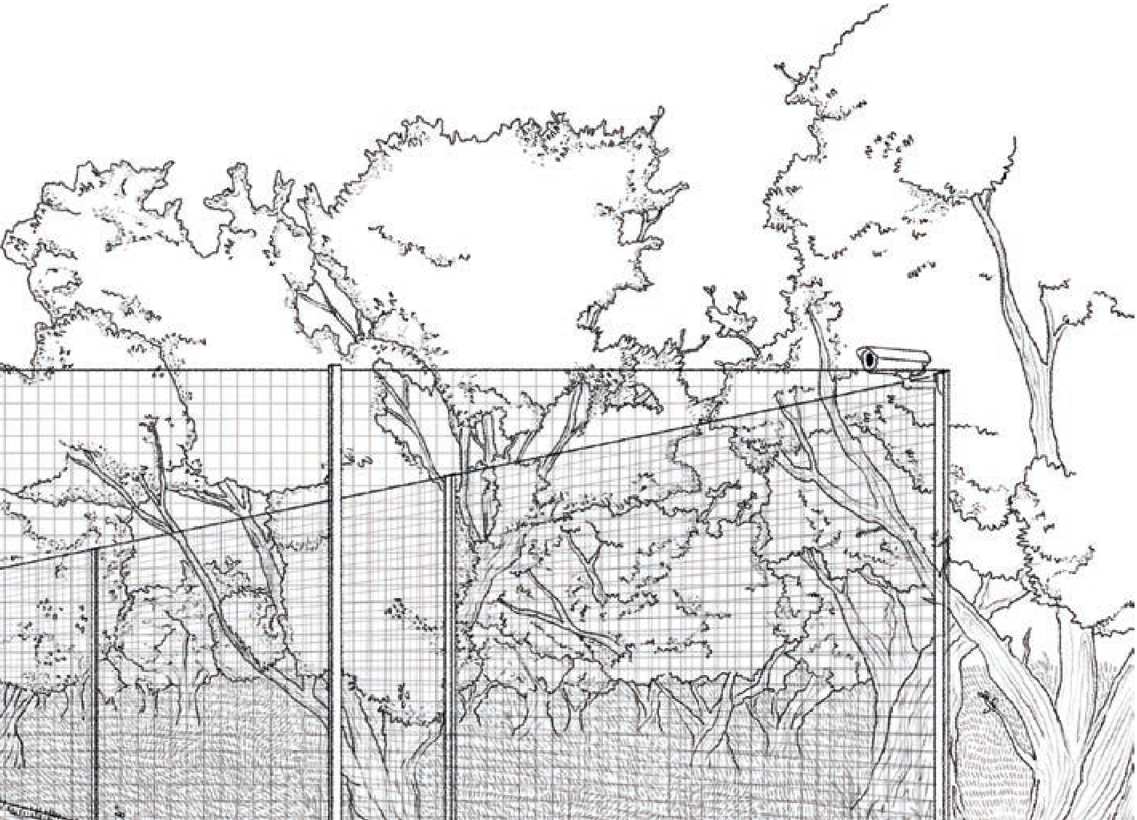
Perspective section to show the condition one solar field on site during the operation stage.

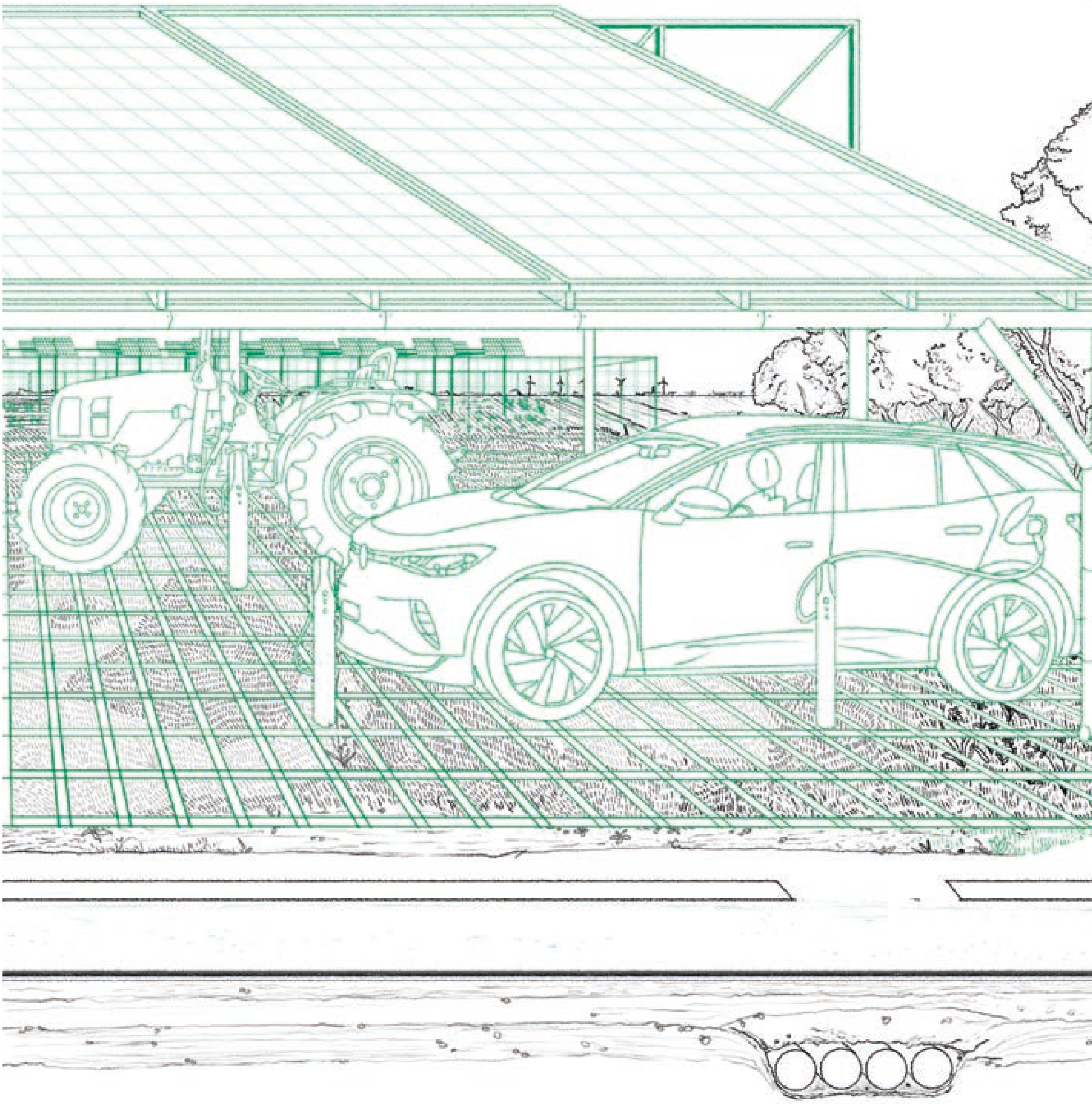
Hand drawing by Simone Baccaglini, 2025.

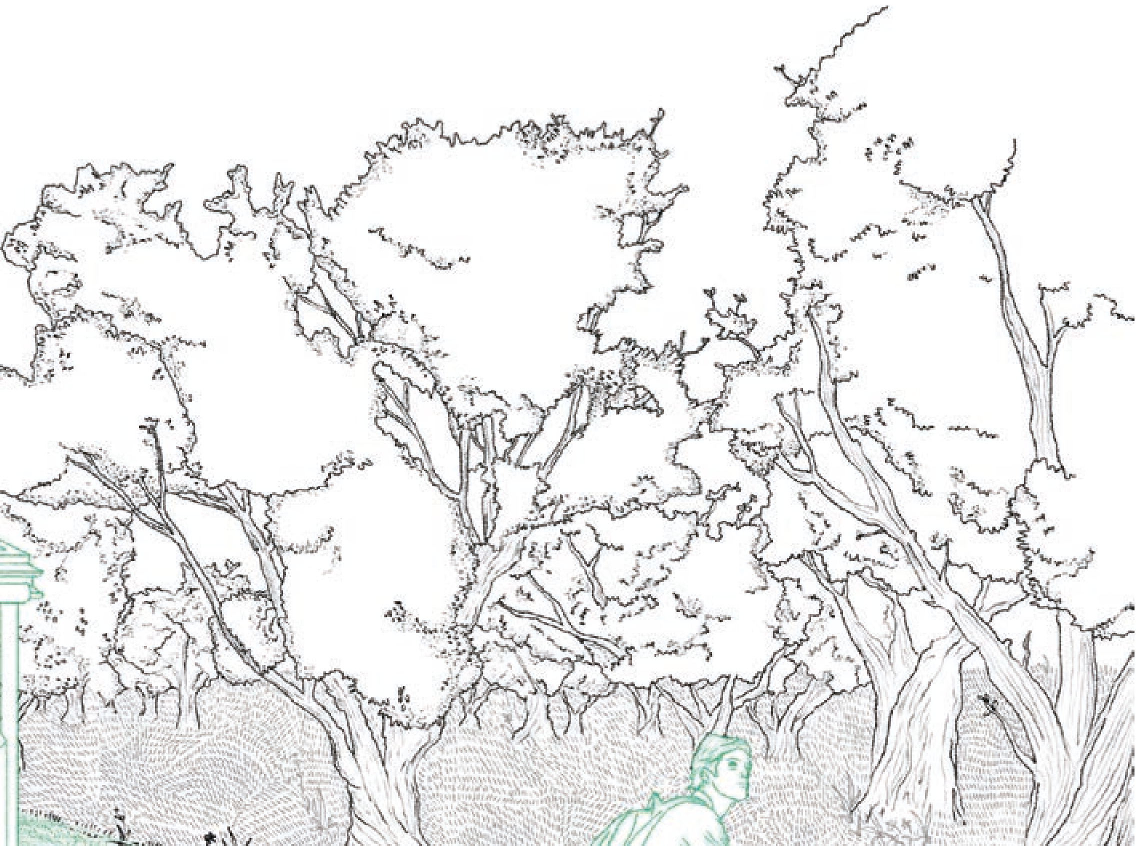




Perspective section to show the site-specific changes in time, before and after the decommission.

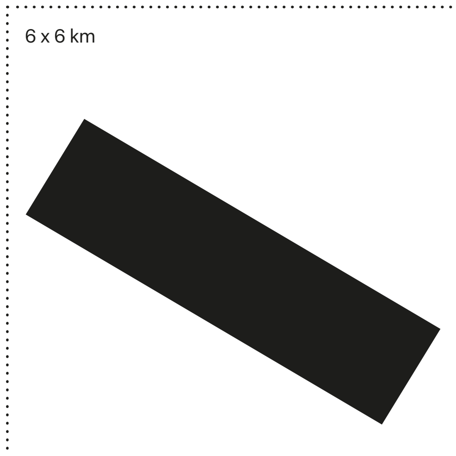
Hand drawing by Simone Baccaglini, 2025.





Ravenna
Lugo

N E W
PERSPECTIVES


6 x 6 km

Filling the interstices

ELENA GUIDETTI

The plain has often been described as a landscape where spatial order and productive use converge, a perspective developed in cultural geography and landscape theory[1]. In Lugo, this dual condition is especially evident: the territory is both a measured framework, marked by the geometry of the Roman centuriatio, and a productive ground whose patterns continue to sustain cultivation and shape settlement[2].

Located in the Bassa Romagna sector of the Po Valley, Lugo sits at an elevation of 10-15 meters above sea level on the alluvial plain formed by the rivers Santerno, Senio, and Lamone. This nearly horizontal terrain, gently sloping toward the Adriatic, has long supported intensive agriculture[3]. Such geomorphological stability provided the basis for the Roman *centuriatio*, a cadastral grid whose orthogonal divisions remain visible today in the alignment of roads, canals, and field boundaries.

The continuity of this framework is reflected in present-day land use. Agriculture remains the dominant sector, with cereals and forage crops still occupying the majority of cultivated land, arranged within the ancient orthogonal structure. The flatness of the plain, reinforced by a dense network of irrigation and drainage channels, underpins the resilience and productivity of the system, sustaining Lugo's role as a nodal point in the agrarian economy of the Bassa Romagna[4].

This logic of measure extends into the urban dimension. The orientation of Lugo's historic center, organized along a cardo and decumano, embeds the same rectilinear order that structures the countryside. Modern industrial areas and transport infrastructures likewise align with these persistent axes, demonstrating how agricultural, urban, and industrial fabrics are all inscribed within a long-standing dialogue between natural topography and human design.

1 Denis E. Cosgrove, *Social Formation and Symbolic Landscape*, 2nd ed., The University of Wisconsin Press, 1998. James Corner, *Recovering Landscape as a Critical Cultural Practice*, in James Corner (ed.), *Recovering Landscape: Essays in Contemporary Landscape Architecture*, New York, Princeton Architectural Press, 1999, pp. 1-26.

2 Marco Cavalazzi, *Looking through the Keyhole*, in "GROMA Documenting Archaeology", n. 5, 2020, pp. 1-24.

3 Stefano Cremonini, *Il paesaggio agrario della Romagna dall'età romana al Medioevo*, Bologna, CLUEB, 1994.

4 In the Emilia Romagna region, as of October 2020, there were 53,753 active agricultural enterprises managing 1,045,000 hectares of utilized agricultural land - 46.6% of the regional surface area. Of this, 83% (863,000 ha) is arable land, largely devoted to forages and cereals (Regione Emilia Romagna 2024).

The current asset of the Lugo landscape.

The palimpsest on the Roman grid

The notion of the palimpsest has become a crucial metaphor in architectural and landscape studies, describing how territories accumulate successive layers of occupation without fully erasing what came before. Following the idea of Rodolfo Machado, the city and its landscape are percived as "palimpsests" in which traces of past structures remain active beneath new inscriptions, creating complex strata of form and meaning. Rather than seeing history as a sequence of ruptures, this approach emphasizes continuity, overlap, and the coexistence of layers[5].

The Renaissance cities of Northern Italy, for instance, often preserve Roman cadastral grids beneath later street networks, even when partially deformed by medieval enclosures. Likewise, agricultural landscapes across the Po Valley retain the orthogonal divisions of Roman *centuriatio* in the alignment of canals and rural roads, despite centuries of transformation through reclamation, mechanization, and industrialization. In these cases, the past actively conditions subsequent development: this grid of earlier frameworks guides the scale, direction, and rhythm of newer interventions.

Lugo can be understood through this same palimpsestic logic. Its urban grid is the city-scale translation of the Roman centuriatio. The cardo and decumano persist in Corso Garibaldi and Corso Matteotti, while the surrounding countryside extends the same orthogonal order through its rural roads and irrigation canals. Modern industrial layouts – yard depths, shed orientations, and parcel subdivisions – have followed rather than broken this geometry, reinforcing the underlying cadastral logic. The result is a territory where Roman, medieval, agricultural, and industrial layers remain superimposed, each legible in form and function.

From this perspective, the proposed integration of photovoltaic fields can be understood as the inscription of a new layer on the palimpsest. Energy production becomes not only a technical necessity but also a design act, reinforcing the continuity of the grid while addressing contemporary ecological and economic challenges. By occupying underutilized voids between industrial fabrics, photovoltaic fields act as connective tissue, filling gaps without disrupting the orthogonal order. At the same time, they establish a gradient between agricultural and industrial uses, embodying the productive hybridity that characterizes Lugo's landscape. In this sense, photovoltaics are not an intrusion but a further "reading" of the palimpsest, an additional trace that strengthens the legibility of the grid while expanding its productive role into the domain of renewable energy.

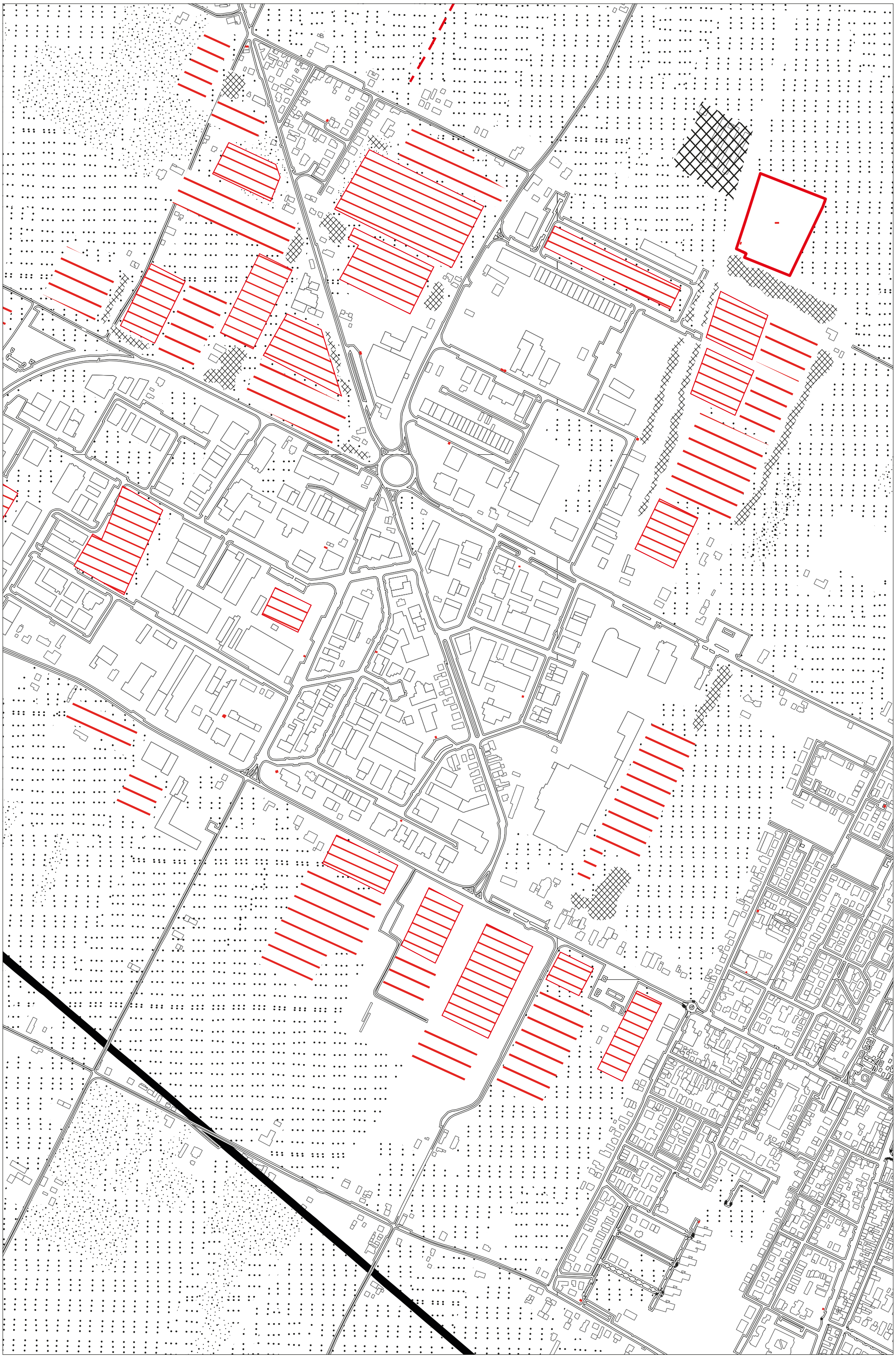
This research-by-design approach focuses on two exemplary districts to demonstrate this potential: the Centro Merci Intermodale, inaugurated in 2001, whose logistics platforms extend the long tradition of rail-edge industry structured by the centuriation[6]; and the Zona Industriale Nord, where the orthogonal pattern of streets such as Via Di Vittorio and Via Buozzi exemplifies the survival of the Roman framework, now formally recognized

5 Rodolfo Machado, *Old Buildings as Palimpsest: Toward a Theory of Remodeling*, in "Progressive Architecture", vol. 57, n. 11, 1976, pp. 46-49.

6 Assemblea Legislativa Emilia Romagna, *ZLS – Emilia-Romagna: Nodi logistici e aree produttive individuate*, Bologna, Assemblea Legislativa, 20 October 2021. Provincia di Ravenna, *Polo funzionale 9 – Centro Intermodale di Lugo*, Provincia di Ravenna, Settore Pianificazione, 2005. Provincia di Ravenna, *Polo funzionale 8 – Stazione ferroviaria di Lugo*, Provincia di Ravenna, Settore Pianificazione, 2005.

Above. Reframing the Peripheral Grid. A Large-Scale Shading Strategy across Lugo's landscape.

Next pages. Reframing two urban rooms. The intervention on the Industrials fringes: Zoom 1 and Zoom 2.



ELENA GUIDETTI

within the Paesaggio Protetto della Centuriazione[7]. In both contexts, the photovoltaic layer is conceived not as an isolated technical infrastructure but as a new inscription in the palimpsest, aligning with Machado's vision of the territory as a continuous and cumulative text.

Reframing the periphery

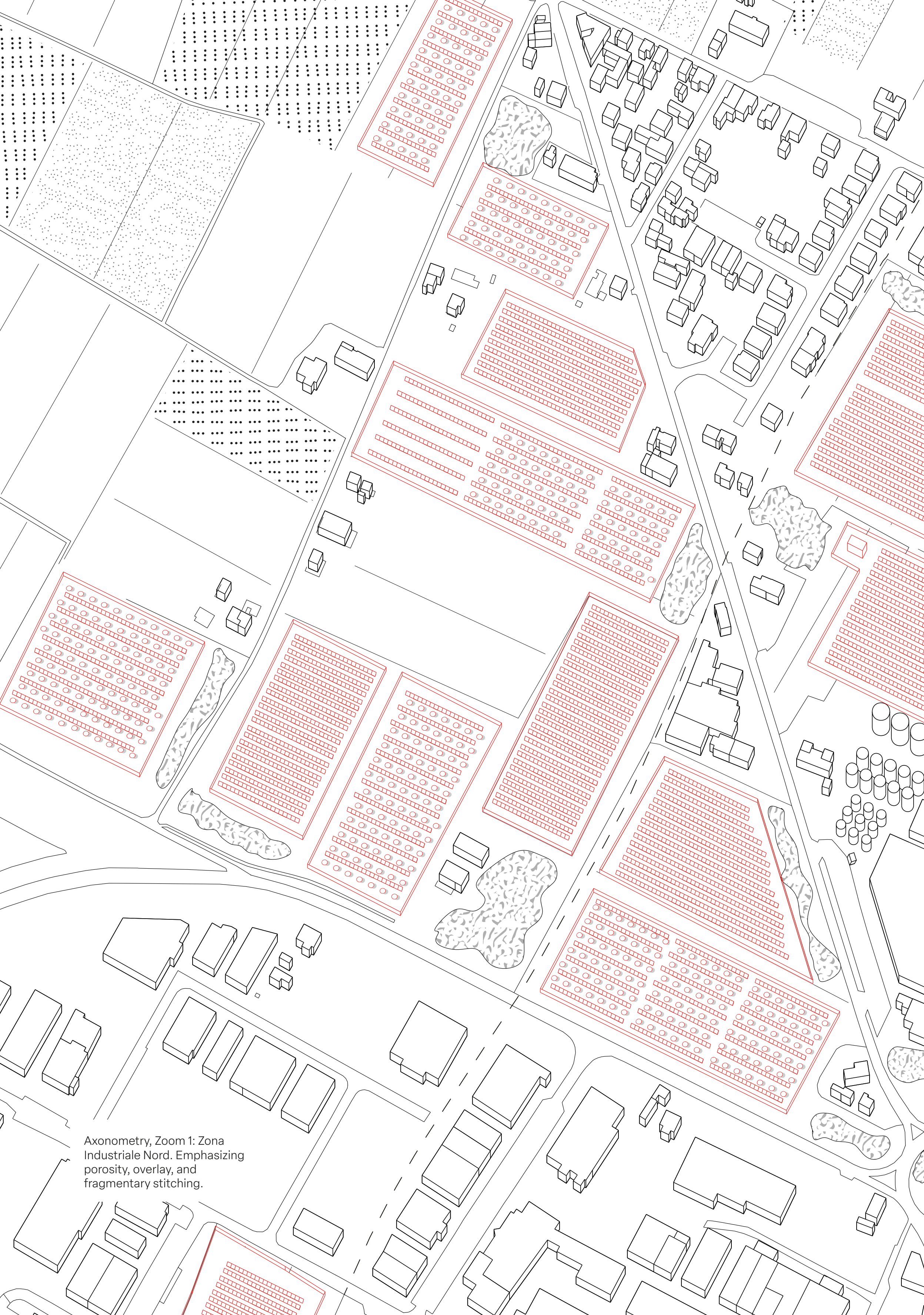
Filling the gaps and reinforcing the primary axes, the proposal activates residual industrial landscapes into connective tissue. It positions new solar fields as structural threads, integrating and amplifying the urban and natural axes at the periphery.
The project inserts a calibrated infill into the existing grid (approx. 710 x 710 meters) by densifing the peripheral industrial sites, thereby stitching together rural and urban realms. Each "field" is dimensioned as a mediator (somewhat larger than industrial halls, yet smaller than typical agricultural parcels) evoking the scale and rhythm of city blocks. Rather than abrupt boundaries, the strategy employs gradation and shading to articulate continuity.
The scheme alternates photovoltaic and agrivoltaic fields, situating photovoltaics adjacent to industrial fabric and agrivoltaics toward farming lands. In doing so, the solar zones act as a buffer and gradient device, revealing shadow patterns that reinforce spatial continuity rather than discontinuity.
This rationale is consonant with the "rural-to-urban transect model"[8], which views settlement types as positioned along a continuum rather than in isolated clusters; here, the fields occupy intermediate transect zones. Moreover, the notion of landscapes as gradients rather than discrete patches, as elaborated in landscape ecology, supports viewing these solar fields as a mediating landscape in Lugo landscape, as a threshold zone that negotiates between industrial and agricultural regimes[9].
The proposed horizontal development is conceived not as a one-time masterplan but as a strategic mode of incremental densification across Lugo's industrial interstices. Each field, even when implemented individually, reinforces the historic grid logic of the landscape by reasserting the perpendicular axes.
Between the two intervention zones, the Zona Industriale Nord (Zoom 1) to the northwest and Centro Merci Intermodale (Zoom 2) to the southeast, the city lies in between, mediating them. Both lie on Lugo's periphery: each has one flank facing the historic urban core, and the other flank facing a different river, the Santenio to the northwest and the Senio to the southeast.
In Zona Industriale Nord, with its smaller lot sizes, fragmented pattern, and more loosely defined circulation, the solar fields serve to reintroduce porosity and enable a layered dialogue between infrastructure and landscape. In contrast, the Centro Merci Intermodale must respond to heavier logistical demand, rail connections, and large access corridors, so its fields negotiate integration with hierarchical circulation and infrastructural continuity. In both cases, the shading regimes, field typologies, street layout, and vegetation strategies are adapted to the local

7 Regione Emilia Romagna, *Paesaggio Protetto della Centuriazione (Lugo–Cotignola)*, Bologna, 2011.

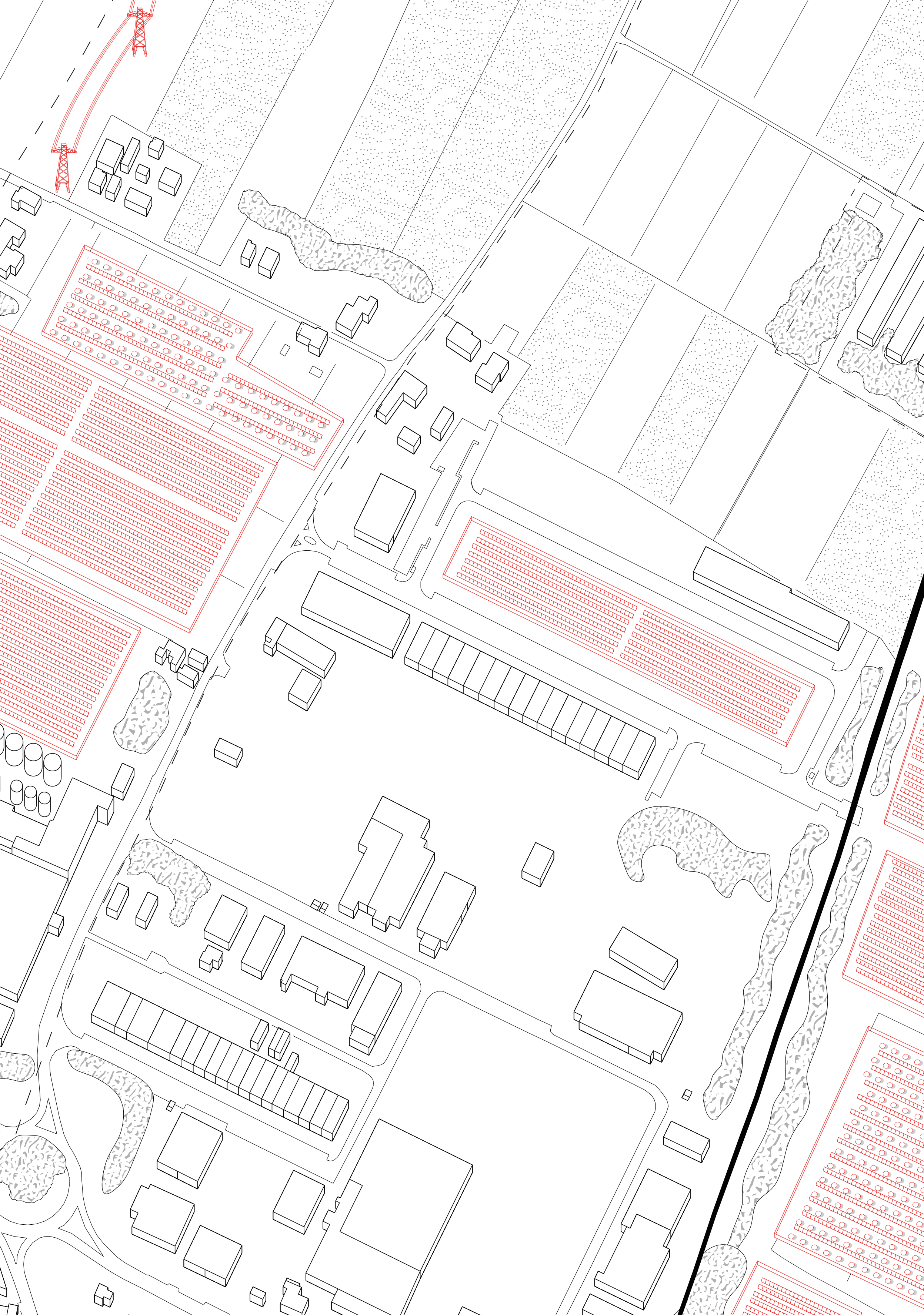
8 The logic of "transect planning" underpins the New Urbanist idea of organizing settlement types along a continuum from rural to urban, rather than as isolated typologies. Andrés Duany, Emily Talen, *Transect Planning*, in "Journal of the American Planning Association", n. 68 (3), 2002, pp. 245-266.

9 The "gradient concept" articulats how ecological landscapes are better represented as continuous gradients rather than discrete patches. Kevin McGarigal, Samuel A. Cushman, *The Gradient Concept of Landscape Structure*, in John A. Wiens, Michael R. Moss (eds.), *Issues and Perspectives in Landscape Ecology*, London, Cambridge University Press, 2005, pp. 112-119. The notion of "mediating landscapes" in postindustrial contexts, is essential to emphasize threshold conditions rather than dominance of one regime over another. Udo Weilacher, *Between Landscape Architecture and Land Art*, Basel, Birkhäuser, 1997.

axes, flows, and constraints – yet they uphold a unified, coherent spatial logic across Lugo's periphery.
This project demonstrates how a landscape-based approach can unlock potential by employing a site-specific methodology. It envisions photovoltaic and agrivoltaic fields inserted between the two industrial zones of Lugo, in response to the existing terrain and infrastructure. While the scheme allows for gradual contraction or expansion over time, it is presented as an open-ended strategy rather than a fixed master plan. Solar energy production becomes integral to the spatial logic, interwoven with industrial and agricultural uses rather than simply added on. In this structure, shading patterns inherent to agrivoltaic systems play a central role in managing the transition between uses, and the densification of industrial brownfield interstices helps reactivate sprawling campus-like industrial zones. The interstitial fields act as connective tissue that reinforces the orthogonal grid rather than interrupting it, enabling a hybrid productive landscape in which industry, agriculture and renewable energy coexist in a coherent spatial logic. Ultimately, this approach shifts focus from a one-time intervention to an incremental strategy: it reads the palimpsest of the Roman grid, agricultural plain, and industrial periphery and proposes a new layer of productive infrastructure without erasing what came before. It invites a future in which the plain evolves not by negating its past but by augmenting it, where solar fields serve as an infrastructural agent for continuity, resilience, and landscape renewal.



Axonometry, Zoom 1: Zona Industriale Nord. Emphasizing porosity, overlay, and fragmentary stitching.

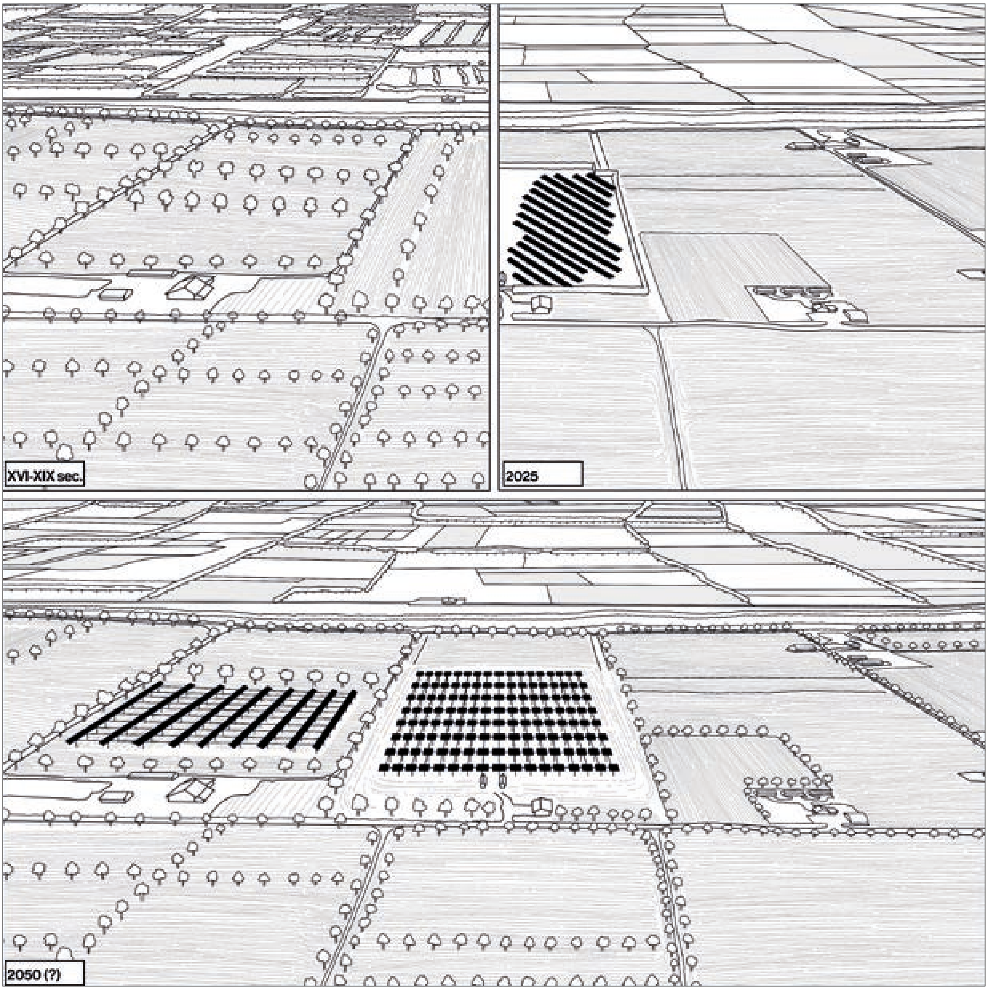


Towards a conscious agrivoltaic landscape

SIMONE
BACCAGLINI

Lugo, a municipality located in the Emilia Romagna region in northeastern Italy, represents a rural landscape that has evolved through centuries of agricultural exploitation, water management, and infrastructural transformation. This flat territory, characterized by a strong geometric configuration and long valued more for its productivity than for its ecological significance, is today part of one of the centers around which Italy's energy transition is taking place. It provides an important case study on how post-agricultural landscapes can adapt to new functions, such as photovoltaic energy production. The underlying premise is that, through a project grounded in the ecological history of the territory, it is possible to make this energy production coexist with the most characteristic features of the area, in this case food production.
At the same time, it is important to be aware that every type of stratification that has occurred over time represents a new layer within the ecological palimpsest of the landscape under examination. For this reason, it will be crucial to consider the existing energy infrastructure in its least immediately recognizable dimension, that is, its ecological dimension, in order to understand its characteristics and to pose the right questions during the design phase, ultimately enabling decisions to be made with the fullest possible awareness.
It is not possible to think in a purely pragmatic way when dealing with a landscape project, particularly when it involves the revamping, decommissioning, or conversion of a photovoltaic field. More generally, the end-of-life phase of a photovoltaic field requires a project that is conscious both of what is to come in the future and of what is being left behind – which, as we will see, is hardly reducible to a mere infrastructure composed of structures, cables, and panels.
There is a deeper issue of responsibility towards the community. In *Architecture and Democracy*[1], Giancarlo De Carlo alludes to the idea that when discussing landscape, one must introduce the political dimension, while distancing himself from the concept of "political

1 Giancarlo De Carlo, *Architettura e democrazia*, Rome, Officina Edizioni, 1969, p. 138.



Historical and ecological palimpsests: Lugo between past, present, and future visions.

landscape" developed by Martin Warnke within the research of the Center for the Study of Political Iconography at the Warburg-Haus in Hamburg. He understands it instead as a «discourse by citizens and among citizens»[2] its etymological meaning, inspired by the notion of the community's general interest and the quality of living. De Carlo discussed this in relation to the responsibility of both citizens and professionals towards the territory. Today, his thinking seems particularly relevant. When applied to these infrastructured landscapes, the balance of responsibility clearly leans more heavily on professionals, who should prioritize the care of the landscape over market-driven logic, which too often shapes decisions that have and will continue to have repercussions for everyone, including citizens, who in this sense should be considered as passive parties alongside the landscape.

2 Martin Warnke, *Politische Landschaft: Zur Kunstgeschichte der Natur*, München, C.H. Beck, 1992.

A vertical dimension before a horizontal one

Lugo is a small municipality in the province of Ravenna, a place of plains. The horizontality of space is perhaps the feature that most strikes the visitor who ventures on a Sunday trip through the Romagna countryside. There are no vertical elements of significant relevance, no noteworthy infrastructures except for a few photovoltaic fields – which will be analyzed later –, nothing but cultivated land. And that seems fine, one might think. From a romantically Pasolinian[3] perspective, with eyes filled with nostalgia and the mist that blurs the horizon, it would be easy to assume it has always been this way, a place that is unchanging, immutable, and still.

And yet, Lugo changes. In fact, it has already changed, and without a doubt, it will continue to change. There are historical traces of what Lugo once was, showing how its landscape was shaped and what its main characteristics were. By examining photographs dating back to 1943-1944[4], one can identify at least two distinctive features that defined a landscape radically different from how it appears today. The first is undoubtedly linked to the remarkable fragmentation of agricultural parcels, which was once far more diverse than it is now.

There are several historical and technical reasons that can be considered when defining the factors that have modified its characteristics over time, causing a progressive concentration and consolidation of agricultural areas. From a historical perspective, in the pre-industrial era, agricultural property was often highly fragmented. Small farms, inheritance divisions, and sharecropping practices produced a strip-like pattern that characterized the Romagna countryside, including the lands surrounding Lugo.

In addition, there is a reflection on the origins of the territory, whose generative matrix likely derives from Roman centuriation, an orthogonal and rational grid of roads and fields that still today, at least in its general layout, continues to define the territorial structure[5].

Land reclamation and hydraulic management, including canalization, drainage works, and modest local land reform interventions, influenced over time both the types of crops and the configuration of plots, favoring their consolidation into more homogeneous areas in order to optimize entire cultivable agricultural blocks from a technical perspective.

It is also important to consider the mechanization process that affected agriculture in the twentieth century and the market evolution that followed. While increasingly efficient agricultural machinery became available, larger plots of land were needed to make investments sustainable. For this reason, a process of land consolidation occurred, transforming small holdings into larger farms. This trend was reinforced by post-war agrarian reforms that encouraged larger cooperatives and enterprises.

Therefore, while on one hand we can observe how the texture of the landscape has profoundly changed over time, another major

3 Pier Paolo Pasolini, *Scritti corsari*, Milan, Garzanti, 1975, p. 91. See also Pier Paolo Pasolini, *Il vuoto del potere in Italia (ovvero la scomparsa delle lucciole)*, in "Corriere della Sera", February 1, 1975, https://www.corriere.it/speciali/pasolini/scomparsa_lucciole.shtml [last access October 2025].

4 *RAF Aerial Reconnaissance Photographs, Emilia-Romagna 1943-44*, Geoportale Regione Emilia Romagna, Sezione Cartografia storica, https://geoportale.regione.emilia-romagna.it [last access October 2025].

5 Nicola Mancassola, *La grande proprietà fondiaria nel territorio dell'antico Esarcato di Ravenna (secoli IX-X)*, in Jean-Marie Martin, Annick Peters-Custot, Vivien Pringent (eds.), *L'héritage byzantin en Italie (VIIIe-XIIe siècle). IV: Habitat et structure agraire*, Rome, École française de Rome, 2017, pp. 119-144. https://cris.unibo.it/handle/11585/598286 [last access October 2025].

difference that emerges when analyzing the current territory and comparing it with the past is the complete loss of the vertical component represented by the use of the Piantata Padana[6].
By Piantata Padana we mean an integrated agricultural system that became established between the late Middle Ages and the early modern period – 14th-17th century – in fertile yet waterlogged areas of lower Romagna and the eastern Po plain – *Atlante degli ambiti paesaggistici, Ambito 16*[7]. Vines were trained on trees such as elms, poplars, or field maples, while arable crops – wheat, barley, or forage – were grown between the rows. Tree lines functioned as property boundaries, supports, and sources of timber, creating a multifunctional system capable of producing wine, cereals, forage, and wood within a single plot.
Beyond its economic role, the Piantata Padana provided significant ecological and visual benefits. It protected the soil from wind erosion, promoted biodiversity, and regulated water drainage, while its vertical rhythm of tree rows defined a landscape of strong identity – an ordered, living matrix visible both from the air and at the human scale. In contemporary land use, most of this vegetative complexity and vertical stratification have disappeared. Traditional tree-lined roads, *maceri* – ponds for hemp retting –, and drainage channels have largely been filled or converted into farmland. Urban and infrastructural expansion has further simplified the geometry, though the overall centuriation grid remains partially legible, now hosting vast monoculture fields – mainly wheat, corn, rice, sorghum, soy, and sugar beet – that extend across the non-urbanized areas.
Today, Lugo exemplifies a condition of peri-urban sprawl, where low-density development coexists with high-intensity agriculture. Although productive land use remains dominant, new forms of occupation, including industrial, logistics, and increasingly energy-related developments, have begun to redefine the identity of the landscape.

A project that must not be just another project

The Emilia Romagna region can be considered one of the most agriculturally productive regions in Italy. According to data[8], cultivated land covers more than 50% of the territory. As we have seen in the introduction and in the previous paragraph, the landscape of Lugo has historically represented a rural model of intensive agricultural production[9].
However, the area under study does not fall within environmentally protected zones of the region. Therefore, the perception is that it is a territory of limited ecological value[10], whose significance has inevitably been linked to its extractive value, in the past for food and fiber and today for energy production, with a future role still to be defined.
In order to outline an end-of-life project that is coherent with the context in which we are operating, it is necessary once again to highlight the main characteristics of the landscape from historical, technical, and ecological perspectives, emphasizing those

6 Regione Emilia Romagna, *Adeguamento del PTPR dell'Emilia-Romagna. Atlante degli ambiti paesaggistici, Ambito 16*, Distretto agroalimentare romagnolo, Bologna, 2010, updated 2024, https://territorio.regione.emilia-romagna.it/paesaggio/risorse/studi-analisi-e-approfondimenti-tematici/intr_amb_pae/aggiornamento-ambiti-paesaggistici-dati-socioeconomici [last access October 2025].

7 Regione Emilia Romagna, cit., 2010.

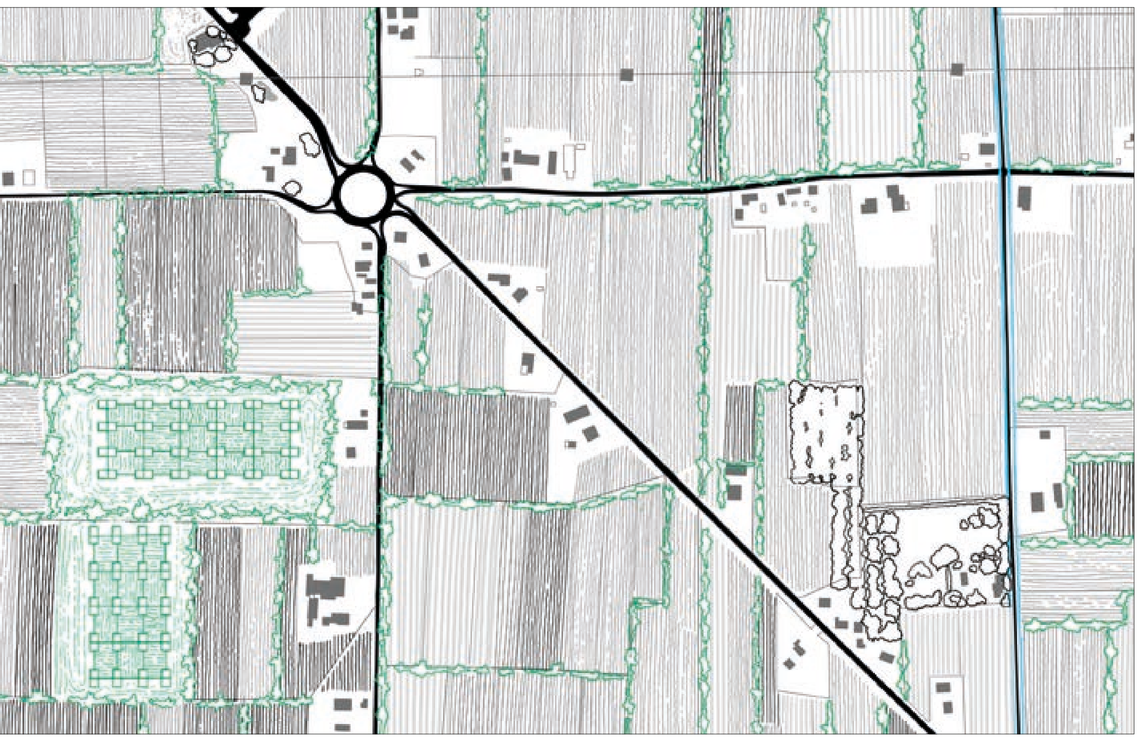
8 Mauro Agnoletti, *Il paesaggio rurale italiano: cultura, storia, territorio*, Rome, Laterza, 2010.

9 Regione Emilia Romagna, *Carta delle vocazioni agricole e dell'uso del suolo*, Servizio Sistemi Informativi Territoriali e Osservatorio del Paesaggio, 2022, https://geoportale.regione.emilia-romagna.it [last access October 2025].

10 ISPRA, *Carta della Natura della Regione Emilia-Romagna: carte di valore ecologico, sensibilità ecologica, pressione antropica e fragilità ambientale (Rapporto 354/2021)*, Rome, Istituto Superiore per la Protezione e la Ricerca Ambientale, 2021..

Above. Existing condition, photovoltaic field, Lugo.

Below. Project condition, conversion into agrivoltaic park, Lugo.



elements that can effectively become the cornerstones around which to structure the optimal strategy. As we have seen, one of the defining traits of Lugo's spatial organization is its geometric regularity. The orientation of agricultural plots, inherited from early land divisions, continues to structure both agricultural and infrastructural systems, maintaining a clear modular logic across the territory[11].

In addition to this geometric order, Lugo's landscape has been profoundly shaped by centuries of hydraulic engineering. Soil fertility and the region's productive potential were made possible by extensive drainage and reclamation works, initiated in the Middle Ages and continued during the Renaissance. These interventions transformed marshy areas into cultivable land, establishing a durable foundation for long-term agricultural intensification.

The hydrological network follows two main orientations – east-west drainage and north-south tributaries – forming a multiscale system of canals and embankments that ensures efficient water management. In the lower Romagna plain, the fluvial character of the landscape becomes more evident. Meandering riverbeds, abandoned oxbows, floodplains, and river islands coexist with agricultural fields and tree plantations. Poplar groves, in particular, often occupy former river spaces, reinforcing the hybrid nature of this landscape, which is at once artificial and natural, productive and geomorphological.

The persistence of centuriation and the continuous use of historic water management systems give Lugo's spatial organization a strong sense of historical continuity. These same patterns are now being adapted to new functions, particularly for the regular installation of photovoltaic fields, where ancient territorial modules are being reprogrammed for emerging infrastructural uses.

Another significant aspect of Lugo's current transformation is its integration into the regional and national energy network[12]. The area hosts strategic infrastructural nodes such as the RFI substation in Lugo[13] and the TERNA substation in nearby Alfonsine[14], which are part of a broader energy corridor that crosses the entire Romagna plain. These installations exemplify a wider trend in which rural landscapes, once dedicated exclusively to agriculture, are being redefined as spaces for energy production and distribution.

The morphological clarity and accessibility of Lugo's centuriated landscape have over time made it particularly suitable for the installation of photovoltaic systems. The flat topography, low ecological sensitivity, and high solar exposure create ideal conditions for solar energy generation. Moreover, the regularity of the land division simplifies the planning and alignment of photovoltaic panels. However, this transformation raises complex questions regarding land multifunctionality, prioritization of use, and the visual identity of the landscape.

Despite its visual openness and extensive vegetative cover, Lugo's landscape today offers limited ecological value. The simplification of the agricultural matrix, combined with the disappearance of

11 Archivio Storico del Comune di Lugo (1261–1984), Istituto per i Beni Artistici, Culturali e Naturali della Regione Emilia Romagna, "Fondi catastali storici e mappe localizzate," https://archivi.ibc.regione.emilia-romagna.it/ead-comparc/IT-ER-IBC-039012-001-001 [last access October 2025].

12 Regione Emilia Romagna, *Piano Territoriale Paesaggistico Regionale (PTPR), sezione "Paesaggi rurali e dinamiche agricole"*, Bologna, 2023, https://territorio.regione.emilia-romagna.it/paesaggio/ptpr [last access October 2025].

13 RFI – Rete Ferroviaria Italiana, *Impianti elettrici e sottostazioni in Emilia-Romagna*, 2021, https://www.rfi.it/it/societa/impianti-elettrici.html [last access October 2025].

14 TERNA Rete Italia, *Atlante dell'energia rinnovabile in Emilia-Romagna*, Rome, 2022, https://www.terna.it/it/sistema-elettrico/atlante-energia [last access October 2025].

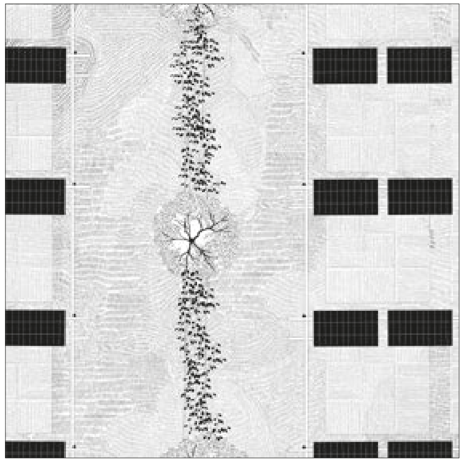
Schemes to illustrate the boundaries, technical structures, and biodiversity in their evolution, adaptation, and changes on site.

Diagrams by Marco Agosti, 2025.

1. Boundaries. The highly introverted fence becomes an opportunity for design reflection.The reintroduction of the Piantata Padana redefines the landscape both in three-dimensional terms (restoring its vertical component) and from an ecological perspective (introducing new yet historically coherent forms of biodiversity).

2. Structures. It marks the transition from PV to AGV, once again emphasizing the three-dimensional aspect while revealing the potential to integrate energy production with food production – the territory's true vocation.

3. Biodiversity. The reintroduction of the Piantata Padana, together with the integration of food production (through agriculture 4.0) alongside energy generation, aims to enhance the biodiversity of a territory historically defined by intensive cultivation.



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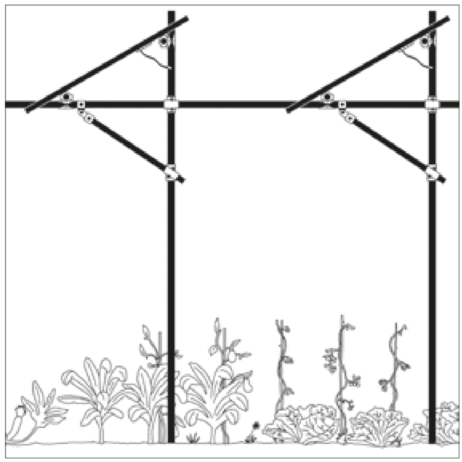

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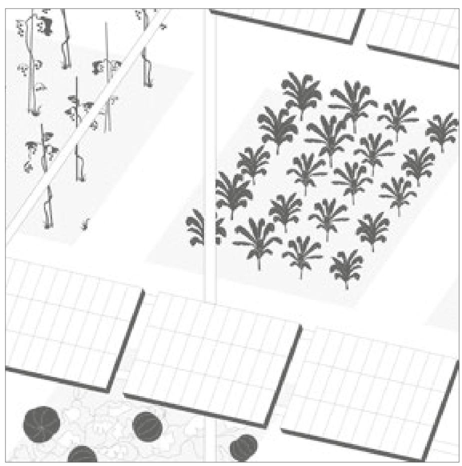

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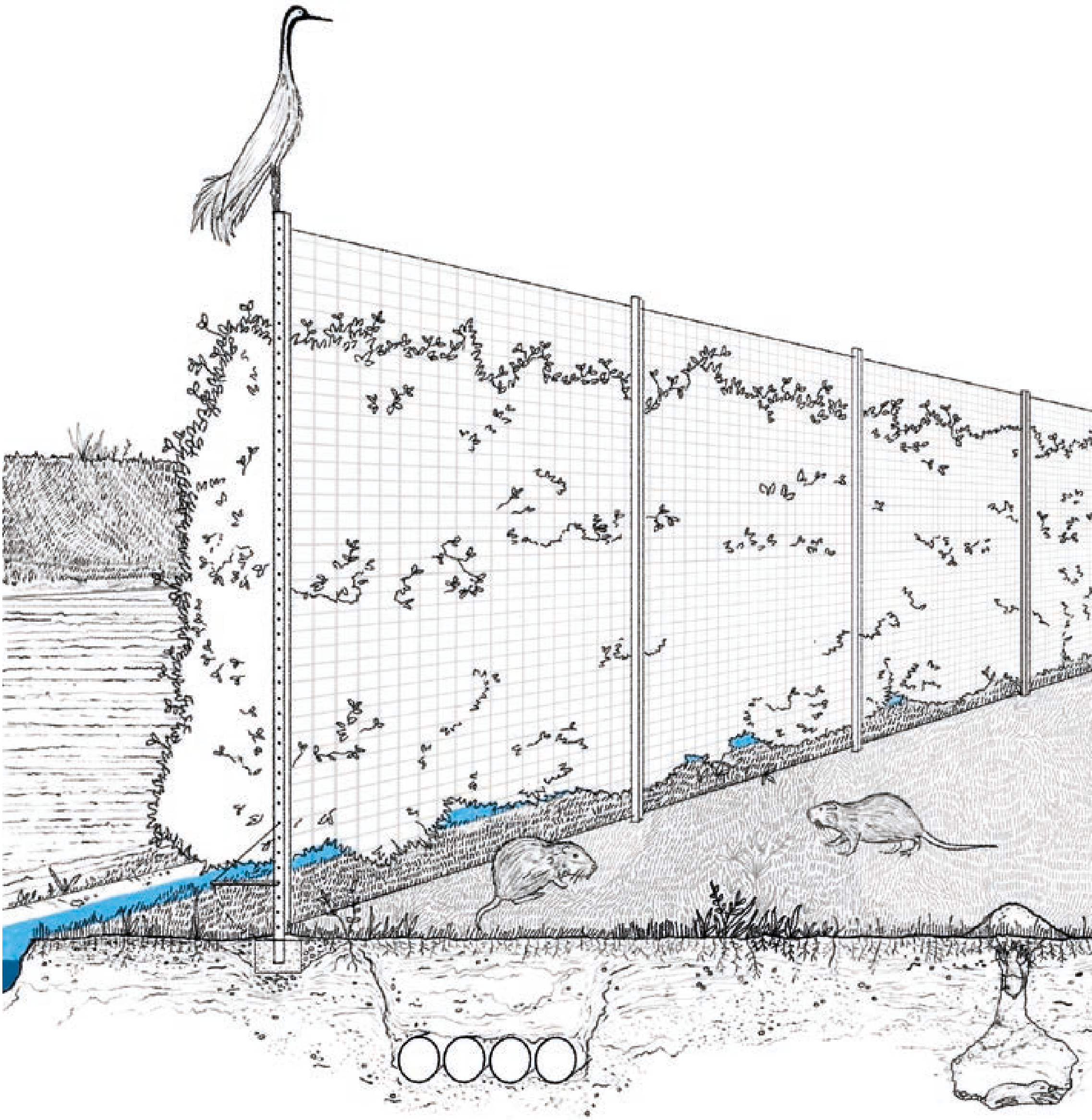
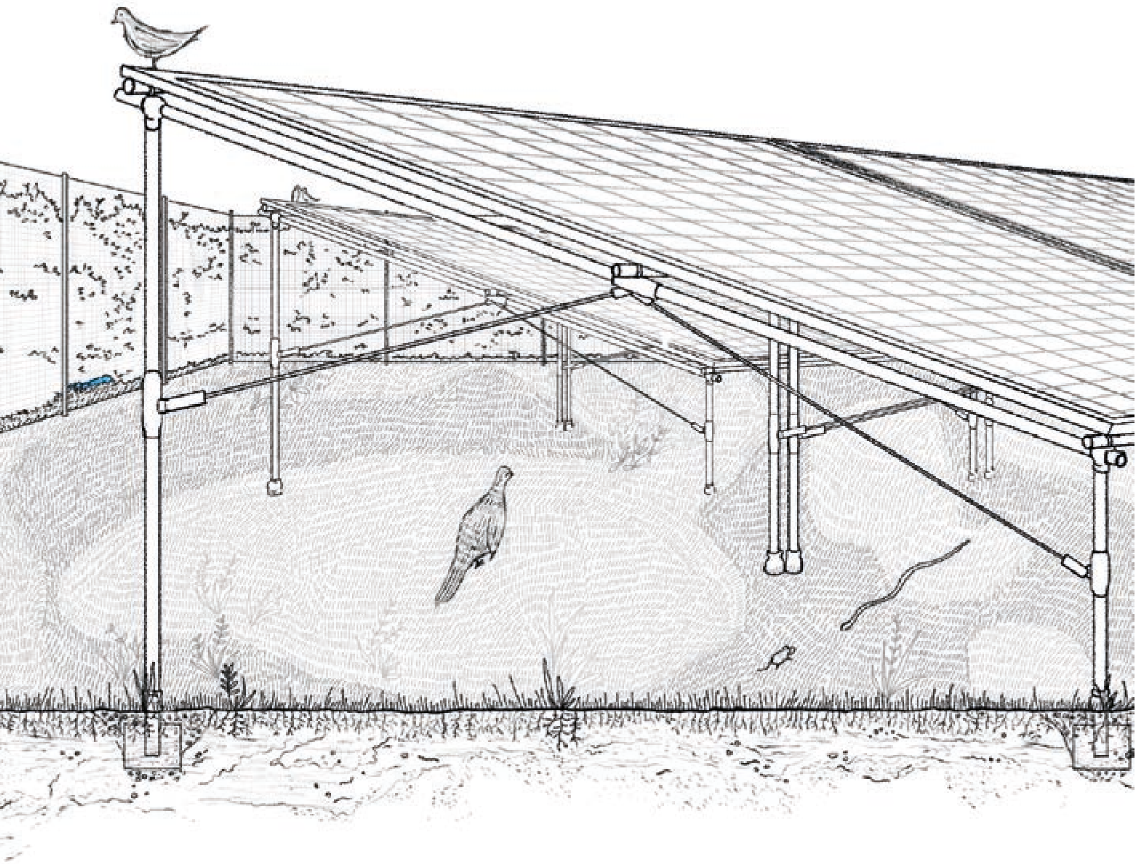
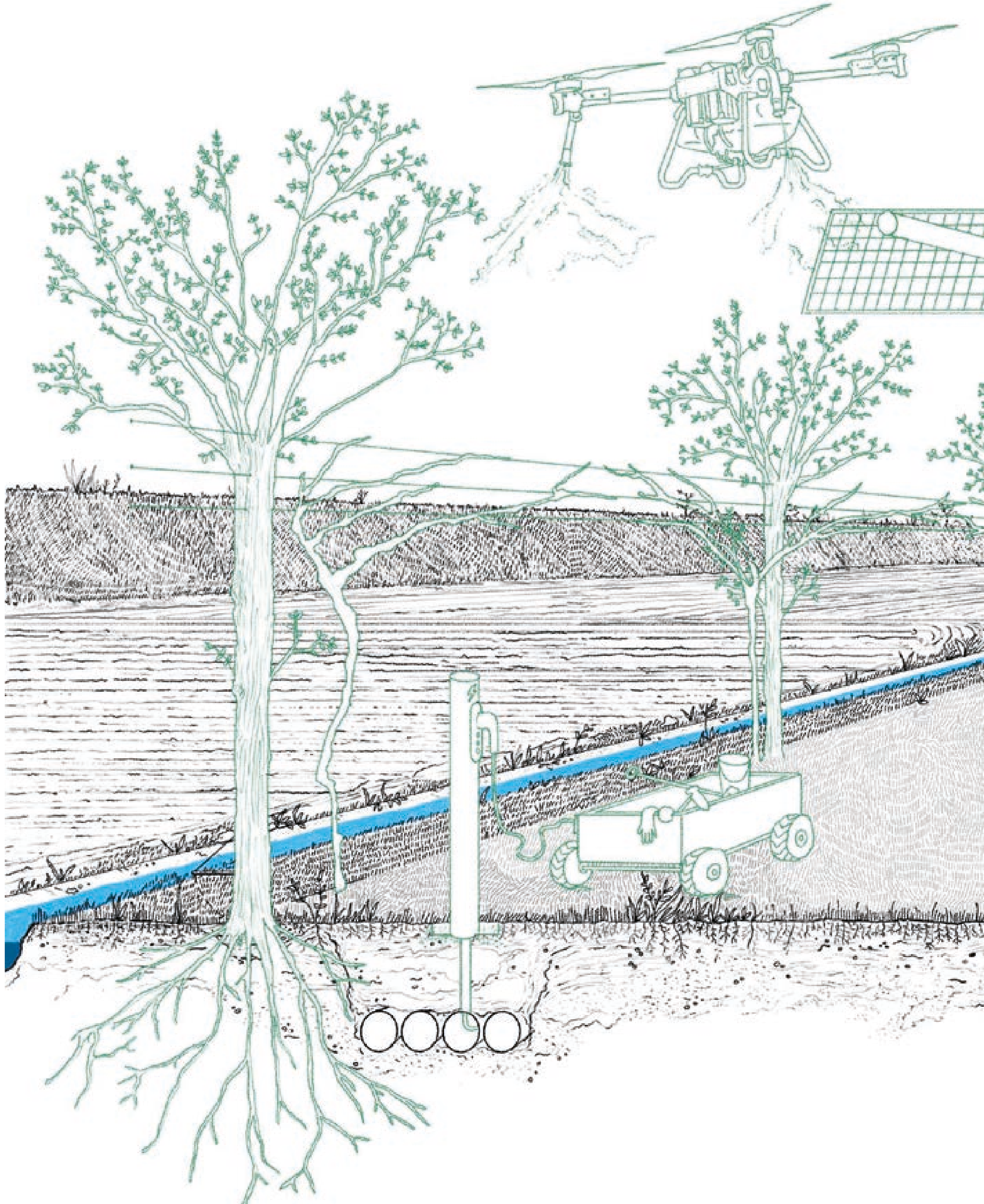
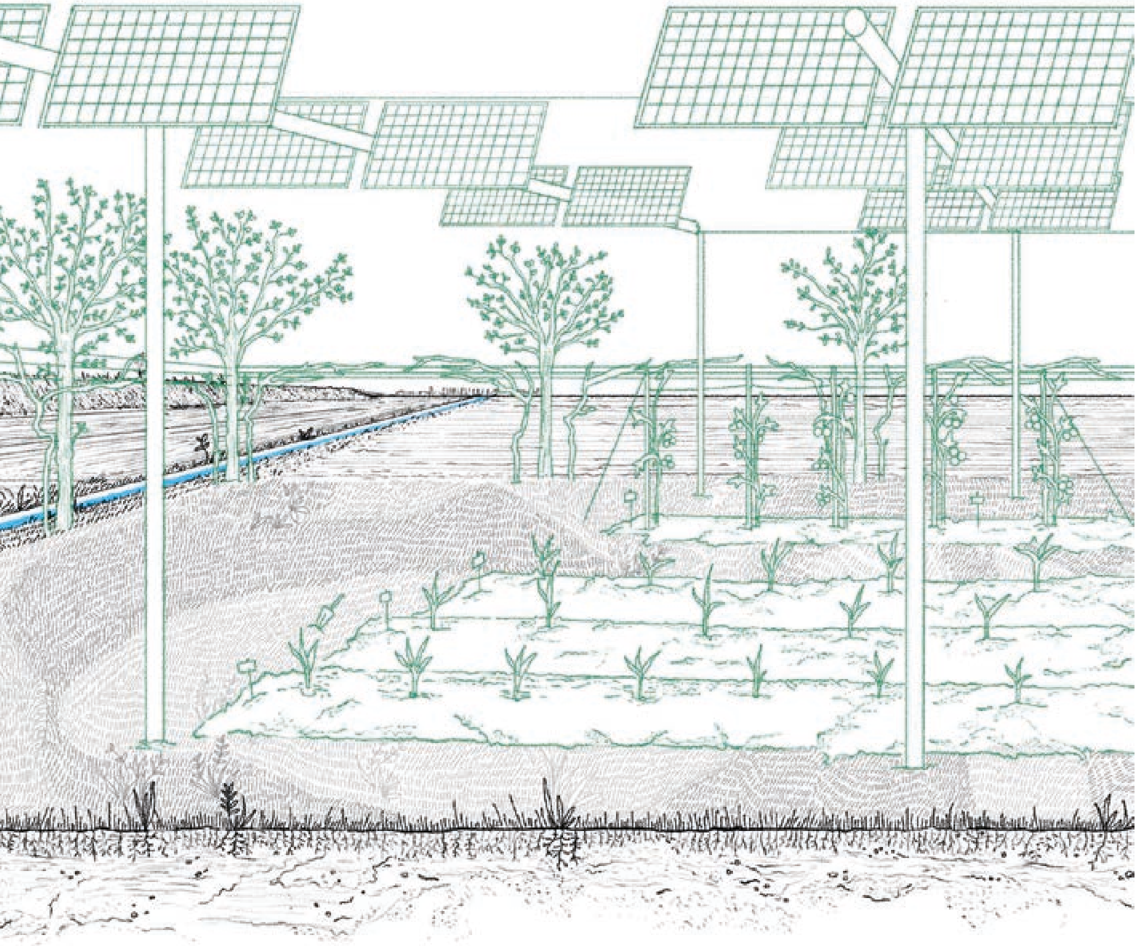


Perspective section, existing condition, photovoltaic field, Lugo di Romagna.





SIMONE BACCAGLINI



Perspective section, project condition, conversion into agrivoltaic field, Lugo di Romagna.

many semi-natural elements, has led to significant habitat loss and a reduction in biodiversity. The once-diverse mosaic of trees, vines, water bodies, and hedgerows has been transformed into a monocultural expanse that provides few ecological niches. Spontaneous vegetation is usually confined to marginal spaces, along canal banks, field edges, and isolated fragments of uncultivated land. River corridors represent the most significant form of ecological continuity in the territory, functioning as semi-natural axes in an otherwise impoverished context. These riparian strips are among the few areas where native plant and animal species can still survive, but they are increasingly under pressure from intensive land use and infrastructural expansion.
Inadequately planned solar installations can exacerbate habitat fragmentation and accentuate landscape homogenization. However, the presence of such areas, which are often difficult to access, can also support certain ecological functions. Solar parks designed with ecological buffer zones, native vegetation, and the integration of grazing areas or pollinator corridors can act as biodiversity corridors within a highly modified context.
At the same time, the inaccessibility of these parks and the "almost forgotten" nature of these locations create opportunities that must not be underestimated and should be considered during decision-making. Local fauna tends to reclaim areas with minimal human presence, leading to the formation of micro-ecosystems that develop new characteristics, coexist with infrastructure, and should be considered as fully legitimate ecological spaces.
In this sense, Lugo can be considered an experimental laboratory for hybrid models that combine energy production with ecological regeneration. From the reintroduction of wetland elements and hedgerows to the design of multifunctional infrastructure, the challenge lies in rethinking the territory not only as a productive machine but as a multilayered and multifunctional landscape.

Conclusions
Lugo embodies the tensions and potential of a rural territory in transition. Its deep historical layering, rational spatial structure, and productive legacy make it suitable for experimenting with new forms of land use, particularly those aligned with the global transition to renewable energy and the future decommissioning of these systems.
For landscape architecture, Lugo is a laboratory to explore how historical patterns can be reinterpreted in light of contemporary needs. Instead of viewing photovoltaic fields as an external imposition, designers can interpret them as new layers in a palimpsest, a continuation of the territory's productive vocation. By doing so, in a possible future scenario of photovoltaic system decommissioning, these fields could transform the image of the plain, from a space of ecological emptiness to a landscape of renewed complexity and significance.
For these reasons, the proposed suggestion is to use the field hosting the end-of-life photovoltaic installation under study

as a site for an agrivoltaic system, which can integrate energy production, one of the new characteristics of the territory, with food production, one of the historical vocations that has always distinguished this portion of the landscape.

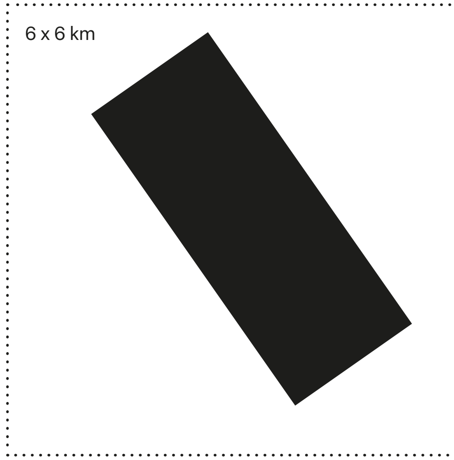
The idea of leveraging existing infrastructure to implement an agrivoltaic project and integrated Agriculture 4.0 combines in this case with an ecological vision that is both a suggestion and a provocation. The restoration of the Piantata Padana, adapted to what could be defined as partial divisions of agricultural land that diverge from the large-scale farms currently shaping the territory, is provocative because the project, within its new boundaries defined by the Piantata Padana system, does not strictly adhere to property limits but rather speculates on a vision of the future that aims for a more equitable distribution of land, avoiding large intensive monocultures generated by classical capitalist speculation and investment in the Po plain.

The agrivoltaic system also presents a completely different landscape impact compared with the pre-existing field, featuring fewer panels on a lighter structure that integrates with the underlying cultivated fields, which in turn intersect with surrounding farmland.

In conclusion, it is important to return to a crucial point. Regardless of what becomes of a photovoltaic field end-of-life conversion project, the political dimension of the choice that determines its fate is indispensable. This is a decision that must be conscious of both gains and losses. Too often, such choices are delegated to simple reports submitted during the authorization process, yet in a sense, these decisions transcend time and do not consider how a photovoltaic field effectively impacts the ecology and micro-ecologies of a place.

It is impossible to make a choice without relinquishing something. In this case, we choose to restore in Lugo a scenario grounded in the identity of the place, focused on food production and the redefinition of a historical ecological system, such as the Piantata Padana, in order to foster biodiversity and reintroduce a less horizontal landscape pattern that had consolidated over centuries in this part of Emilia Romagna. At the same time, the value of the impact that the photovoltaic field has had on the territory must be recognized, particularly its positive aspects, such as creating an enclosed area with very limited human accessibility, where some micro-ecologies have formed, stabilized, and which would likely be removed if an agrivoltaic system were implemented.

Cuneo
Fossano



N E W
P E R S P E C T I V E S

Boosting the infrastructure

SIMONE PAROLA

The project proposal presented in this chapter aims to redesign the current energy landscape in the province of Cuneo, Piemonte. The project aims to restructure the fragmentation of the energy system by boosting mobility infrastructure and promoting the natural rehabilitation of decommissioned photovoltaic fields.
From a design perspective, if the urban features that Aldo Rossi[1] identified as persistent elements within the city find their most evident expression in monuments, what are their counterparts within the landscape? In the context of Cuneo, settlements, orography, and infrastructure can be identified as permanent features within the territory, giving rise to a complex and layered picture. The case of Fossano is an example of this: the city stands out on the hill, the river and natural systems define its base, and the production and connection infrastructures shape the surrounding countryside. What architectural and landscape characteristics does the energy system assume in this context?
Through a macroscopic analysis of the territory, it is possible to read the energy landscape as a mere juxtaposition to the pre-existing layout. As in a photograph by Johnny Miller[2], the absence of organized planning has led to the creation of a system without regulatory order. The rules – often too many or contradictory – and the mere principle of necessity of this energy settlement determine a morphology similar to the informal settlements[3] represented by Miller[4].
In this sense, while from a morphological-settlement perspective it is possible to interpret the city as a process of adaptation and stratification based on pre-existing elements[5], here the process seems to be reversed. The photovoltaic fields do not appear to result from a sedimentation process in dialogue with persistent natural and anthropic configurations, but rather impose themselves as isolated episodes, lacking continuity and connection with the context.

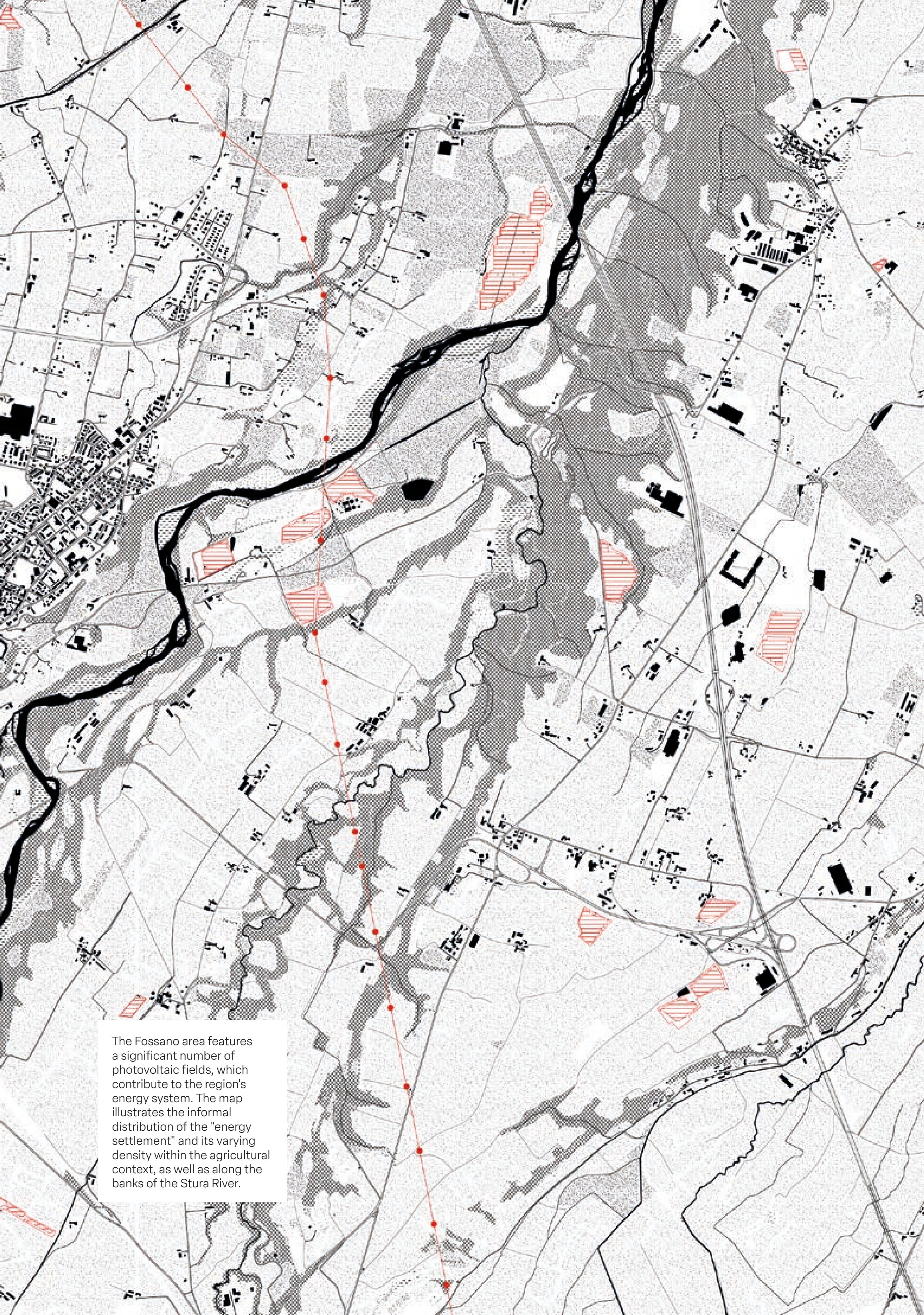
1 Aldo Rossi, *L'architettura della città*, Milan, Città Studi Edizioni, 1995, pp. 55-61.

2 Johnny Miller is an American photographer, journalist, and filmmaker. Among his many projects, *Unequal Scenes* has received widespread acclaim for depicting inequalities between formal and informal parts of cities.

3 Theorized by British architect John F. C. Turner in the 1960s, informal settlements differ from formal ones in several fundamental ways: legality, self-production, response to the principle of necessity, and absence – or considerable flexibility – of urban planning regulations.

4 This territory is positioned in an intermediate condition between Brindisi's high localized concentrations and Ravenna's episodic dispersion.

5 Saverio Muratori, *Studi per una operante storia urbana di Venezia: 1*, Rome, Istituto Poligrafico dello Stato, 1959, pp. 14-35.



The Fossano area features a significant number of photovoltaic fields, which contribute to the region's energy system. The map illustrates the informal distribution of the "energy settlement" and its varying density within the agricultural context, as well as along the banks of the Stura River.

Energy: Hydrography, Nature, and Orography

By reducing the scale of analysis to conduct a more detailed reading of the design possibilities offered by this territory, it is possible to observe a strip of landscape along the west bank of the Stura River that is strongly characterized by its energy footprint. Although built over many years and with very different technologies[6], they share a geographical and orographic position of particular interest, defining a design area with great potential. If the logic of their construction can be traced back to those previously introduced, a further element to note is their location within flood-risk areas, which is therefore unsuitable for building[7]. Land use becomes selective, creating or exploiting residues, margins, and interstices that prevent the photovoltaic fields from constructing a cohesive landscape system. The second element of interest concerns the ecosystem composition of the territory. Agricultural fields and the natural system intertwine and alternate with the energy system, interacting with the hydrographic structure and large areas of land covered by spontaneous forests[9]. From an architectural point of view, this heritage is a further permanent element that defines and orients the area of interest for production and acts as a landmark identifier for the space[9]. The third element to consider is the orography of the territory (from 290 m above sea level to 370 m), which not only characterizes but also structures the perception of the landscape, generating distinct places and helping to define its *genius loci*[10]. This element should be enhanced as a pre-existing resource and a qualifying feature of the area, rather than a limiting factor.
Starting from this context, which is marked by complexity and critical issues, how can the energy landscape project serve as a bonding agent for the existing elements without compromising the need for production?

The infrastructure and its potential

Investigating the possible strategies for planning the new energy landscape introduced at the beginning of this section and pursuing the path of redesigning the city's boundaries can be functional for reducing the ecosystem impact. The areas around the city provide positive exposure, but this must be weighed against two conditions: the impossibility of exploiting large areas due to the orography, and the natural and anthropic articulation of the urban boundaries. The latter element, if amplified by the energy project, would require transforming the currently purely residential margins of the city into productive areas lacking in coherence and landscape quality[11].
At the same time, the presence of these closely spaced photovoltaic fields defines a significant energy density for the peri-urban area, which could constitute a functional premise for revamping interventions. The project could therefore propose to saturate the interstitial areas that are still free, in order to achieve a real local energy concentration. However, the suitability maps would not encourage such a solution close to the river banks in this case[12].

6 In this area, photovoltaic fields are concentrated near or in the immediate vicinity of the river and have been built with varied technologies and timelines: 2011 Bi-axial PV; 2012 Static PV; 2023 Mono-axial PV. The data refer to the information previously reported in p. 64.

7 The northern most photovoltaic field is located within the medium and high-risk areas of the neighboring Stura di Demonte river.

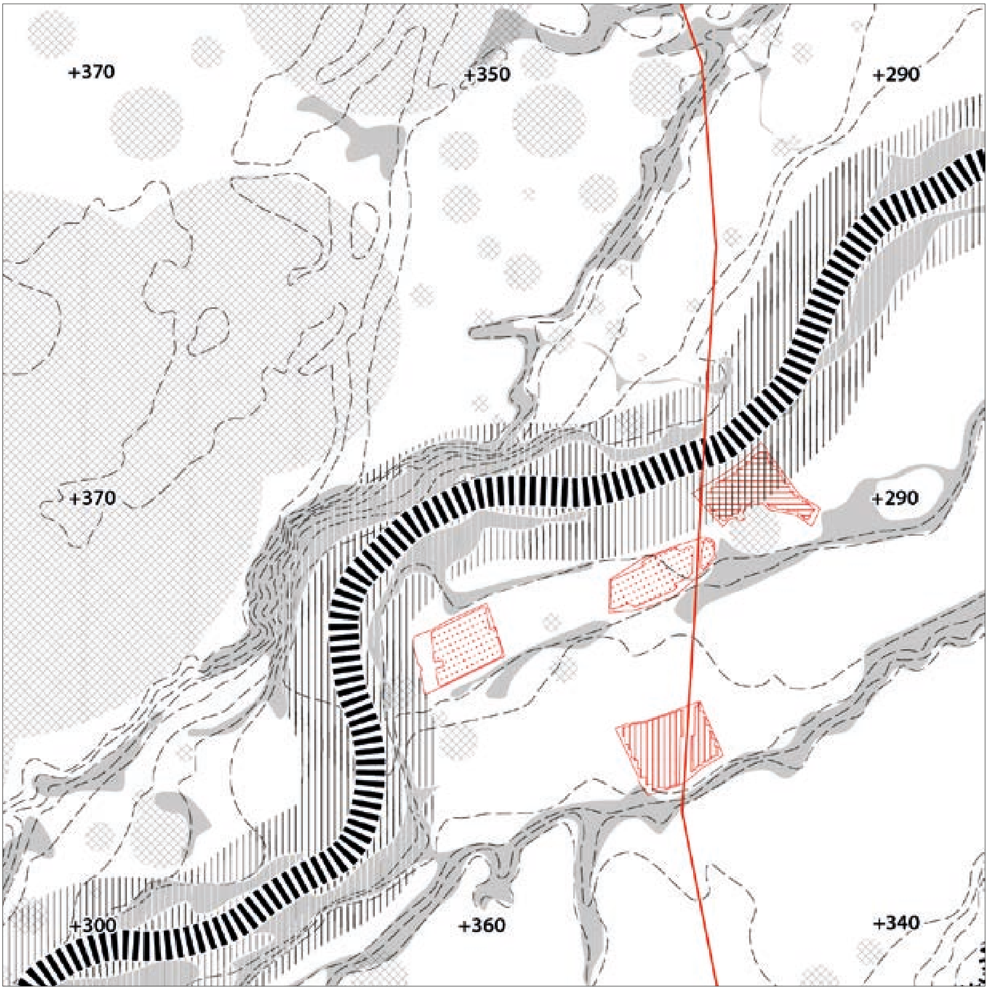
8 Inside the area under analysis, energy production does not follow a spatial continuity, interrupted by the spontaneous coniferous forest that covers part of this space and extends throughout the rest of the countryside. For the project, it is therefore a question of understanding whether the new energy structure should override the pre-existing one or engage in dialogue with it to define a new level within the existing layout.

9 To make the natural image of the place even more complex, erosion caused by the river has brought to light the presence of a fossil forest dating back about six million years ago, right in the area of analysis.

10 Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture*, New York, Rizzoli, 1980, pp. 34-39.

11 This part of the city already shows residential areas of varying density interspersed with anthropized and natural structures. To meet today's energy needs, these natural areas would have to leave space for the energy program, undermining the ecosystem value of the landscape.

12 In this specific context, simply complying with minimum distances may not be sufficient to justify energy system planning in this location, and the ecological quality of the forest and cultivated areas would not see adequate improvement.



The analysis of the area reveals three identity systems: the river and its appurtenances/areas of unsuitability; the forest as density and organic geometry within the territory in relation to the agricultural production system; the orography of the hill in relation to space. These elements have defined today's energy project and become useful tools and actors in its reprogramming.

- Wooded areas
- Stura River
- Inhabited settlements
- River's areas of unsuitability
- Contour lines and reference elevation (m)
- High-voltage line
- Static PV
- Mono-axial PV
- Bi-axial PV

The hill, visible in its extension in section, and the river at its foot are the dividing line between the city and the cultivated and wooded areas, defining a division between organic and anthropized landscapes. The energetic presence can be read as sporadic action within the landscape, incapable of defining a truly cohesive energy system.

It is therefore necessary to consider what other elements within the landscape could be exploited to redesign and plan energy production in this context.
One possibility is offered by the road infrastructure connecting the city of Fossano to the surrounding area at the bottom of the hill. Although it is a simple provincial road, this infrastructure is also an element of landscape drawing that characterizes the territorial organization. In this sense, it is possible to follow Bernardo Secchi's suggestions and read this infrastructure as a lasting support and an integral part of constructing the territorial project capable of articulating quality spaces[13]. Although Secchi dealt mainly with urban planning, the same fragmentation and methods of appropriation are visible here and can be treated similarly. Road infrastructure can be considered not merely a technical route but a morphological axis capable of organizing new centrality.
Exploiting this set of complexities, the project must address the individual elements to transform critical issues into opportunities.

1. The proximity of existing photovoltaic fields returns the functionality of energy connection to the project[14].
2. Decommissioning existing photovoltaic fields allows for enhancing the forest that runs parallel to the road.
3. The unsuitability maps, limiting the construction of new infrastructure close to the river, allow for the definition of a buffer zone cleared of the energy system, safeguarding its suitability.
4. Although the terrain orography presents significant differences in elevation, the road layout appears more regular and continuous[15].

Therefore, the project aims to capitalize on the high degree of complexity present in this context to create an energy landscape that represents a new level of the existing program and a unified part of the territory. The aim is to achieve the "difficult unity" theorised by Robert Venturi for architectural design, which can represent a process that includes all elements, even through variable power relations, without resorting to the simplification of exclusion[16].

Based on these considerations, the project proposes two physical and temporal actions. The first action involves decommissioning production structures far from the road axis and/or within areas at risk of flooding[17]. The decommissioning of these areas, therefore, becomes fertile ground for defining a new energy production structure, to return a project of formal coherence. Starting from this basis, the second action focuses on the new morphology of the energy landscape, concentrating on the road infrastructure as both a permanence to be improved and a structure to be exploited as an ordering principle for the project. In this sense, the proposal leverages the road as a fault line to identify and analyze the consistency of the two opposite sides: towards the river, the current landscape dotted with photovoltaic fields of different

13 Bernardo Secchi, *Progetto di suolo*, in "Casabella", n. 50 (520-521), 1986, pp. 19-23.

14 The high-voltage line runs perpendicular to the connection infrastructure, allowing the new energy system to be connected to the rest of the territory.

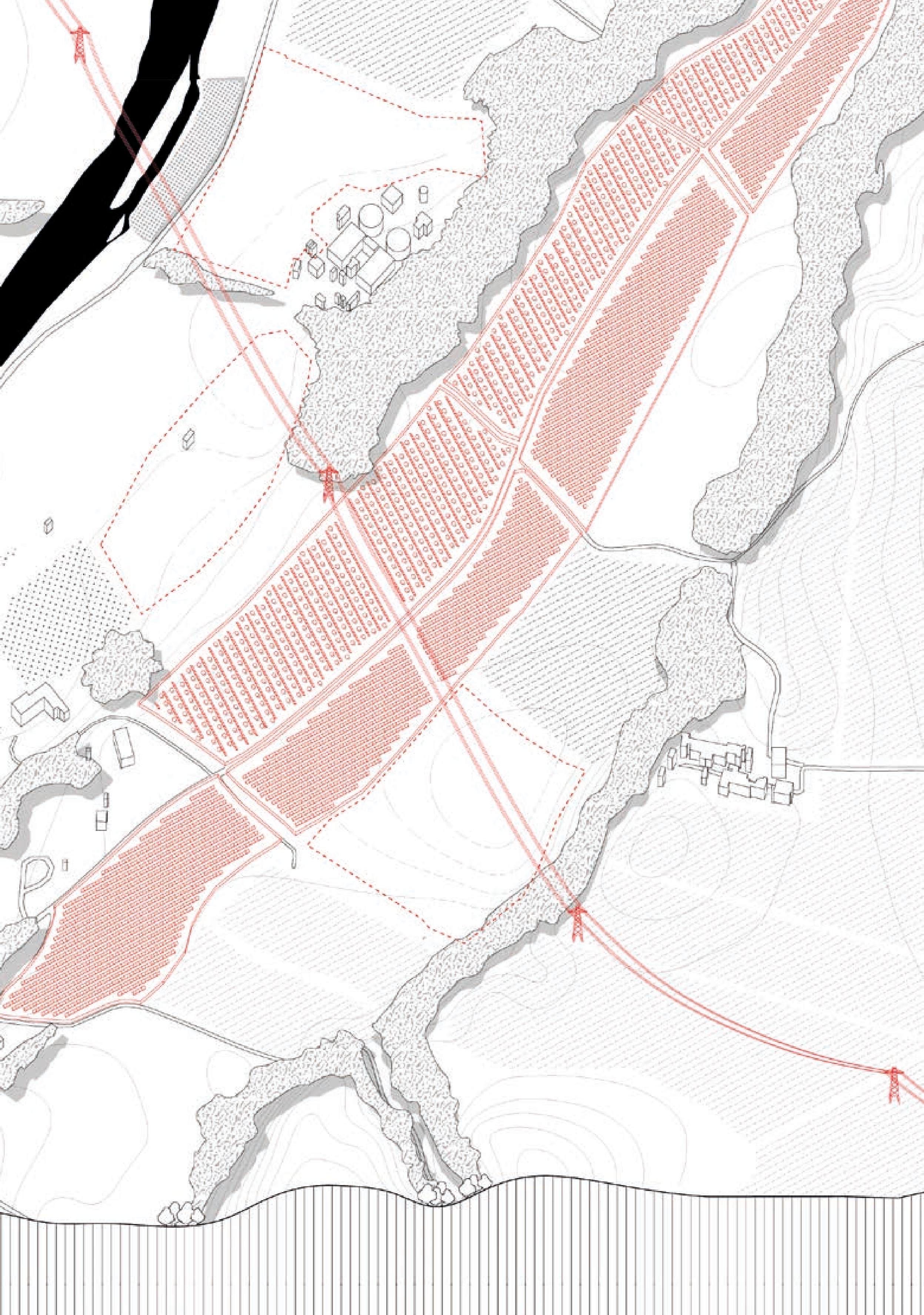
15 The road infrastructure that crosses the Stura River at one point and then leaves it to continue parallel to it – via Salmour – provides space for the new energy project, also thanks to a relatively slight change in elevation.

16 Robert Venturi, *Complessità e contraddizioni nell'architettura*, Bari, Dedalo, 1980, pp. 17-22, 105, 124.

17 This action, therefore, allows for the protection of the river and the existing forest and offers opportunities for their enhancement.

The possibilities offered by different planning strategies for the new energy system suggest a more effective solution to boosting road infrastructure. The edges of this part of the city do not allow for a practical photovoltaic project due to the architectural sprawl and typology, as well as the orography itself. The close connection with the river and the presence of the forest require natural enhancement rather than further energy densification, limiting the reuse of already impermeable space.

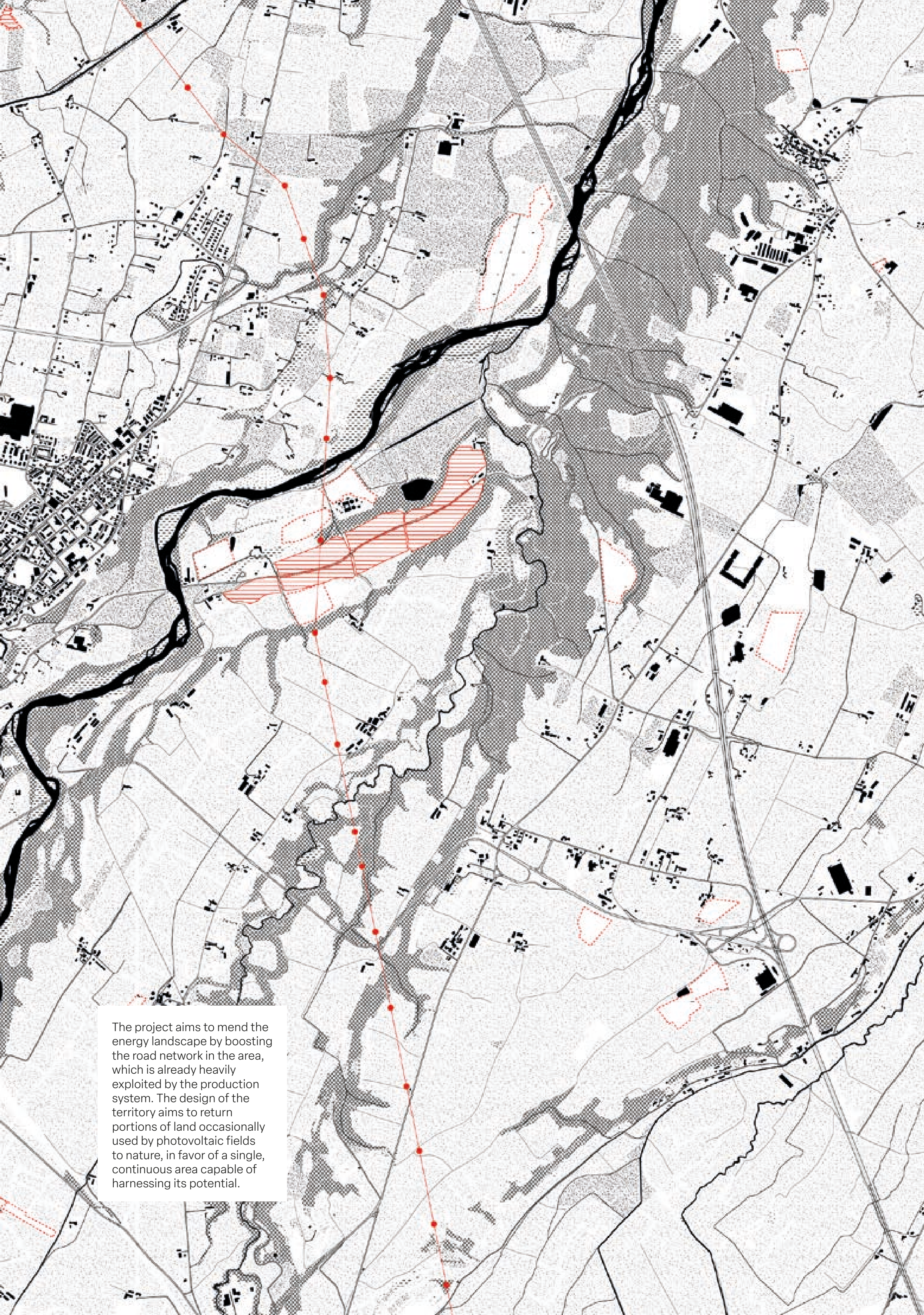
The new energy landscape plan aims to work in harmony with both natural and anthropic elements. The liberation of former photovoltaic fields at the end of their life cycle allows for the redevelopment of the ecological structure of this landscape. In contrast, distinct types of energy fields give new form and power to the road infrastructure that runs parallel to the river.



types and sizes stands between the forest and the river buffer zones; on the opposite side, the single energy and settlement presence is the basis on which to operate the reconnection. To leverage the two sides of the road structure, the project explores the possibilities offered by agrivoltaics on the first side and favors the concentration of static photovoltaic fields on the opposite side. The choice of two different solutions acts as a tool to ensure a more porous configuration and better ecological continuity with the natural environment towards the river, thanks to the alternation of energy and nature, and to concentrate the distribution of static photovoltaic fields on the opposite side, in relation to the morphological configuration and production needs.

In this perspective, the context of Fossano becomes a laboratory for a radical approach to energy design. The aim of the project is to avoid pursuing the logic of juxtaposing new energy layers with existing ones, thus preventing episodic action within this context. Through these objectives, the project proposes a new landscape in which energy, nature, and the city are coherently intertwined, allowing them to coexist within the territory. The necessary liberation of the riverbanks and their immediate surroundings, and the avoidance of further alteration of the already jagged edges of the city or the very orography that characterizes the place, are thus transformed from constraints into design opportunities for defining the new energy structure.

Finally, the project's scope is broadened beyond the immediate vicinity of the areas specifically analyzed, in order to go beyond a purely technical response to production needs and deliver a coherent program. The project thus becomes an architectural exercise in territorial mending, through the enhancement of infrastructure and the liberation of natural areas, capable of incorporating energy into the complexities of the landscape.



The project aims to mend the energy landscape by boosting the road network in the area, which is already heavily exploited by the production system. The design of the territory aims to return portions of land occasionally used by photovoltaic fields to nature, in favor of a single, continuous area capable of harnessing its potential.

Renaturation as radical design

GIULIA
CAZZANIGA

The objective of the intervention is to convert a necessary infrastructural dismantling – the decommissioning of the Single-Axis Tracking (SAT) photovoltaic power plant located within the Stura di Demonte river floodplain – into a proactive, design-oriented, ecological, and educational asset. The end-of-life stage of a photovoltaic plant is viewed as an autonomous and independent design phase itself, not merely as a endpoint, but as a process that guides and follows a strategic and architectural plan. It focuses on spatial relationships to develop a riverine landscape natural park capable of evolving over time. Dismantling encompasses technical procedures such as extracting cables and infrastructure, recycling panels, de-compacting soil, and removing paved surfaces. Conventionally, projects stop at these steps; however, we propose advancing this phase by conceptualizing it not as reverse construction[1], as our current regulation requires, but as an opportunity for innovative layout and design.

Shifting from restoration to rewildening

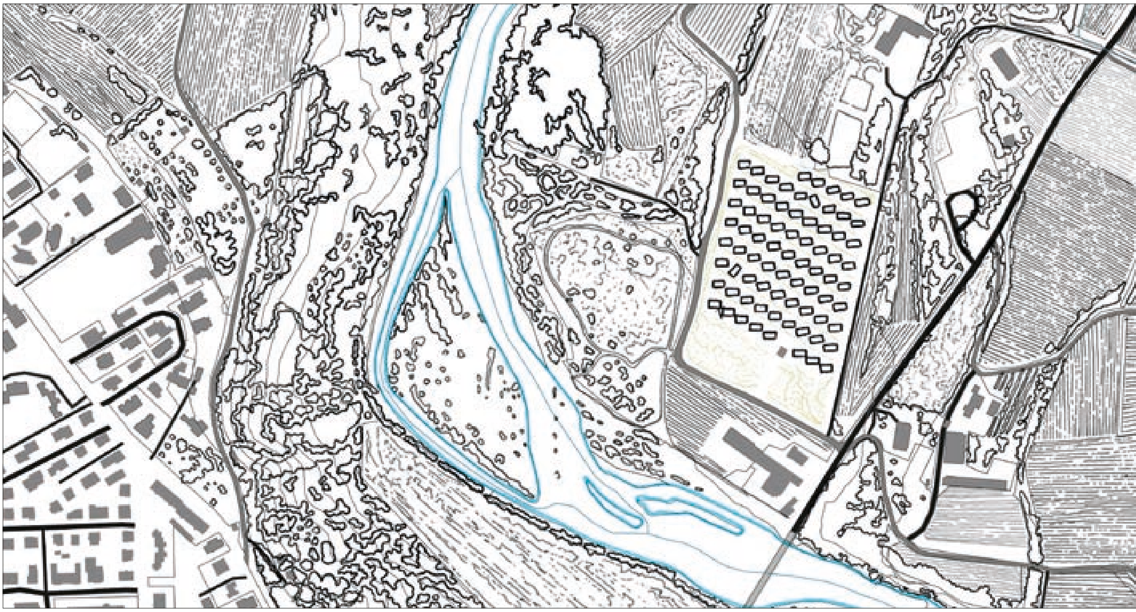
The project aligns with the morphological reorganization proposed by the Politecnico di Torino research unit and must consider decommissioning selected photovoltaic fields at the end of their lifecycle and operational efficiency, within a framework of reshaping the productive landscape. Based on our research and analysis, our role was to interpret in the most sensitive way the tendencies of this landscape, proposing the most adherent and forward-looking scenario of change possible.
For the Fossano case study, the strategic vision is to fully decommission the SAT photovoltaic power plant, ending its productive use and creating large-scale ecological change.
This approach is based on a contemporary understanding of river landscapes[2], which sees rivers not as fixed channels but as dynamic, interconnected systems that include the active channel, floodplains, and riparian corridors. Critically, we oppose the notion of ecological restoration, the attempt to revert a site to a specific,

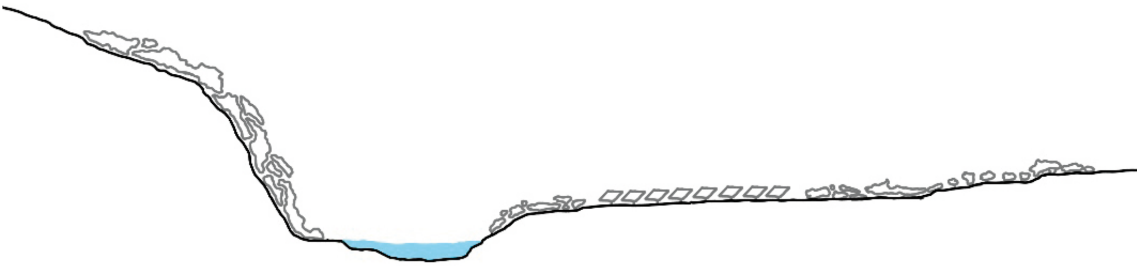
1 D.Lgs n. 199/2021, and Direttiva RED II UE 2018/200; D.Lgs. n. 190/2024.

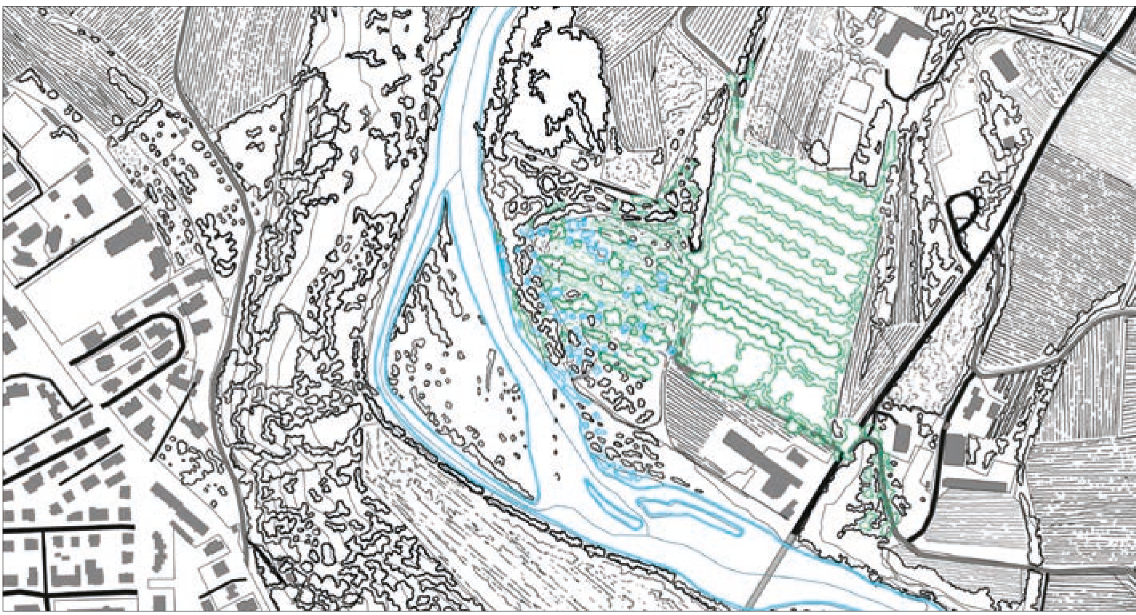
2 Many studies are focusing on fluvial landscape, in particular I refer to Anuradha, Mathur, Dilip da Cunha, *Mississippi Floods: Designing a Shifting Landscape*, New Haven, Yale University Press, 2001.

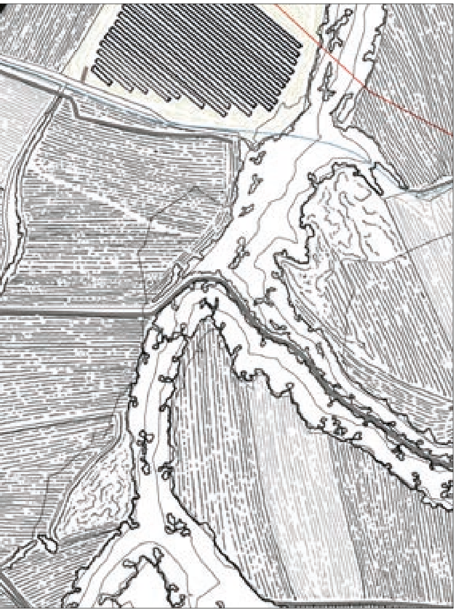
idealized historical state, as both philosophically flawed and practically unfeasible.
As James Corner argues in *Terra Fluxus*[3], – which advocates for landscape as a dynamic process rather than a fixed form – the very concept of restoring a past condition is impossible; it imposes an arbitrary choice of a point in time to which the landscape must return, be it agricultural, post-reclamation, or primeval wilderness, and fundamentally ignores the irreversible, continuous co-evolution of land, atmosphere, and life. Therefore, renaturation advances beyond restoration towards rewilding, encouraging self-sustaining, evolutionary ecological processes.
The landscape architecture project aims to intentionally accept the area's inherent hydrogeological instability – a trait often seen as a liability – and strategically redirect it to support natural succession. This fundamental decision to shift the site's role from power generation to ecological process management through a design intervention is supported by a comprehensive assessment. Our research indicates that reasons for fully decommissioning and renaturing the site fall into two main categories: addressing issues like pollution vulnerabilities and site-specific risks, and seizing opportunities to enhance the site's history and redefine the narrative of the productive landscape. The site currently hosting SAT photovoltaic power plant poses two primary concerns linked to its presence within the riverbed area. First, the location subject's valuable energy infrastructure to high hydrogeological risk, making its eventual flood-related damage inevitable and economically unsustainable. Relocating solar production to a safer area directly addresses this vulnerability. Second, and more critically, the presence of photovoltaic infrastructure within the flood zone constitutes an ecological hazard. During flood events, the plant's embedded structures, including cables and foundations, risk contamination, leaching toxic substances into the soil and aquifer. Therefore, the complete removal of all technical components is not merely a step in the procedure, but a necessary preemptive measure to secure the environment and prevent long-term contamination of the regional aquifer. Furthermore, the site's environmental constraints make any form of intensive productive land use – be it photovoltaic energy generation, traditional agriculture, or large-scale farming – fundamentally ill-suited for the riverbed area. This is exemplified by existing practices, where current farming activities require strict regulation to manage sewage, a known contributor to regional aquifer pollution.
Given the land's critical hydrogeological function, the conversion to renaturation is the only strategic choice that removes the cumulative pressure of all inappropriate productive activities, prioritizing ecological resilience and environmental safety over short-term economic output.
In contrast to these liabilities, the site presents exceptional characteristics that offer significant design opportunities. First, decommissioning enables the ecological reconnection of the area with the adjacent Gesso and Stura River Park, reinforcing the

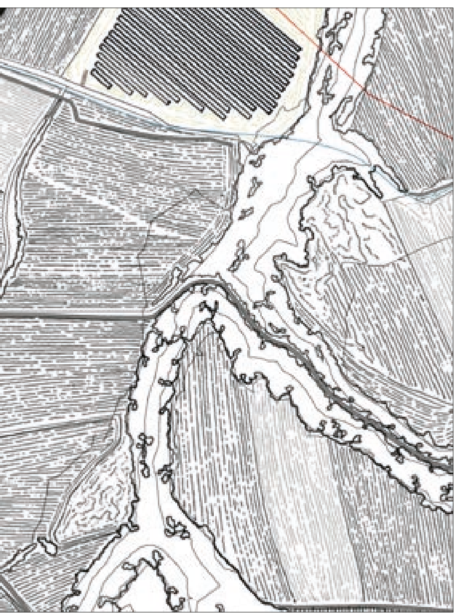
3 James Corner, *Terra Fluxus*, in Charles Waldheim, *The Landscape Urbanism Reader*, New York, Princeton Architectural Press, 2006, pp. 21-33.











Above. Drawing representing the actual condition of the site, before the dismantelling.

Below. Representation of the Project of rewildening to create the Riverine landscape park, illustrated at the territorial scale.

Hand drawings by Simone Baccaglini, 2025.

functional connectivity of the European Natura 2000 Network. Within this expanded ecological matrix lies the Foresta Fossile[4] (Fossil Forest), a unique palaeobotanical feature in northern Italy. Renaturation allows the park to expand, significantly enhancing its potential to host new educational and open-air museum experiences along the river.
The second deeper opportunity lies in the symbolic meaning conveyed by the site's morphology, which can be enhanced through a design choice that selects a clear narrative rooted in the area's evocative qualities. The strategic vantage point along the riverbank provides a privileged visual connection to the complex layers of human intervention that have shaped the landscape.
The design of the new natural environment will highlight, rather than hide, these historical and engineering landmarks: the visible erosion phenomena, the urban dwelling of Fossano, the imposing modern architecture of the A6 bridge, a symbol of major anthropogenic alteration and connectivity, and the historical railway bridge, a monument of engineering merit.
By designing a new, structured natural environment – accessible only in designated areas – the landscape architecture project will transform the space into an active narrative, using these visual references to tell the comprehensive story of the productive landscape, its centuries of reclamation, and its continuous transformation.

Shifting from Procedure to Design
As previously stated, the dismantling phase of a photovoltaic power plant generally follows a systematic procedure involving technical steps to deconstruct the photovoltaic infrastructure and associated services. The decommissioning process is governed by specific legal and regulatory requirements, particularly concerning waste management and site restoration, and may commence after the completion of initial legal examinations and approvals. Furthermore, the decommissioning of the photovoltaic power plant must strictly comply with both national and European waste directives, principally the Waste Electrical and Electronic Equipment (WEEE) regulations.
The subsequent technical phase moves through three clear stages. First, the plant must be fully isolated electrically before all WEEE components – panels, inverters, and transformers – are systematically removed. Second, the mechanical infrastructure, including metallic support structures, is dismantled. Crucially, the final step involves the extraction of all foundations and buried electrical cables. This underground removal is essential for two reasons: mitigating the pollution risk from residual contaminants and preparing the site for new use. Following these extractions, the final mandatory technical action is soil decompaction to restore the ground's permeability and healthy state, especially where heavy machinery has caused disturbance[5].
In our vision, the mandatory removal and soil decompaction are transformed into the core design innovation, as we leverage

4 It is a type of archeo-botanical site where the remains of an ancient forest have been preserved in situ (in their original place of growth) through the process of fossilization.

5 D.Lgs. 387/2003 for renewables) explicitly includes the decommissioning obligations, timelines, and acceptable level of site restoration.

operational tools to sculpt new microtopography and deliberately shape the natural park's layout. These excavations reveal the hidden network of buried infrastructure that keeps the system active and connected within the site and to the wider network. From a design perspective, this can be seen as a purposeful grid made by these carvings, which creates precise spatial opportunities to shape and manage the future landscape.
Applying the renaturation to the fluvial landscape, the first consideration in this type of territory is to reflect on the role of water bodies, projecting them into future development and updating management to align with our current awareness of climate change. Instead of performing conventional "backfilling" to restore a uniform, flat grade, the decommissioning process becomes an active geomorphological intervention. The precise pathways of removed cable trenches will be intentionally widened and contoured to create localized micro-depressions and topographical variations. These features serve three strategic ecological and hydraulic functions: they act as temporary lamination tanks during high-water events, promote differential soil moisture and light exposure across the floodplain, and accelerate varied plant successions, thereby effectively controlling and leading the rewilding process. In this way, the operational necessity of hazard removal is precisely translated into a design opportunity, influencing the site's future morphology and hydrological performance. This vision fundamentally challenges the legacy of the historical drainage practices carried out over centuries to improve productivity. We aim to move beyond the philosophy of contemporary reclamation, which artificially limits water flow within systems created solely for exploitation. Instead, our goal is to develop an adaptive hydrological network that allows water to flow freely, serving as an effective flood mitigation measure. In fact, «rivers are not just made of water»[6], but of the water, the floodplain, the groundwater, and the flow of time[7]. This strategy is directly inspired by contemporary precedents, such as the Renaturation of the River Aire in Geneva (Atelier Descombes Rampini, 2002 - ongoing), a project that demonstrated how the controlled widening of the riverbed and the creation of designed wetlands allow the river to design itself[8]. This approach embodies two core principles: interrupting cycles of resource extraction and framing the fluvial elements as dynamic features that actively support the complex coexistence of various living organisms.
In line with this vision, the removal of paved surfaces, such as asphalt streets and de-paving connections, and the use of techniques to prevent earth compaction, become strategies that influence how people perceive and experience the pathway, beyond just restoring ecology, aiming for the maximum porosity across the site by cracking the surface. These measures open opportunities to create diverse spatial conditions by reinterpreting the old infrastructure in a new spatial system: the presence of the original grid is not erased permanently but, leaving the material in place, a trace of the past is incorporated into a slow metabolic

6 Elisa Cozzarini, *Gli intrecci del fiume, Piccole trame in equilibrio variabile*, Udine, Forum Editrice, 2023.

7 JV Ward, *The four-dimensional nature of lotic ecosystems*, in "Journal of the North American Benthological Society", 1989, n. 8 (1), pp. 2-8.

8 Georges Descombes, Julien Descombes, *Aire: The River and Its Double / La riviere et son double / Der Fluss und sein Doppelganger*, Zurich, Park Books, 2018.

process where natural elements, atmospheric events, and design choices concur to create a specific layout condition over time. This temporal strategy impacts both ecological recovery and storytelling: plant recolonization rates will vary depending on the size and gradient of the asphalt removal and, at the same time, the granulometry of the fractures can enable the development of different surfaces within the park suitable for walking, cycling, or exploring. This design intentionality, which prioritizes the evolution of the pathway over its fixed form, is exemplified by Wagon Landscaping practice. Their work treats depaving not just as a procedural method, but as a critical tool for defining architectural space, intentionally incorporating the ludic and experiential dimensions that are essential to the life of successful public landscapes[9].

Simultaneously, this approach extend to the plantation: in fact, rewilding doesn't mean inaction rather it requires design choices that establish a flexible, geometric framework guiding the process over time. This framework should be open-ended to accommodate natural developments and successions – a foundational structure that can evolve. This methodology is central to Michel Desvigne's philosophy of *Intermediate Natures*[10], wherein the designer acts not as a static creator but as a director of existing systems. As Desvigne states, the pleasure of this practice consists of combining, domesticating, and directing living systems, necessitating rigor and patience. The initial stage, therefore, involves rigorous mapping of the already-present vegetation on the site, using these spontaneous ecologies as the primary structural elements to be reinforced by new, context-appropriate planting. This principle directly relates to designing with existing vegetation and managing its evolution over time, as seen in the Bordeaux Rive Droite project[11], where the goal is not to create a permanent fixed form but to establish a pattern or impression that leaves a lasting trace in future natural developments.

Shifting from Design upon to Design within Landscape

This research presents a project hypothesis, a "vision" intended to trigger radical thinking about landscape transformation. Renaturation is not a passive withdrawal but a deliberate project and design choice that demands deep, interdisciplinary collaboration among ecologists, hydraulic engineers, and landscape architects. The success of this vision relies on establishing a shared framework that simultaneously resolves complex technical and hydraulic issues while imbuing the site with a renewed, proper landscape meaning. The proposed initiative is thus driven by the principle that ecological restoration must be actively guided by design, drawing foundational inspiration from Ian McHarg's environmental approach, *Design with Nature*[12]. This demands viewing the project as a dynamic process that operates across three interconnected conceptual pillars. First, the intervention requires Multi-Scale Design, working at the Territorial Level to position the renatured area as a vital link

9 Wagon Landscaping's depaving projects exemplify a philosophy of minimal transformation, in-situ recycling, and embracing living dynamics. See the landscape projects by Wagon Landscaping, *Jardin des Joyeux* and *Asphalt Jungle* in Paris. https://www.wagon-landscaping.fr/tous-les-projets [last access October 2025].

10 Michel Desvigne, Alexandra Gille, *Intermediate Natures: The Landscapes of Michel Desvigne*, Berlin, Birkhäuser Architecture, 2011.

11 Parc aux Angéliques, Right Bank (Rive Droite) of the Garonne River, Bordeaux, France. Extends from the Pont Saint-Jean to the Pont Jacques Chaban-Delmas, Michel Desvigne Paysagiste (MDP) 2012-2018.

12 Ian L. McHarg, *Design with Nature. Garden City*, New York, The Natural History Press, 1969.

13 Andrè Corboz, *The Land as Palimpsest*, in "Diogenes", n. 31(121), 1983, pp. 12-34.

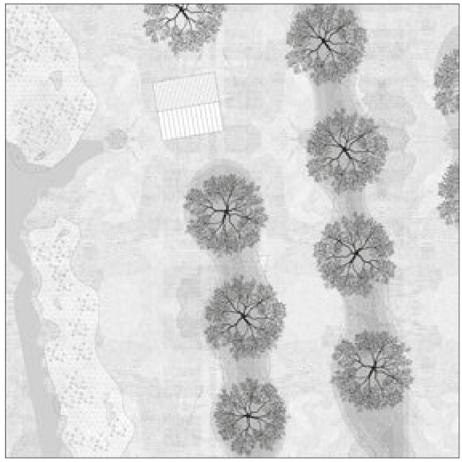
Schemes to illustrate the boundaries, technical structures, and biodiversity in their evolution, adaptation, and changes on site.

Diagrams by Marco Agosti, 2025.

1. Boundaries. The renaturation process blurs the boundaries between river beds and PV power plant surfaces. The margin becomes a threshold where a future of coexistence among various environments and species is possible.

2. Structures. The removal of infrastructures, cables, and foundations to create a new micro-topografy allows for a colonization of pioneer vegetation and the programmed plantation of new trees. The biodiversity will be enhanced by benefiting from varied soil composition, water availability, and sunlight exposure.

3. Biodiversity. The increase in biodiversity is also achieved through depaving. Over time, soil porosity will improve as asphalt is gradually removed and pioneer, as well as planted, species colonize the area.



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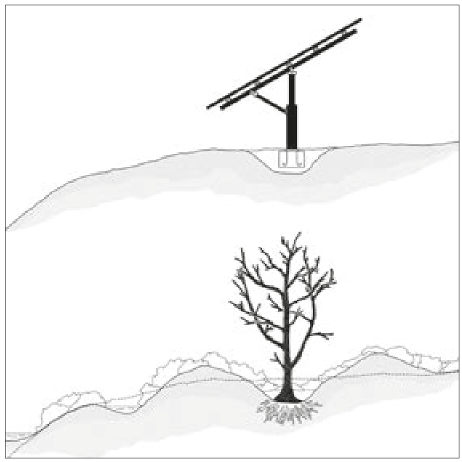

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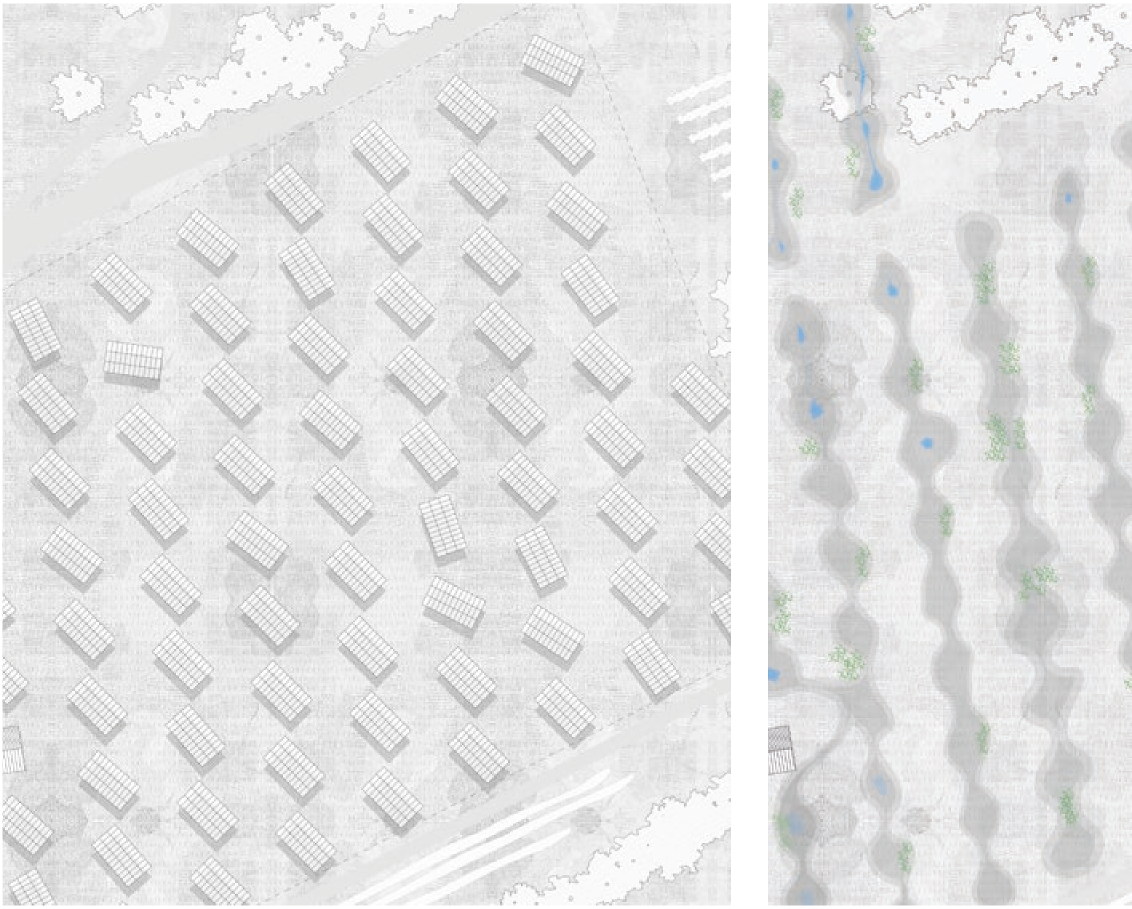
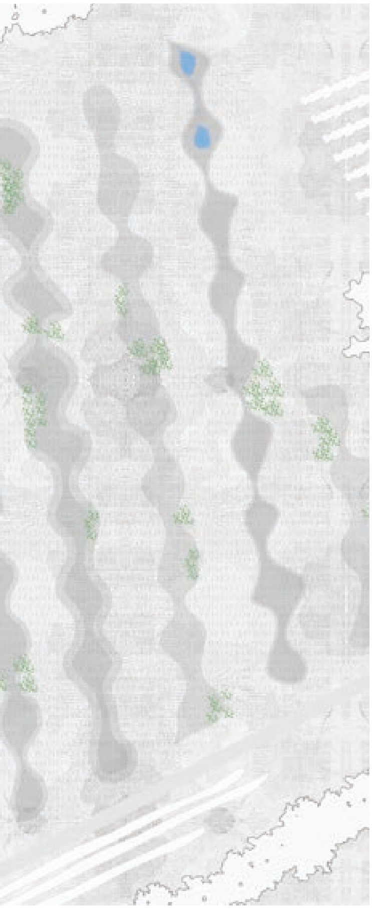


Drawings illustrating riverbed evolution through erosion and sedimentation on a design layout that will be erased.

Hand drawings by Simone Baccaglini, 2025.

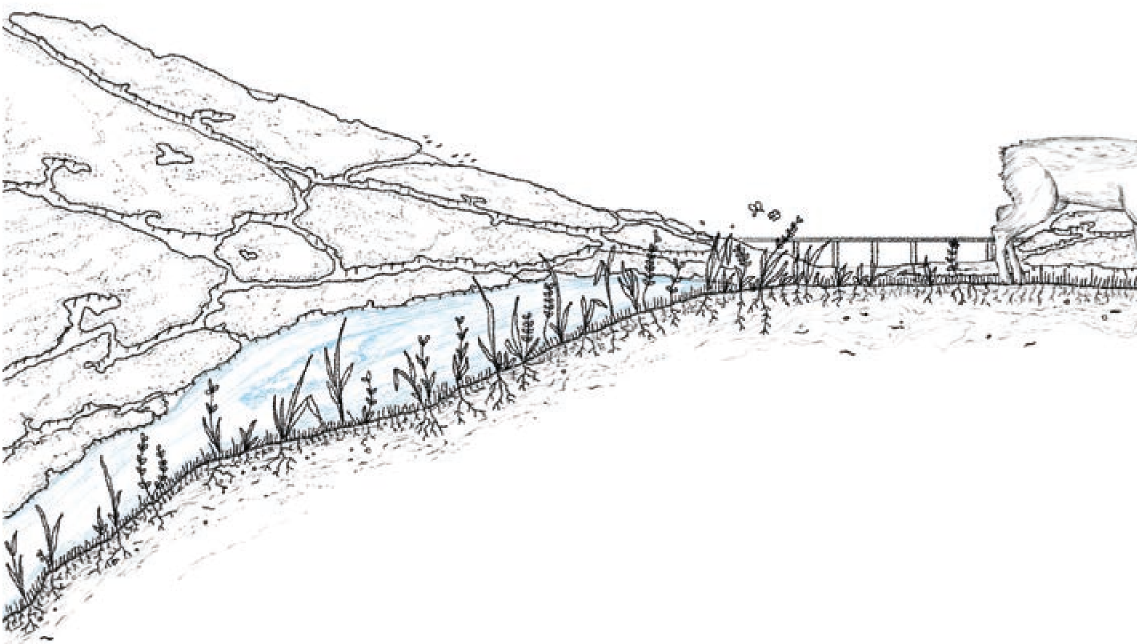
within larger ecological corridors that enhance regional green infrastructure and biodiversity flow, and at the Local Level to facilitate ecological succession through the strategic use of pioneer species and geomorphological modifications. Second, the design adopts Corboz's theory of the Palimpsest[13]: the renaturation does not require erasing all traces of the photovoltaic field, but rather integrates them. The necessary civil engineering works – specifically the carving and trenching required to remove cables and foundations – become intentional linear disruptions designed as micro-depressions for water retention and topographical variations that promote diverse plant successions. Third, the project requires Intentional Design to specify the precise parameters for rewilding, including the management of early vegetation growth and the design of interfaces for public access and the Foresta Fossile's educational pathways. This

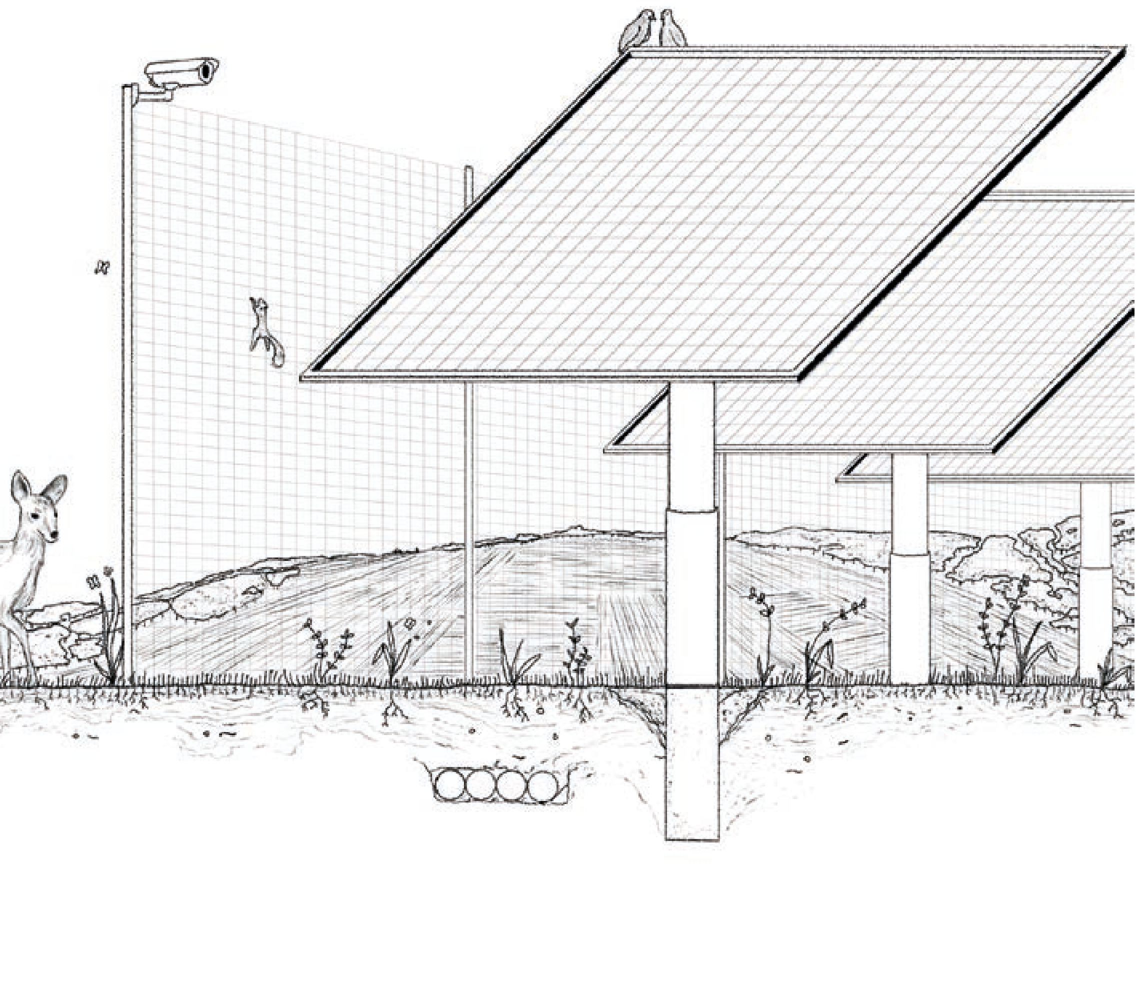


coherent strategy ensures the landscape is ecologically robust, structurally sound for mitigating hydrogeological risk, while narratively engaging for the new museum experience. Ultimately, by transforming the operational necessity of decommissioning into a deliberate, multi-scalar, and micro-topographic design act, this project proposes a definitive break from the extractive use-consume-restore logic. Renaturation, in this radical sense, is an active commitment to the landscape's dynamic processes, embracing the uncertainty of its future evolution and establishing a new paradigm of care, coexistence, and perpetual transformation.

Section on Fossano former SAT PV Power Plant, before its decommissioning.

Hand drawing by Simone Baccaglini, 2025.





Section on Fossano after the decommissioning envisioning the Riverine Landscape Natural Park.

Hand drawing by Simone Baccaglini, 2025.

SOLARSCAPES

AN ECOLOGICAL PERSPECTIVE

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I N S I G H T

In Italy, ground-mounted photovoltaic systems currently cover 16,434 hectares, with a nominal installed capacity of 9,436 MW (GSE, 2025). Compared to the main agricultural land uses, photovoltaic systems occupy 0.5% of arable land and 0.14% of total agricultural land. A report by the European Commission's Joint Research Centre (JRC, 2023) found that combining farming and solar energy, known as agrivoltaics, could surpass the EU's 2030 solar power goals. By dedicating just 1% of the EU's utilized agricultural land to agrivoltaics, it would be possible to generate enough electricity to meet or exceed the 2030 target of 720 GW. Based on these percentages, the overall impact of photovoltaic fields on the landscape and agricultural production appears marginal. However, a closer analysis, considering the examples discussed in previous chapters, reveals that the distribution of these systems is highly uneven, being concentrated in specific areas, which results in a relevant ecological and landscape impact.
Ground-mounted systems have been, and continue to be, installed only under the following conditions:

- A substantial medium-term economic advantage of electricity generation from ground-mounted photovoltaic systems compared to the main local agricultural production.
- Full mechanization capability for both installation and routine or extraordinary maintenance of the system.
- Easy access for vehicles and personnel for inspection and maintenance.
- Proximity and convenient connection to the electricity grid.
- The need to diversify farm income sources.
- Presence of an active business with sufficient capital available for both agricultural and non-agricultural investments.

For these reasons, photovoltaic systems have primarily been established in areas characterized by viable and intensive agriculture. Marginal hilly and mountainous areas have been minimally affected, and forested areas or lands with spontaneous herbaceous or shrubby vegetation have remained largely untouched.

In other words, there is a clear competition between conventional intensive agriculture for food production and land use for renewable energy production. A survey of 96 photovoltaic fields in the Po Valley showed that 21% were located on land classified as first-class of land-use capacity, 37% in the second class, 33% in the third, and only 8% on land with severe limitations for potential agricultural use. Supporting this, an examination of the cases observed shows that most installations are situated in predominantly intensive or very intensive agricultural areas.
Considering existing agricultural systems, installations are most likely to be found in cereal-livestock farms in Piedmont and Veneto, and in fruit-growing areas in Puglia, particularly in regions with older, extensive olive groves. This indicates that photovoltaic systems have not, and still do not, serve as an opportunity to revitalize land use in areas where alternatives to agroforestry are most needed to support local economies. Rather, photovoltaic systems have primarily supported farmers' incomes in regions where agriculture is already strong and productive.
Medium-term profitability and the requirement for significant initial investment have also attracted financial participation from private enterprise outside the traditional agricultural sector, seeking diversified and "green" investments. Leveraging these investments with the resulting bioenergy production has enabled access to green certificates and the carbon credit market, further increasing interest in photovoltaics among non-agricultural stakeholders.
Although ground-mounted photovoltaic systems have a greater impact on agricultural land compared to rooftop, industrial, or infrastructure-adjacent installations, their lower installation and maintenance costs, combined with larger system size, have boost their deployment, despite less favourable electricity supply contracts. In other words, the cost per unit of energy from ground-mounted systems was often lower than that of systems installed in more complex settings, due to reduced installation and maintenance costs.
Another factor influencing the location of ground-mounted photovoltaic arrays is their frequent association

with biogas and biomethane plants. This is linked to the availability of smaller plots no longer usable for agricultural purposes on farms where large-scale production must optimize digester feed, as well as to farmers' interest in generating income from bioenergy as an alternative or complement to traditional agricultural sources.
This has led to the creation of "districts" where agricultural production and land use are largely devoted to bioenergy, photovoltaics, and biogas or biomethane, accounting for up to 25–30% of the land once dedicated to food and feed crops. These areas are expanding, as the profitability of traditional crops declines while that of bioenergy production rises. Consequently, bioenergy is increasingly seen as a key solution for supporting farmers' declining incomes. Concern over the growing competition between ground-mounted photovoltaic systems and agricultural production has pushed the national legislator to promote agrovoltaic as an intermediate form.
This perspective underlies initiatives promoting agrovoltaics—the coexistence of traditional agricultural production with energy generation on the same land—and the development of "integrated food–energy systems" (FAO, 2010), aimed at fostering dual-purpose agricultural and energy production. However, competing demands – ranging from feed, fibre and the production of biofuels to the expansion of urban areas – require that agriculture be efficient and productive to support the integration of energy production in a food conventional system (FAO 2025). Complex energy systems, dual use of land, and energy storage might be the most important challenges for future research (Pestisha et al., 2023).

Technical Characteristics and Land Use Aspects
Various system characteristics influence local environmental and ecological conditions. Briefly, they can be summarized as follows:

- Height and dimensions of the structure supporting the solar panels. These depend on the spot-welding system used. The biaxial tracker plant, which allows the panels to vary the angle of the vertical axis, i.e., the orientation and tilt of the horizontal axis, requires a columnar structure that raises the panels from a height off the ground, typically between 2.5 and 8 m. Single-axis tracker plant, which rotate only on the horizontal axis, changing their inclination, like fixed panel plants, have a reduced height from the ground, with panels ranging from 0.5 to 4 m supported by a much lighter structure.

- Foundations. Dual tracker require much greater ground anchoring due to the weight they must support, resulting from the structure supporting groups of 50/60 panels, the panels themselves, the electric motor, and the spot-welding plant transmission. Therefore, dual plants require concrete plinths to be buried up to 4 meters deep. Conversely, Single-axis tracker and fixed plants require a lightweight frame supported by numerous legs driven directly into the ground without any other stability aids; typically, modules with two legs for every eight panels.
- Degree of ground coverage. This also depends largely on the tracker plant. Without considering service corridors, in dual plants the degree of coverage of the panels with respect to the underlying ground, considering a zenithal assessment, varies from 28 to 35% depending on the inclination. In single-axis and fixed plants, the degree of coverage is greater, ranging from 40 to 60%, with some cases approaching 80%.
- Service corridors. When defining ground coverage, it is necessary to consider not only the self-shading between panels with respect to seasonal variations in the sun's inclination and therefore the casting of shadows, but also the need to place service corridors for vegetation management and ordinary maintenance activities.
- Topsoil management. In all the analyzed plants the land was covered with herbaceous vegetation. In most cases, the vegetation is spontaneous and characterized by a polyphyte presence, while in a few cases it was overseeded (sowing over existing turf) to strengthen the vegetation cover, also in relation to its use as pasture, according to a "sub-panel" grazing method with sheep.

Grass cover is necessary to allow vehicle access even in the event of rainfall, to reduce dust raised by vehicles and wind, and therefore to better clean the panels, thus reducing the need for dust removal. To maintain the grass cover, repeated mowing is performed 4:6 times a year in Northern Italy and 2:3 times in Southern Italy. Originally, many of the dual plants were designed to be intercropped with dedicated agricultural production (winter cereals, forage crops, grain legumes, and open-field vegetables). In no case was this dual use, energy and agriculture, maintained due to constraints on the mechanization of the structures supporting the panels, the risk of collisions with agricultural machinery, and the dust generated by various activities such as soil cultivation, sowing, fertilizing, and harvesting. Since no cultivation is possible other than grazing, in most cases the cut grass is left on the ground, having no economic use. In a limited number of cases, it is grazed by sheep. Sheep farming in this context, however, is seen less as a supplement to the income provided by the plant, and more to reduce maintenance costs for managing the vegetation on the ground. Some plants have attempted to grow horticultural species suited to shading conditions; however, the difficulty of mechanizing and even carrying out ordinary manual tasks has discouraged its continuation. The current availability of fully autonomous cutting robots allows for the automation of the management of the grass under the panels. This solution reduces ordinary management costs and further eliminates the risks associated with laborious manual mechanization; for this reason, too, the need for agricultural management of the under-panel is increasingly diminishing. Recently and increasingly evidently, ground-mounted photovoltaic plants have an almost exclusively bio-energy significance, while their agricultural significance is completely marginal. May be in future the technology related to luminescent solar concentrators and semi-transparent photovoltaics, could boost the growth of agrivoltaic plants (Sollazzo et al., 2025).

Ecological indicators

Impact assessment must require an agro-ecological analysis through ecological indicators that encompasses the soil (underground portion) and the aboveground portion (aboveground portion), considering both from different perspectives. These aspects are necessarily highly variable, depending substantially on the environmental context in which the plant is located. Therefore, the assessment is presented in comparative terms, that is, evaluating the results compared to conventional and prevalent agricultural management of the surrounding area. To express the impact, it is necessary to use indicators that summarize the following aspects:

- Level of soil vegetation cover. This expresses the protective effect exerted by vegetation on the soil. The level of cover can be expressed synthetically as the percentage of soil covered by living vegetation, in this case herbaceous, throughout the year.
- Size of the root system. This expresses the physical stability of the soil and its capacity to support telluric flora and fauna, as well as the effect in maintaining gaseous exchanges between the atmosphere and the soil itself, an indicator of the system's vitality and biodiversity.
- Biomass production. Expresses the capacity to absorb atmospheric carbon and convert it into organic carbon, and therefore the potential formation of soil organic matter (SOC).
- Biodiversity. Expresses the potential richness of microorganisms, fauna, and vegetation. High biodiversity ensures greater coherence with the ecological systems of the environment in which the facility is located.
- Resilience. Expresses the system's ability to tolerate environmental changes, both climatic and medium-term and short-term or seasonal meteorological changes.
- Edge management. Expresses the potential positive or negative interaction between the facility's environment and the surrounding environment, considering the ecotonal and management effects of perimeter fences, including those vegetated.

- Infrastructure management. Expresses the characteristics and management of the facility's service structures (access roads, cables, and electrical cabins).

Table 1 summarizes the indicators used in the analysis conducted on ground-mounted solar plants during 2024-2025.

Ecological item	Indicator	Unit of Measurement	
Vegetation cover	Average annual soil cover		%
	Duration of green cover	no. of months / 12	%
	Average annual Leaf area index	LAI	
Soil	Soil density and permeability	Soil density	t/m^3
	Root biomass	Biomass D.M. 0-30 cm	t/ha
Above-ground biomass	Total annual harvested production	D.M	t/ha
Biodiversity	Vegetation richness	Plant species	n.
Resilience	Residual biomass	Residual biomass after disturb or stress	t/ha
	Steady soil covered with vegetation	Spontaneous species	%
Edges	Presence of vegetation	Vegetated perimeter with hedges or trees	%
	Wildlife barriers	Present	yes/no
Infrastructures	Artificial foundations	Present	yes/no
	Artficial soil cover	Present	yes/no
	Permanent infrastructure	Electrical cabins	m^2/ha

Table 1. Ecological impact indicators

Ecological assessment

The results of the ecological analysis, conducted using the highlighted indicators, allowed to compare ground-mounted photovoltaic systems with the most commonly cultivated agricultural crops in the surrounding area (Table 2). The comparison was made considering different types of plants (fixed structure, single-axis trackers, dual-axis trackers) and crop types (arable crops, orchards, permanent grassland) in relation to the different ecological items identified.

Ecological item	Indicator	Fix structure	Single-axis trackers	Dual-axis trackers	Arable crop[1]	Orchard[2]	Permanent grassland
Vegetation cover	Average annual soil cover	●●	●●	●●	●	●●	●●●
	Duration of green cover	●●●	●●●	●●●	●	●●	●●●
	Average annual leaf area index	●	●	●●	●●	●●	●●●
Soil	Soil density and permeability	●●●	●●●	●●	●	●●	●●●
	Root biomass	●●	●●	●●	●●	●●●	●●●
Above-ground biomass	Total annual harvested production	●	●	●●	●●●	●●	●●
Biodiversity	Vegetation richness	●●	●●	●●	●	●●	●●●
Resilience	Residual biomass after disturbance	●●	●●	●●	●	●●●	●●●
	Long term vegetation composition	●●	●●	●●	●	●●	●●●
Edges and barriers	Presence of vegetation	●	●	●●	●●	●●	●●●
	Wildlife barriers	●	●	●	●●	●●	●●●
Infrastructures	Artificial foundations	●●	●●	●	●●●	●●●	●●●
	Artficial soil cover	●	●	●●	●●●	●●●	●●●
	Permanent infrastructure	●	●	●●	●●●	●●●	●●●

Table 2. Ecological impact indicators of a ground-mounted photovoltaic plant compared with the prevailing adjacent agricultural use.

(1) Maize, Wheat
(2) Apple Orchard

Ecological Impact
- • High
- •• Mid
- ••• Low

The comparison shows that both the soil and vegetation have impacts comparable to those of a field managed as an orchard, often lower than that of arable crops, but still lower than that of permanent grasslands.

The biomass produced, however, is lower than that of crops because the shading effect of the panels on the ground is obviously very high in order to best intercept solar radiation. Conversely, biodiversity and resilience are satisfactory because spontaneous herbaceous vegetation allows for the establishment of a large number of plant species, certainly higher than that of a arable crop. The main limitations of ground-mounted photovoltaic systems concern the barrier effect, as the perimeter of the systems is always surrounded by a fixed, continuous, and significant tall fence. This barrier often does not include hedges, and almost never rows of low-sized trees, even on the north-facing side. Finally, the presence of infrastructure, as expected,

has a significantly greater impact on ground-mounted fields than any kind of crops, resulting in ecological units separated from the context and dominated by artificial structures.
Overall, the main impact of ground-mounted photovoltaic systems is not on the basic ecological components (soil, vegetation, biodiversity, resilience), but rather on the barrier and fragmentation impact on the ecomosaic. For this reason, it is important to carefully evaluate their role in the evolution of rural landscape structure.

Evolution of the Rural Landscape

In a context such as that of European Union countries, the relative value of energy exhibits a higher growth rate than that of common agricultural production. Therefore, the relative advantage of investments in renewable energy sources, including photovoltaics, appears to be progressively greater. Furthermore, technological progress regarding the efficiency of panels has exceeded that of the efficiency of ordinary agricultural production factors (water, fertilizers, pesticides, mechanization). These factors combined define a future scenario where photovoltaic systems may become increasingly widespread and decommissioning concerns an extremely marginal number of cases. The recent advantage of investments in renewable energy could foster even more the evolution of the rural landscape and its transformation in a dual or integrated food–energy systems (Reyneri, 2020).
The rural landscape could therefore become composed of a greater number of patches of photovoltaic systems inserted into a matrix still consisting of crops intended for the feed and food sectors. Therefore, the integration of food and energy crop production systems at the farm to landscape scale has greater potential for ecological intensification, although conflicts with traditional nature conservation targets may arise (Dauber and Miyake, 2016).
One of the most significant landscape impacts is due to large ground-mounted photovoltaic plants; those plants are 5-10 times larger than the average size of the landscape patch of agricultural crops. These large systems, which in both Northern Italy, such as Piedmont,

and Southern Italy, such as Puglia, cover areas of over 40 hectares, while the average crop patches are of 3:5 hectares. For these regions, their impact on microclimate and the hydraulic network will be significant and negative.
Three factors can curb this expansion: regulatory constraints and landscape plans that, at the national, regional, or municipal scale, impose a cap on the area covered; the ability of the electricity grid to absorb the sharp variations in electricity availability generated by systems that supply energy intermittently, depending on weather conditions as well as circadian rhythms; finally, the emergence of temporary storage facilities for excess energy produced by photovoltaic systems for subsequent injection into the grid when it is unable to process it.
While medium or long-term storage is possible thanks to the presence of high-altitude hydroelectric systems, which use the energy to pump water into mountain basins when there is a surplus, short-term storage, in the absence of new technologies, is provided by battery storage. In this regard, starting in 2027, operators of photovoltaic and wind farms with a capacity between 100 and 999 kW may be required to install and activate remote disconnection systems or energy storage devices. This will significantly increase the number of artificial infrastructures (cabins or containers) designed to house the batteries.
Finally, the development of the surface electricity grid for connection to the main grid is also influencing the evolution of the rural landscape (Bogdanski, 2012; Markussen et al., 2015). However, in rural areas where these systems are predominantly widespread, the electricity grid is already widespread, while it is less diffuse in marginal areas where, on the other hand, photovoltaic systems are less widespread.
In conclusion, the rural landscape is undergoing significant transformation, and the growing demand for renewable energy is partly driving the speed with which this evolution is occurring Furthermore, over time, society's energy demand has always exerted a strong influence on the landscape. While until the 19th century, energy demand was primarily met by wood combustion, resulting in a significant reduction in forest cover across the landscape, the subsequent widespread use of

fossil fuels (coal, oil, and natural gas) has significantly reduced the use of forests for energy purposes and their enormous expansion since the mid-20th century. In recent decades, and likely in the coming decades, the rural landscape will once again be characterized by the presence of crops for the production of biofuels, biogas, and biomethane, but especially land for wind and photovoltaic energy. If this trend continues, the process will lead to integrated food-energy systems, where the entire rural production system will be geared toward the dual purpose of producing a combination of food and energy.

On the other hand, the landscape has always been subject to major transformations, reflecting the evolution of the societies that govern it. Di Castri (2002) already observed that in the current historical phase, the entire system is becoming highly dynamic and unpredictable, and that the concepts of balance and sustainability reflect a human aspiration that generates feelings of security rather than an observable reality. This should likely lead to a more in-depth and critical reflection on the meaning of landscape conservation and its ecological perspective under a scenario of development and growth of plants for the production of renewable energy.

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