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# FUTURE RURAL LANDSCAPES
## The necessary co-evolution between agricultural landscape and energy landscape

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ABSTRACT
This article explores the ongoing transformation process affecting the agricultural and energy landscape. The complexity of the landscape (natural and artificial) in which we live, calls for urgent reflection on how to achieve effective integration between vegetation and the built environment. The landscape has always been subject to mutation. Man and the consequences of his actions have often been the trigger for it. Today we are in a necessary transition phase, especially from an energy point of view. The landscape will change again and this time more quickly because of the urgency imposed by the new policies implemented (European Green Deal, NRRP, etc.). The article emphasises the indispensable process of formal co-evolution between architectural or built elements and agrarian vegetation to guide research into the problems of future agricultural territories, which must be guided by a new and conscious relationship between architectural forms and plant form.

KEYWORDS
agrarian mosaic, form, agriculture, energy landscape, rural landscape

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The consequences of climate change on our planet are now visible. Much of the damage caused by the continuing rise in the global average temperature, due to anthropogenic greenhouse gas emissions, is now permanent and the repercussions on the ecosystems of our planet will soon be irreversible. In the IPCC Working Group II report – Climate Change 2022 – Impacts, Adaptation and Vulnerability, it was pointed out that increasing heatwaves and droughts are exceeding the tolerance thresholds of plants and animals, inevitably leading to the mortality of many species. These events are becoming increasingly difficult to manage, and the report makes it clear that if we are to avoid environmental catastrophe, we only have few years left. António Guterres[1], Secretary-General of the United Nations, stated that «Unchecked carbon pollution is forcing the world's most vulnerable on a frog march to destruction – now. The facts are undeniable. This abdication of leadership is criminal. The world's biggest polluters are guilty of arson of our only home. It is essential to meet the goal of limiting global temperature rise to 1.5 degrees» during the press conference launching the IPCC report. We are at the point of no return. Accelerating the phase-out of coal and fossil fuels by implementing a fair and sustainable energy transition, based on the use of renewable energy, is the only direction to go today.

When we speak of energy transition, we inevitably speak of landscape transition, since the use of energy resources certainly does not occur in an 'aspatial' vacuum but directly involves the territorial dimension (Puttilli, 2014). The landscape will be inevitably subject to new development characterised by the replacement of pre-existing formal values with other values responding to the new conditions. The energy landscape – characterised by thermoelectric and nuclear power plants, overhead power lines, gas pipelines, fuel distributors, photovoltaic panels, wind turbines or simply by the diffuse street lightning – profoundly modifies the landscape by acting on the scenic, aesthetic and identity values of the places involved (Fig. 1). The difficult environmental situation is speeding up these processes of transformation. The imminent planning opportunities, offered moreover by the investments (put in place by the NRRP) to accelerate the achievement of the ambitious global[2] and European objectives to 2030 and 2050 (United Nations, 2015; European Commission, 2019), impose the urgency of new reflections. In this phase of change, the agrarian landscape stands out as one of the main protagonists and the role of architecture, as the person responsible for the processes of land transformation, is therefore crucial.

The article initially sets out to reflect on the formal relationship between agrarian mosaic and architectural forms to understand how these two worlds, only apparently distant from each other, are instead formally united by the same compositional rules. It then moves on to analyse the specific relationship between agrarian vegetation and energy landscape elements in light of the upcoming design opportunities for rural areas. Today we can learn from the design experiments conducted in the past which, although not always positively inserted in the process of constructing the agrarian landscape, offer us the opportunity to analyse certain principles. These principles, together

**Fig. 1** | Wind turbines, Tehachapi, California (credit: A. MacLean, 1991).

with other more recent examples, are capable of guiding research into the form problems of future agricultural territories, which must be guided by a conscious relationship between built forms and vegetal forms.

**Nature or artifice?** | The redefinition of the relationship between architecture and agriculture undoubtedly holds a prominent position among the emerging themes within the contemporary architectural and urban planning debate. The questions left unresolved are not few, and for this reason, the subject has been at the centre of two very recent exhibitions held between 2019 and 2020: Architecture and Agriculture – Taking the Country's Side curated by Sébastien Marot (2019) as part of the Lisbon Architecture Triennale, and the highly anticipated and much-discussed Countryside, The Future, curated by AMO and Rem Koolhaas (2020), held at the Guggenheim Museum in New York. This renewed need for the countryside is quite frightening because of the rapidity with which transformations are taking place within the agrarian landscape. A world that had maintained a slow pace with progressive changes becomes part of a frenetic world that necessarily needs new services, roads, and the cutting down of hedges and trees to facilitate agricultural mechanisation (Bonora, 2015).

Agricultural vegetation and buildings are both logical constructions placed on the land by rules dictated by man. This condition leads us to distinguish nature from agriculture and instead, on a formal level, to associate the latter with architecture. Where the hand of man is not present, nature appears irregular and disordered, while where man has left his mark, nature seems to be subject to a regular order or geometric pat-

tern. The agrarian landscape embodies this condition as the parallel furrows of crops, the straight lines of roads and the regular cadence of plantations replace the irregular tracks of uncultivated woods or the winding paths found on stream beds (Pagano, 1938; Fig. 2). As Pagano makes clear, the agricultural landscape is a strongly structured territory both morphologically and functionally; its 'form' is built on dimensions and geometries that are repeated according to a precise principle.

Precisely because of its characteristics – orientation, size, position, the relationship between the parts – the layout of the countryside must be considered analogous to that of architecture. On the other hand, Carlo Cattaneo (1845) recalls that in the German language the art of building and the art of cultivating are referred to under the same word. The settler is a builder (Bauer) and for this reason, the term agriculture (Ackerbau) is closer to construction than cultivation. According to Cattaneo, people must 'build' fields like cities. The distribution of crops, the planting of fruit trees, water courses and the geometry of fields are artificial products of human labour. It supports but, more often, transforms the spontaneous order of nature to the point of determining themselves the form and, even more, the entire scene of the agrarian landscape, just as an architecture does. In agricultural territories, row crops constitute the fundamental texture of these landscapes. They reveal and regulate both the shape and size of agricultural plots. It is not only a problem related to agriculture or production, but is also a problem related to agrarian structure, since the rows are as if they were erecting a permanent architecture (Desplanques, 1959). Countryside and built-up areas are not unrelated or even contradictory to each other but are both parts of a transformation driven by a common denominator.

**Roots and stratifications** | The history of the city and architecture is intimately linked to that of productive territories; it is a co-evolution that occurred during the Neolithic

**Fig. 2** | Agricultural fields and built adapt to the natural course of the Rio Grande River, Los Ebanos County (credit: J. Begley, 2016).

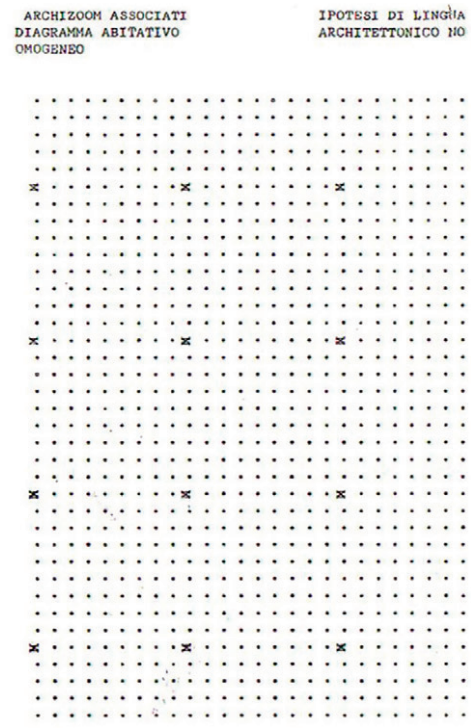




**Fig. 3** | Centuriation still evident in the Padovan territory (source: Google Earth, 2021).

**Fig. 4** | The grid system that still defines most of the American landscape (source: Instagram account @the.jefferson.grid).

**Fig. 5** | Homogeneous living diagram: hypothesis of non-figurative architectural language (credit: Archizoom Associati, 1969).

or First Agricultural Revolution. Sébastien Marot (2019) in Taking the Country's Side – Architecture and Agriculture, a volume that is part of the series of books for the fifth edition of the Lisbon Architecture Triennale, assumes, as many do, that Agriculture and Architecture are twin practices and disciplines; the splitting of which occurred mainly with the rural exodus caused by the Industrial Revolution, only two centuries ago. An extraordinary phenomenon that immediately makes one understand the link between these two worlds is the phenomenon of the Roman centuriation where the composition of the rural and urban terrain is the same. The form, the techniques, the hierarchy between the elements and the orientation coincide to such an extent that between the centuriation of the countryside and the layout of the castrum there is no solution of continuity (Grassi, 1980). This type of organisation of the agrarian territory and then also of the foundation of the new colonial cities, which the Romans introduced at the time of the Republic and then of the Empire to organise the territories of conquest, is the sign of a long period of history that has come down. Today it is still perfectly recognisable in certain parts of Italy (Fig. 3).

The experience of the Romans would later also inspire the visionary Thomas Jefferson, who through the Land Ordinance of 1785, subdivided the American territory into perfectly square or rectangular miles. Both vegetation and buildings were grafted together (United States, 1785; Fig. 4). Similarly, within the avant-garde impulse of the Italian critique of consumerism and capitalism, Archizoom Associati's No-Stop City (1970), to study new forms for the city, will also be governed by a geometric grid that extends infinitely over the territory (Fig. 5). The agrarian landscape is thus complex and ever-evolving and is the result of stratifications on which different writings are progressively accumulated and added to the previous ones (Tosco, 2012).

**The rural landscape project** | To be able to protect the rural landscape and its history and to ensure the coexistence and function between the different stratifications, past and future, the rural landscape project becomes fundamental. Analysing, describing, breaking down and evaluating the various phenomena affecting the agricultural landscape, often in an unclear and contradictory manner, becomes more indispensable than ever today to identify the right tools for a possible rural landscape project. To do this, it becomes necessary to understand the entire system of connections and relations (spatial, historical, functional, formal) of which a project is part, to safeguard the quality of the entire system into which it is then grafted. The agrarian landscape is a field of investigation that has been particularly investigated by geography; Gambi (1973), Turri (2002), Sestini (1963) and Valussi (1968) are just some of the names on the Italian scene that have dealt with the rural territory. The role of this discipline in the study of the forms and characteristics of the landscape is truly remarkable, but geography limits itself to describing and giving definitions of the constituent elements of the landscape because it does not have the tools to then be able to develop a real project. A task that falls instead to the discipline of Architecture.

**Fig. 6** | Lower 'Casone' of Brenta, near Padua (source: Pagano and Daniel, 1936).

**Fig. 7** | Agricultural geometrization (source: Edilizia Moderna, n. 87-88, 1965, p. 58).

Since the beginning of the 20th century, the debate around the morphological problems arising from the phenomena of city dispersion has given rise to a period of strong experimentation based on the possibility of building new parts of cities immersed in the agrarian landscape. Often, however, these activities and proposals for integration have been focused above all on the functional and technical-constructive solutions of individual buildings, to the detriment of open space, especially in rural contexts where the space of connection between buildings, made up of vegetation and other elements – farmyards, open spaces, vegetable gardens, crops, fences, the irrigation system, the energy system – constitutes the structuring part of the rural settlement.

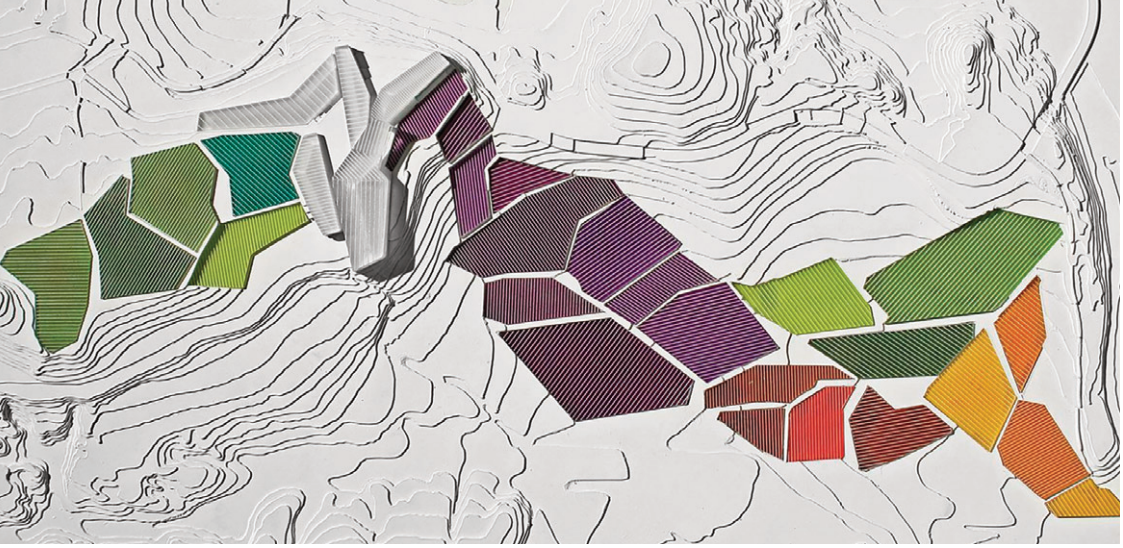
In the 1930s, for example, Giuseppe Pagano highlighted the link between rural architecture and rationalism, but his attention was only focused on individual rural houses, never mentioning the relationship with the surrounding vegetation in his catalogue Architettura Rurale Italiana (Pagano and Daniel, 1938; Fig. 6). Instead, for the historical context of those years, Alberto Sartoris' considerations (1944) are important. In his book entitled Introduction to Modern Architecture, Sartoris dedicates three chapters to the issues of the city-countryside relationship. In the first of these chapters (Organizzare le campagne), like Pagano, he limits himself to talking about the country house, which must be designed and built according to the principles of rational architecture, making use of modern construction means.The focus is always on buildings that reflect the spirit of the contemporary architectural movement. In the chapter 'La città deve andare verso la campagna', the author begins to reflect on the arrangement of sites in which to locate the building, thus beginning to pose the problem of the intimate union between nature and geometry and how vegetation becomes part of the orthogonal volumes of modern architecture. It is also affirmed that urbanism, through a return to the beauty of the earth, is attempting to organise nature in the same way as modern houses are equipped.

Italian architecture's interest in the landscape, especially in landscape design, was renewed from the 1960s onwards, thanks to the theoretical foundations of certain contemporary orientations in the discipline of architecture. Particularly important were the reflections that emerged from some of the articles in number 87-88 of the magazine Edilizia Moderna (1965), entitled 'La Forma del Territorio' (lit. The Shape of the Territory). These reflections were dedicated to a list of problems in the work of architects related to environmental problems on all dimensional scales, «The 'form' is no longer the perceptible aspect of the work, but a structural problem, which has to do with the aspect of relations between the parts of a system. The 'shape' of the territory observed through aerial photographs shows that the interpretative criterion does not vary if the transformations have been carried out by nature or by man: where they establish descriptive formal sets, the presence of the project can be recognized» (Tesoriere, 2020, p. 49; Fig. 7).

Among the articles on the subject, Norberg-Schulz (1966) expounds on the need to analyse the formal properties of both landscape and architecture in detail to be able to work on the landscape without destroying it. This can only be done by using the same concepts when defining forms of landscape and forms of architecture. The 87-88 issue of the magazine Edilizia Moderna (1965) developed a debate that certainly produced some important conceptual tools, but in later years, these theories were reduced and trivialised. In such studies, however, the agrarian mosaic was rarely taken into consideration by architects as a built element on a par with buildings. Some valuable insights were left unfulfilled concerning their potential, such as Wright' Broadacre City (2013) or Giuseppe Samonà's City in Extension (1976).

Even in the contemporary context, looking for projects, in which the building is conceived in perfect communion with the agrarian forms, is by no means easy or obvious. A remarkable example of integration between the two worlds, where the design process of the final work is perfectly legible, is the Royal Wine Centre by Nieto Sobejano Arquitectos (Fig. 8). The project that was not realised but won first prize in the Rioja Wine Museum Competition (Spain, 2005), is a true landscape intervention where the geometry of the building and vineyards is conceived with the same design rules, so becoming a single design (Fig. 9).

The Royal Wine Centre is as much landscape as building. The design evokes geometric laws that were intrinsic to this vineyard-rich landscape. The terraced surfaces of the buildings adapt to the irregularities of the area to naturally define the different elements of the project, which consists of five bodies, forming areas for exhibitions, training, hotel and restaurant services, and parking. The architects imagined how the agricultural characteristics could be the suggestion to start a project in which the proposed spaces are not limited to a specific shape or size – as they are expandable or reducible vineyards – but become the expression of a geometric rule that can eventually change its dimensions or positions to expand or concentrate new areas in the future. The building thus represents the encounter between topographical landscape and archi-



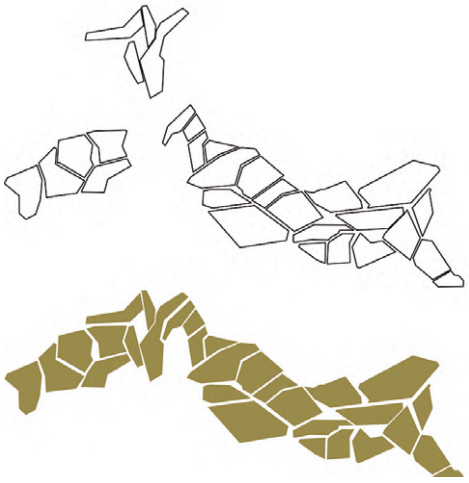


**Fig. 8** | The Rioja Wine Centre project in Logroño, Spain (credit: Nieto Sobejano Arquitectos, 2005-06).

**Fig. 9** | Outline of the Rioja Wine Centre: the same geometric rule governs the shape of the building and vineyards (author's elaboration, 2022).

tecture. Finally, giving architectural form to the countryside is a very difficult task and thinking of it as a part of the settlement is certainly one of the most difficult tasks for an architect today (Gregotti, 2003).

**The new risks** | Until the middle of the last century, global ecosystem balances and the balance between species held. Furthermore, biodiversity managed to ensure that cycles and circularity work properly. The 1950s were the years of great acceleration when man began to raise the levels of aggression against natural systems to intolerable levels. After a long process of cultural contrasts, where the countryside suffered the unstoppable advance of the city, we are now in a phase of change. Compared to the trend that occurred in the 1950s-1960s, characterised by the exodus from the countryside to the cities, a slow reversal is taking place: the rural exodus is beginning to be replaced by the urban exodus. The phenomenon has been greatly accelerated by the recent pandemic, which has contributed to spreading this 'fashion' of a quieter and healthier life accompanied by less frenetic rhythms, leading to a reap-

praisal of the pros of rural life, as opposed to the frenetic and stressful urban life. A realisation that was known even before, but that Covid-19 has crystallised.

The difference concerning the past is that the rural territory, today more rapidly than in the city, is undergoing considerable changes due to both environmental problems and ever faster technological advancement. The dynamics of economic development together with the maximum exploitation of agricultural productivity have come at the expense of the preservation of fundamentally important elements within the rural territory, such as hedges or groves, which contributed to the formation of an agrosystem. The richness provided by these elements not only contributes to shaping the construction and perception of the landscape but also functions as an ecological bridge, creating a balance of biodiversity and contributing significantly to the decrease in the vulnerability of the landscape. The extension of monoculture and the consequent cancellation of the cultivation warps have distorted and trivialised the landscape textures. As a result, the countryside no longer seems to correspond to the idealised icon of a pleasant space, due to the infrastructures that mutilate the ecological networks, made ugly by warehouses, rows of small villas and megastores, flattened by the logic of agroindustry and victim of monoculture and its endless fields (Bonora, 2015). Paola Bonora makes it very clear how often the agrarian landscape is both victim and executioner of its disfigurement.

Putting pressure on rural landscapes and pushing architecture to new urgent reflections, today the new challenges are also proposed by the NextGenerationEU (European Commission, 2020) or the PNRR (Italian Republic, 2021), which aim to achieve 'carbon neutrality' in 30 years. Coal, along with oil, is one of the most widely used fossil fuels and the most polluting and climate-changing, and it is no coincidence that a large part of the $CO_2$ that infests the air is caused precisely by the disproportionate use of coal. When we talk about energy transition, we inevitably also talk about landscape transition. The use of renewable sources is like bringing the energy landscape

**Fig. 10** | Garzweiler surface mine, Germany (credit: A. Mueseler, 2019).

**Fig. 11** | Photovoltaic system in Troia (credit: EOS, 2020).

closer to our culture, also because traditional fossil fuels can often be associated with landscapes that not only do not convince us but also do not belong to us. For a series of reasons, they cannot be realised in our territory, because not only they are dangerous but also need specific infrastructures (in Italy there is only one active coal mine, and it is in Sardinia). So it is in neighbouring Germany, whenever a new coal mine must be opened, villages and hectares of farmland are easily destroyed to make room for the mines (Ulivieri, 2020; Fig. 10). Resorting to renewable energies is therefore urgent and necessary, but how will wind and photovoltaic plants, which are the two technologies that will contribute most to the increase in renewable capacity, be placed in the landscape?

**Landscapes of the near future. Photovoltaic 'fields'?** | The National Recovery and Resilience Plan – with the investments envisaged for the 'Protection and enhancement of architecture and the rural landscape' in Mission 1, and the conspicuous investments made available for the Green Revolution and Ecological Transition envisaged instead in Mission 2 – aims to accelerate the ecological transition in Italy. It moves towards complete climate neutrality, cutting climate-changing emissions, through energy efficiency, the promotion of renewable energies, the circular economy and the protection of natural and agricultural ecosystems and biodiversity. People should be aware that after roofs – covered with photovoltaic panels that often mortify architecture itself – landfills and disused industrial areas, shovels and panels will have to spread to the countryside as well. The report on land consumption 2021 by the Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA, 2021) revealed that 179 hectares of land were 'consumed' in 2020 for the installation of new ground-mounted photovoltaic systems. In particular, the second municipality for land consumption in 2020 is Troia (Foggia, Italy), with 66 hectares of increase. The origin of this land consumption is due to the expansion of the areas destined for the installation of ground-mounted photovoltaic panels, on previously agricultural areas (Fig. 11). It is therefore a landscape problem. The landscape has often been considered an 'empty' space at the disposal of human needs. It is not only an aesthetic problem and due to its complexity, cannot be underestimated and left to the choices of industries, the desperation of farmers in search of subsidies and the inability of administrators (Silvestrini, 2022).

The risk of accelerating these challenges is certainly that of not having an overall vision that holds together the agrarian territories' project, landscape, history, nature, and culture. The 'time' factor is therefore among the first critical issues to be considered. Since these investments, which also translate into new infrastructures to produce those renewable energies that will fall right on the landscape, must be completed by 2026, experimentation is necessary to obtain effective results. Also, necessary research activities are needed, which – as those involved in agriculture know – take years, to try not to fall into a false ecologism – concealed behind slogans such as wind 'parks', solar 'farms', photovoltaic 'fields' – that only leads to the contamination of the landscape.

**Fig. 12** | Gujarat Solar Park, India; Plant near Viterbo, Italy; Gemasolar, Andalusia, Spain; Solar power plant in Ouarzazate, Morocco (author's elaboration, 2022).

**Fig. 13** | Agrivoltaic systems (credit: NETF Milano Srls, 2022).

**Fig. 14** | A rendering of the channel section (credit: Solar Aquagrid LLC, 2021).

Reasoned choices must be made in the identification of suitable areas where wind and photovoltaic plants will be located, as these are elements whose harmonious inclusion in the landscape requires considerable design sensitivity. Also, because renewable energy plants generally have a much lower production capacity per unit area than traditional fossil fuel plants, so their diffusion will affect much larger areas of land and therefore landscape (Magoni, 2013).

The impact of photovoltaic plants on the landscape can easily be seen by looking at the landscape from Google Earth (Fig. 12). Renewable energy plants are certainly an opportunity to be seized, but the risk of a serious loss of biodiversity and speculation of agricultural soils is equally high. What is needed, therefore, is a systemic vision of the landscape that corresponds to the logic of both ecological-landscape balance and sustainable energy exploitation, which can only be dictated by rigorous planning (Barbera, 2022).

It is incumbent on architects to study at this stage the different forms of compatibility between energy installations and the formal structures of the landscape that embrace buildings, geography, saltus and ager at the same time. We cannot risk once again neglecting the landscape value of agrarian landscapes, which does not mean imposing either a conservative or a technicalistic approach (Magoni, 2013), but accepting that the landscape implies transformation. Therefore, it must be designed bearing in mind that all the elements that belong to it – vineyards, olive groves, buildings, wind turbines, photovoltaic panels, watercourses – must be part of a unitary design.

Considering the complexity of a unitary design is fundamental today. If we do not want to fall into the errors of the past since everything that will be 'thrown' onto the landscape without a design logic will contribute to the perception of 'forms' that will characterise that place for a significant time. Transformation is inherent in the very concept of landscape, and therefore also of energy landscapes. Let us think of the windmills that have characterised the landscapes of Europe and other continents for many centuries, and which are an example of an artefact in harmony with nature that can utilise a renewable resource. There are many proposals underway, such as the recent spread of agro-voltaics (Fig. 13).

Are there alternatives? Yes, but largely yet to be defined and the timeframe for experimentation is very short. California, for example, is testing its first solar channels. The Solar AquaGrid research study, commissioned by the Citizen Group and conducted by researchers at the University of California, Merced, and UC Santa Cruz, revealed that numerous advantages can be gained by installing solar panels on open water channels compared to traditional ground-mounted solar systems. In the paper entitled 'Energy and water co-benefits from covering canals with solar panels', published in Nature Sustainability, the American scientists tested that solar panels shield canals from direct sunlight, helping to mitigate evaporation and the growth of aquatic weeds, reducing water loss, generating solar energy, and without occupying arable land (McKuin et alii, 2021; Fig. 14).

**Concluding remarks** | The landscape is changing and will inevitably undergo major formal transformations, in addition to all the possible environmental hazards, e.g., related to soil erosion. What we call 'landscape' is certainly a process of adaptation between the environment and man and results modifiable over time. It is essential to accept that the future landscape will be different from the current one and that new challenges may be solved through a new co-evolution between man and the environment (Scandurra, 2022).

The change taking place certainly cannot be assessed only from an optimistic purely technical-energy point of view. To avoid uncontrolled growth of photovoltaic panel 'fields' or wind 'parks' – which could become part of a new ideal additional chapter to Emilio Sereni's Storia del Paesaggio Agrario Italiano (1961) – and in the hope that what such projects will bring will not further contribute, as has happened in the past, to the gradual disappearance of beautiful Italian landscapes in favour of ungainly and dishevelled forms (Bonora, 2015), designers, planners, agronomists and legislators will have to tackle the problem together, taking into account, on a case-by-case basis, the impact of each intervention. It is necessary to adopt coherent design criteria and a unified project design that considers the positioning of the various components on the landscape and verifies that the new project is carried out with respect for environmental, ecological, and pre-existing values. It is also necessary to decipher the landscape, highlighting how relations with the energy issue have contributed to shaping it over time (Briffaud and Ferraraio, 2015).

The realisation of new interventions is therefore an opportunity to reflect on new opportunities for enhancing agricultural landscapes through the proposal of new elements as an integral part of the landscape in which they are inserted. It becomes fundamental that the new formal proposal affects not only the productivity of an area, but also the aesthetic quality of its landscape and the quality of life of the people living there (Magoni, 2013). Fully understanding the co-evolution of landscape and energy use becomes essential to minimise the impact of the new insertion and to ensure that the energy transition is guided by a unified landscape design. The timeframe is long in agriculture and the spatial response still uncertain.

**Notes**

1) The Secretary-General's video message at the press conference Launch of the IPCC report 28/02/2022 can be found at: media.un.org/en/asset/k1x/k1xcijxjhp [Accessed 20 August 2022].

2) More information on the Sustainable Development Goals (SDGs) can be found at: sdgs.un.org/goals [Accessed 20 August 2022].

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