

## RENEWABLE ENERGY TECHNOLOGIES IN THE ALPINE LANDSCAPE AND LOCAL COMMUNITIES' PERCEPTION OF CHANGE

Bruno ZANON

Department of Civil, Environmental and Mechanical Engineering, University of Trento, Italy  
e-mail: bruno.zanon@unitn.it

### Abstract

The article addresses the issue of social perception of landscape change connected to energy production from renewables, in an Alpine area. The Alpine regions have undergone extensive transformations in the last century, and energy has played a key role in socio-economic phenomena and in landscape change, because of the availability of oil products and the impact of hydroelectric plants. Currently, a variety of renewable energy technologies (RETs) are available, providing new opportunities for mountain areas but producing important effects on the landscape. Their use requires a change in the frames of reference of the actors involved and a new perception of landscape values by local communities. The paper analyses how the insertion of RETs in the landscape of Trentino, in the Italian Alps, is impacting on the social perception. The methodology builds on the results of recent research conducted in the province of Trento on the perception of landscape characters. This allows identification of the values at stake when making use of a new technology in the open space, and analysis of how and why impacts are coherent with local communities' perception of landscape. This analysis makes it possible to frame the crucial issues concerning use of such technologies in the Alpine landscape and to discuss how such a change is perceived, drawing some conclusions of general interest.

Keywords: Energy landscapes; Social perception; Alps, Trentino

### The Alpine landscape in transition

In recent decades, the Alpine regions have undergone extensive transformations reflecting wider socio-economic phenomena, in particular the crisis of traditional agriculture and the consolidation of a post-industrial economy. Energy has played a key role in these phenomena, because it has been the availability of fossil fuel that has wrought a profound change in lifestyles and local economies, supporting mobility, the development of new energy-intensive activities, and the abandonment of the previous large-scale use of firewood. We can recognise, in the evolution of this process, the first three stages identified by Pasqualetti (2013) in the history of humankind: the organic, mineral, and electric economy. The task today is to construct the fourth one: the sustainable economic stage.

In the early 1900s, the Alps became an energy landscape because of the availability of water, which allowed the development of an impressive hydro-electric industry. This was a sudden modernization process, which invested more remote and higher mountain areas with huge dams, tunnels, electric power stations, power lines etc. Hydropower played (and still plays) a key role in energy production. In Italy, until the early 1960s, nearly all electricity was provided by hydropower, while the diffusion of renewable energy technologies (RETs) has encountered difficulties, in particular due to their perception in the landscape.

After the completion of the hydro-electric infrastructures, a slow process of re-naturalization started to change the features of what were considered controversial signs of modernity: vegetation covered building sites, access roads became forest lanes, some residual water flowed along the riverbeds. It was not only a matter of healing scars but also of an evolving perception: man-made lakes became part of the landscape, and some huge works are today considered monuments.

The current phase, characterised by a post-industrial economy, allows use to be made of new technologies taking advantage of material and immaterial resources which were not previously exploited, thus supporting the energy transition (Puttilli 2010). In particular, the role of RETs is becoming increasingly important. RETs provide new opportunities but they

require a change in the frames of reference of the actors involved and a new perception of landscape values by local communities.

Questions arise, therefore, about how local communities perceive landscape transformation. In particular, while rapid change is occurring due to new economic activities, changing lifestyles and urbanisation processes, the perception of how the landscape – by which is meant the living space of communities – is transformed, links not only to personal sensitivity but also to the collective process of construction of imagery connected to education, regulations, and communication. Material change and cultural elaboration proceed at a different pace, creating friction and, in some cases conflicts.

The paper addresses such questions with particular attention paid to an Alpine region, Trentino, in Northern Italy. Here, the landscape has long been a key issue for local policies aimed at development, considering conservation and valorisation of natural and man-made features of the territory key strategies for a sustainable future of a mountain area. The results of a research study, which has been conducted on perception of the landscape, is a basis for better understanding how innovative technologies for energy production can be accepted in the landscape.

### **Landscape perception**

Perception is the key for definition of the landscape, according to the European Landscape Convention (ELC). In fact, this document states that “Landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe 2000). Therefore, “the term landscape does not simply refer to the environment, but to the world ‘as perceived by people’”, and this allows “the concept of landscape to be used to make connections between people, between people and places, and between society and its environment” (Blaschke et al. 2013).

The ELC definition stresses that landscape does not exist *per se*. It is a cultural construction concerning what we perceive (combining material and immaterial aspects), as well as the meanings and the values that we attach to the different patterns of the environment. Understanding how people, as persons and communities, perceive their living space is crucial for defining what values are to be preserved. The ELC definition implies the reformulation of assessment approaches and methods, as well as defence procedures and planning practices, giving a different task to experts and leaving more space to the expression of people’s feelings and wills.

In short, landscape perception is a complex process which involves physical facts regarding the human senses (not only vision), personal preferences and values (connected to memory, education, and intention of use), collective frames of reference (in relation to the use of space and resources, regulations, rhetoric). Therefore, past, present and future co-exist in our perception of landscape, because memory and education define some of the aspects that we see and appreciate (or reject), the current use of spaces defines our living space, and the coherence between the ongoing change and what we plan (or expect) for the future defines a crucial aspect of positive (or negative) perception. In this regard, a number of theories have been elaborated over time.

The human brain elaborates visual images on the basis of patterns which allow us to understand the environment. Gestalt psychology (started in the first half of the 20<sup>th</sup> century by Wertheimer 1958) highlighted the basic principles of pattern recognition (figure and ground, closure, nearness and similarity), but affirmed that perception is a holistic process whereby the result is more than the sum of the single parts. Such principles tend, however, to be more descriptive than explanatory (Bell 2001).

Our basic relationships with the environment are based, on the one hand, to utilitarian factors (food availability, protection, control of the space) and, on the other to cultural factors and personal and social behaviours. The Biophilia Theory (Wilson 1984) affirms that the natural environment activates primordial feelings of empathy. However, the relationships with the natural processes are complex and mediated by the culture of individuals and communities, and contradictory feelings of comfort, on the one hand, and of fear, on the other, towards natural phenomena, are present.

The ecological theory of perception elaborated by Gibson (1979) stresses that “we do not perceive our environment neutrally, but view it in terms of what it affords us” (Bell 2001). The consequence is that we consider as aesthetically attractive some patterns that we recognise as more meaningful (and useful) to us. And this, in turn, is related to our knowledge, culture, and ability to make appropriate use of the environmental opportunities. Information and education are therefore crucial in determining landscape perception, in particular when change is expected.

Another important aspect concerns the alternative factors of visibility and protection. The prospect-refuge theory (Appleton 1975) highlights that high positions in the landscape are crucial, allowing to control a large space, but at the same time that hidden places are important, providing shelter and protection.

As regards landscape analysis, in general it is based on expert knowledge. Making use of visual-perceptive approaches, it considers natural features as well as historical-cultural ones (Scazzosi 2004). Some terms highlight the nature of the problems: recognition of the ‘character’ of a landscape is different from identification of its ‘quality’, which has a normative content; in parallel, ‘assessment’ (more neutral) is different from ‘evaluation’ (value-laden). For instance, Landscape Character Assessment (a methodology developed in UK and used also in other countries) aims at describing the elements that make one landscape different from another, although human perception – and in particular local communities’ perceptions – is being increasingly considered (Tudor 2014).

Landscape as a cultural construction becomes clear when considering aesthetic values, which are connected to personal education, social environment, as well as to the utilitarian perspective (‘affordances’) attached to the diverse patterns of the environment.

Information contents of landscape can be read, following some authors (Kaplan and Kaplan, 1989, Kaplan et al. 1998), on the basis of the combination of four factors: coherence, complexity, readability and mystery. The first two factors tend to be in opposition, while the first is in accordance with the third one – corresponding to a comprehension process – and the second with the fourth – reflecting an exploration attitude -. Landscape perception is therefore the result of the interaction of these different factors.

Concerning visual analysis, beyond physiological processes other factors must be considered, involving both our deep – primordial – relationships with the environment - regarding utilitarian aspects - and personal and communities’ cultures and behaviours. Such factors are combined within different ‘dimensions’ of the landscape, from the utilitarian one to others that are more cultural and value-laden (ecological, scientific, aesthetic, symbolic, political etc.), which make people not only appreciate but also ‘see’ different objects and processes.

An example of landscape assessment based on visual aspects is the Visual landscape assessment recently developed by Ode et al. (2008). The interest of the method resides in its basis composed of a series of nine visual concepts, derived from the literature, which characterize the visual landscape. They are: complexity, coherence, disturbance, stewardship, imageability, visual scale, naturalness, historicity, and ephemera. These concepts refer to “different theories explaining people’s experience of landscape and their landscape preferences” (Ode et al. 2008). What emerges is that visual perception is far from being

simply a physiological phenomenon; on the contrary, it involves complex cognitive processes. Therefore, the analysis of landscape perception requires more integrated approaches and methods able to interact with people and communities.

### **Alpine landscape and energy**

The Alpine landscapes have a strong character, but they are perceived from alternative perspectives: internal (inhabitants, local communities) and external (visitors, tourists), in connection to consolidated patterns remembering the past and the memory (collective and individual) or, on the contrary, to innovative uses regarding enjoyment of the natural space, the quality of human settlements, or the availability of tourism infrastructure.

Perception, as said, is not only a physiological process connected to vision; it is also the result of a more complex mechanism by which we select objects and detect meanings and values on the basis of our culture, preferences, intentions, etc. When looking at an alpine landscape, what do we perceive? The beauty of the scenery or the geological phenomena? The natural environment or the traditional human settlements? The strength of the environment or the scars produced by man? To what are we giving a positive or a negative meaning? How do we perceive energy technologies?

As already said, energy is part of the Alpine landscape because the Alps were traditionally a source of energy (wood, water), and settlements were characterised by the presence of hydraulic machines. In recent times, hydropower has been a key transformation factor, producing new landscapes which are seen at the same time as negative facts or as the image of modernization. Currently, the increasing cost of energy and the awareness of the limits of fossil sources, as well as of their effects in terms of climate change and environmental degradation, are pushing towards the intensification of energy production from renewable energy sources. But the awareness of the fragility of the environment and the importance assigned to human landscapes, as well as other kinds of conflicts, are hampering the diffusion of the new technologies.

A key issue concerning 'energy transition' is that RES, such as wind, solar, and biomass, are "spatially dispersed, requiring substantial land resources in comparison to conventional energy sources" (Frantál et al. 2014). Moreover, renewable energy is "dependent on specific physical landscape characteristics that may be much more prevalent in some areas than in others" (Nadaï and Van der Horst 2010), thus restricting the alternatives for the localization of energy plants. In fact, the geographical features of places and the landscape's characters define a framework of obstacles and opportunities for energy production (availability of resources, solar exposure, micro-climate, fragility, uniqueness etc.), while the spatial organisation of human settlements, the urban form and density, and the features of buildings, impinge on energy needs (Zanon and Verones 2013).

Energy production and use has therefore become an issue that is more "location and site specific" (Howard et al. 2013), requiring a new awareness of the quality of places and the ability to detect opportunities, to address technical aspects in an appropriate way, and to manage divergent points of view and conflicts on the values at stake. Sustainability is the goal, with particular regard to the construction of sustainable landscapes, and this endeavour requires the ability "to maintain the outputs of ecosystem goods and services that people value or need", (Potschin and Haines-Young 2006).

A sustainable energy landscape can be defined as "a physical environment that can evolve on the basis of locally available renewable energy sources without compromising landscape quality, biodiversity, food production, and other life-supporting ecosystem services" (Stremke and van den Dobbelsteen 2013). The key issues concern on the one hand the ability to modify the landscape respecting its functionality and its cultural values, and on

the other, the need to support a process oriented to accepting change or, in other words, to learning how “to love the landscapes of carbon-neutrality” (Selman 2010). Such a learning process is social in nature and implies endorsing the “underlying narrative” (Selman 2010) of the new landscapes reflecting new ways of conceiving natural values, economic and technological development, human progress and well-being.

There is huge potential for a more intensive use of renewable energy sources in the Alps, but there are still many difficulties, partly technological and organisational, but mostly cultural. For instance, a recent document issued by an Italian environmentalist association, Legambiente, stressed the need to make a more appropriate use of RES, and advanced a number of proposals. But it did not address the social acceptance and the landscape issues attached to such proposals (Legambiente 2016).

### **Landscape management in Trentino, Italy. The challenge of energy production**

The following sections describe the landscape characters of Trentino, Italy, and the main results of an inquiry, recently conducted, into the perception of landscape. The intention is to frame how change connected to energy production making use of renewable energy technologies can be accepted by local communities.

Trentino (Autonomous Province of Trento) is an Alpine province in the southern part of the Region Trentino-Alto Adige-Südtirol. The province’s landscape values have been recognised by numerous international documents and provisions (the Alpine Convention, many Natura 2000 sites, some UNESCO listed sites), which highlight both the environmental features and the role of human activities.



Figure 1. Autonomous province of Trento (Trentino) and Italy

Trentino started along a development path in the 1960s, and the pivotal instrument with which to elaborate strategies and to regulate land use change was a ‘territorial plan’ aimed at supporting socio-economic development by combining ‘modernization’ with ‘conservation’ of natural areas and landscape (PAT 1968). Other planning documents and environment protection actions have followed in recent decades (Zanon 1993; 2001; 2014), until the operating spatial plan (2008) which assumes the concept of landscape as introduced by ELC.

The governance of resources and territory in Trentino has required the development of specific legal frameworks and administrative organisation, and the devising of specialized knowledge and professional practices. This has reinforced the frames of reference orienting the institutional agenda setting, and consequently decisions and actions. Currently, large parts of the province are protected. Landscape control is not the only procedure involved, because forestlands, pasturelands, natural areas, water bodies, and at-risk areas are all strictly controlled, and the use of natural resources is centrally governed as well.

As regards energy, a recent Energy Plan (PAT, 2013) has defined a balance for Trentino, and has set new objectives in terms of both saving and improvement of the use of RES. It makes brief reference to the different sources, which have, until now, been only partially considered because they are ruled by sectoral policies, regulations, and control procedures (woodlands, agriculture, buildings etc.). In recent times, the energy concern has stimulated the application of energy saving methods and plants, and the installation of technologies for on-site energy production at the building scale, namely solar thermal and PV panels.

As regards energy production, hydroelectric energy is a key asset, although it is only partially controlled by local actors and authorities. There are 152 plants, with a total power of 1560 MW, corresponding to 8.7% of the total hydroelectric power installed in Italy, and most of the production is delivered to other regions. The production in 2010 was 3600 GWh (PAT, 2013, p. 40). This positive balance does not mean that additional production is not important, because a huge amount of fossil fuel is consumed for transport and heating, and its replacement with other sources, or the abatement of its use, must be a goal for the near future.

The Energy Plan reflects the new Italian and European frameworks and the goal of becoming self-sufficient within 2050. As regards emissions, the goal is a 50% reduction with respect to 1990 by 2030 and a 90% reduction by 2050 (PAT, 2013, p. 7). The role of renewable energy sources should increase, respecting a governmental provision (a decree, confirmed by the law n. 56, 2012, called burden sharing), from 28.6% of final consumption in 2005 to 35.5% in 2020. Also solar thermal and biomasses (firewood, in particular) contribute significantly, covering 22% of home heating. In the province there are more than 126,000 m<sup>2</sup> of solar thermal panels (6.3% of the total in Italy), corresponding to 238 m<sup>2</sup>/1000 inhabitants (Italy: 33 m<sup>2</sup>/1000 inh.; EU: 64.9 m<sup>2</sup>/1000 inh.)

As regards photovoltaic plants, there is a total power installed of 117 MW (0.92% of the total in Italy), corresponding to 220 W/inhabitant (Italy: 209 W/inh.). Most of the plants have a power output of less than 20 kW. This is the result of fragmented actions because mainly single households are installing home plants, also as the effect of specific rules impeding the installation of panels on the ground and encouraging their placement on roofs, in particular of large industrial buildings (PAT 2013).

Other interesting sectors are agriculture, which could provide firewood from trimming and culture renovation (11 ktoe), and forestry. The effective use of such amounts of biomass requires re-organisation of the supply and production chains. The use of firewood is a traditional way to heat homes in rural areas, and it is based on household collection of firewood from families’ properties or in the commons, while the new technologies, in particular wood pellets stoves, require a market chain. The use of firewood in home stoves is

not problem-free, however, because of incomplete combustion and the production of particles; therefore, on the occasion of certain meteorological conditions, even small villages suffer from air pollution.

The Energy Plan considers the improvement in the use of renewables, and recognises that it is impeded by difficulties and conflicts. In particular, hydro-electric power production cannot be improved significantly because it is necessary to preserve the quality of water bodies, releasing the ‘minimum flow’ of water to sustain the ecosystem. As regards mini-hydro plants, their potential is not significant (17 ktoe). Solar thermal technology may be able to produce 20 ktoe of energy by 2020, after 250000 m<sup>2</sup> of new panels are installed (PAT 2013). As for photovoltaic technology, there is currently a potential of 144 MW installed and, as said, the policy is to install small plants on roofs. Finally, eolic technology is not an important potential source because winds are constant only in some particular areas, i.e. the top of some mountains, and it is clear that wind towers could have a negative impact on the Alpine scenery. The plan does not state prospects for this technology.

### **An inquiry into landscape perception**

Within the framework described, an inquiry was recently conducted in Trentino in order to gain better understanding of how people perceive the landscape and what the main concerns are. The author did not take part directly into the inquiry, which had general goals and was not specifically intended to determine the level of acceptance of energy technologies (PAT 2015). However, some orientations can be inferred on that issue.

In short, the aim of the inquiry was to understand the processes of elaboration of the sense of belonging to the landscape by people and local communities. It sought to determine what representations and meanings tend to consolidate and which ones tend to disappear rapidly. The research project was developed in three steps: a preliminary phase consisted in a series of semi-structured interviews with experts and selected observers. A second step regarded a Delphi process, aimed at focusing better on the most representative expressions of the local society in regard to the landscape. The most demanding phase consisted in a survey of a representative sample of the population managed by the Statistical Institute of the Autonomous Province of Trento.

The interviews with 25 experts were conducted on a semi-structured basis, with nine questions concerning three areas: meanings, representations and perception. The questions on this last area were supported by the use of photographic images. The results stressed the ‘epochal change’ of the landscape as the mirror of a wider socio-economic transition. Physical transformation due to urbanisation processes, extension of the infrastructure, and abandonment of traditional agriculture were the critical aspects most frequently cited by the experts interviewed. As regards values and potentials, both natural values and selected human interventions are considered positive: quality buildings, specialised agricultural spaces, high-level tourism places etc., tend to become the bases for new ‘traditional landscapes’. Change is not seen as negative *per se*. Close attention is paid to decisional procedures and planning methods and regulations. Landscape, as the mirror of the society, includes political processes.

The Delphi process involved 20 experts and opinion makers in a three-step cycle of questions, sent by e-mail, on the potentials and critical points of the local landscapes, on resistance to change and on education.

The sample survey involved more than 1400 people, statistically representing the population, interviewed by a team of 29 trained interviewers, making use of the Computer Assisted Personal Interview (CAPI) technique. In total, 2400 families were contacted and 1457 interviews were conducted, posing 11 questions, 6 of which regarded the evaluation of 52 items, in particular photographic images. The main goal was to represent the ‘common

sense' on landscape that supports the sense of belonging and the identity of local communities, by detecting the relationships representation-perception-meaning. A first aim was to identify the predominant representations of the landscape of Trentino, whether they are visual-aesthetic or economic, natural, cultural, ecological, exceptional. Then investigated were the threat factors that were socially perceived. The intention was to better understanding the extent to which the landscape is a key feature for the local population, able to distinguish Trentino from other territories, and part of the identity of the inhabitants.

As regards the concept of landscape, this seems to be a familiar term which no longer pertains to a traditional aesthetic vision but rather to a more complex concept representing the natural as well as the cultural assets of a locality. The predominant images of the landscape concern on the one hand the natural assets of Trentino ('mountain and woodlands' was the answer given by more than 51.6% of interviewees), and the potentials for leisure ('mountains for tourism', 17.6%), while the agricultural landscape was mentioned by only 8.5% of interviewees, and settlements, historic landmarks and infrastructure were mentioned by only a few respondents.

More variegated were the answers concerning detrimental factors. Traffic, impoverishment of natural places, urbanisation processes, urban peripheries and pollution were mentioned by more than half of the interviewees. On the contrary, less impacting factors were considered ski-lifts (72.7%), extension of woods over previous agricultural land (72.2%), use of water courses (71.6%), structures for specialised agriculture (69.3%), roads (68.7%), followed by odours, noise, and urban expansion.

Finally, a high level of awareness of the value of landscape emerged, together with the confidence that local policies are well orientated towards protection.

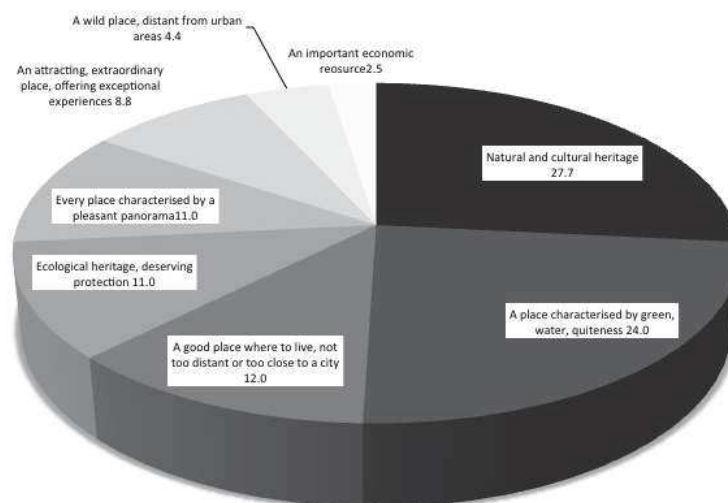


Figure 2. Definition of landscape (Source: Pat, 2015, redrawn)

The diverse social and age groups show different attitudes. In particular, people over 60 years define landscape preferably as a 'quite place, characterised by green and water' (32.9%), with a significant difference compared to younger generations (18–35 years: 19.2%; 36–59 years: 20.1%). Landscape as a 'natural and cultural heritage' is chosen only by 18.0% of the elderly, while it is significant for the younger generations (18–35 years: 30.1%; 36–59 years: 31.3%).

In general, the economic and commercial values of landscape are not considered of primary importance.

As regards the place of residence of respondents, people living in set apart mountain areas define landscape as a 'quite place, characterised by green and water' (29.5%), response



not so frequently given by people residing in the developed mountain areas (20.4%). In such places, landscape is defined preferably as a 'natural and cultural heritage' (28.7%), similarly to the responses of people from dynamic lowland municipalities (28.1%), and differently from set apart mountain areas residents (16.6%).

Interpretation of the research results is not simple, in particular if specific changes, such as those required by RETs, are considered. In general, while there is wide appreciation of the role and value of the landscape, its various components are differently considered by experts and laypeople. Natural features are dominant in respondents' descriptions, but a utilitarian vision emerges when the potential uses of spaces and resources are stressed, also when they require change of traditional uses and the construction of equipment. Side-effects (odours, pollution etc.) are generally underestimated, while, on the contrary, the perception of a 'well managed landscape' is well considered.

### **The impacts of energy production by renewable energy technologies**

Energy production by renewable sources affects the landscape in different ways, in relation to the specificities of the environment involved and the technology used. Perception of the impacts depends not only on the real change of landscape, but on the way landscape is perceived. Therefore, what impacts are caused by RETs? What landscape factors are affected?

A tentative classification can be made on the bases of the principles driving the diverse theories of landscape perception. In short, the following impacts on the major factors involved can be identified.

**Natural environment** (the biophilia theory of Wilson (1984)). Alteration of a consolidated natural system is an impact, and human perception tends to be sympathetic with the natural condition. It must be stressed, however, that the concept of naturalness is debatable, and especially in the case of an environment heavily transformed by man over the centuries like the Alps. In many cases, biodiversity is the result of such interventions. Also re-naturalization processes caused by the abandonment of fields and pasturelands produce a shrinkage of the human landscape. The perception of the 'natural landscape' is therefore strongly affected by personal attitudes and culture.

**Visibility and protection** (the prospect-refuge theory of Appleton, 1975). Dominant points in the landscape are obviously central in perception processes. Many approaches and theories are based on the concept that landscape is what is seen from a specific point (this was the basis of the first Italian landscape defence law of 1939). The protection of such points is usually the main purpose of policies, plans and defence association actions. On the contrary, hide-out areas, closed spaces and less visible places are usually not strictly protected, although in many cases they are highly valuable from an eco-systemic point of view and can be of great interest due to their characters (canyons, gorges, forest canopies etc.).

**Cultural landscapes.** Many approaches and theories, as well as protection actions, are concerned with man-made landscapes. They regard a variety of cases, but in general the layers of history form a complex stock of signs, meanings, and values for individuals and communities which must be appreciated and protected. Landscape perception, in this case, is activated by the personal culture and memory, and change is often perceived as a threat to be carefully evaluated.

**Functional landscapes** (the affordance principle of Gibson, 1979). Perception, as said, is closely connected to personal culture. This means that we see what we tend to look for. In particular, we are sensitive to the opportunities offered by the environment we are experiencing. Therefore, we appreciate a well-cultivated landscape even when it is the result of intensive agriculture, while we feel uncomfortable in front of an abandoned field (or a country house, or a village). The presence of a community taking care of the space is usually

well perceived, even when this implies change of the traditional organisation. There are, however, different perceptions of the same landscape depending on the personal attitudes of cultural, natural interest, sport practice kind.

**Landscape and information** (Kaplan and Kaplan 1989, Kaplan et al. 1998). The inclusion of new technologies in a natural environment or in a human landscape are interpreted also on the bases of the information conveyed. In general, coherence is rarely found in such a coupling, but the notion of complexity can explain why new components are accepted in the heterogeneous system of the landscape. Legibility concerns the possibility to understand why a context has been changed, and what benefits such action has provided; mystery, on the other hand, can stimulate curiosity, but it can also be a factor explaining the opposition to change. Anyhow, some energy projects, concerning both hydro-electric plants and other technologies (PV, wind plants), have leveraged on legibility (of the function) and on mystery (combination of technology and nature) by developing a peculiar design characterized by geometric lines and technological materials in the natural environment and the open space.

### Discussion and conclusions

The insertion of renewable energy technologies in complex and fragile landscapes, as in the case of the Alpine regions, is differently perceived by people and communities. We can refer to the framework of the perception patterns outlined above to extract some insights from the survey conducted in Trentino.

What emerges is, together with the appropriateness of the ELC definition of the landscape, a local politico-administrative experience characterized by the elaboration of a discourse on landscape oriented not only at preserving an asset deserving attention, but at taking advantage of its values and at reinforcing the sense of belonging of local communities. The inquiry analysed highlights that landscape is generally considered not simply as a 'panorama', but as the living space of people and communities, composed of natural and man-made spaces, material components and immaterial meanings and values. The interviewees' answers often mixed substantive aspects with politico-administrative and planning issues.

However, the experts exhibited a different sensitivity with respect to local communities, one more orientated to a functional concept of the landscape. In this regard, landscape values are strongly attached to the opportunities offered – and created – for an efficient economy and a qualified level of living. And such perspectives differently characterize individual communities, thus explaining why some proposals are accepted and seen as positive in some places, while they provoke opposition in others.

The visibility of the technology in the landscape is certainly a key issue, together with the transformation of consolidated landscapes. But the survey showed that visibility and change are not 'the' problems. More complex mechanisms operate in perception, as testified by many answers and by a number of conflicts over RETs projects in recent times, where similar proposals have been differently accepted by local communities.

As said, in many cases the perception of communities is oriented by a utilitarian vision: if the technology is perceived as necessary or useful, it becomes part of the landscape. Of course, an appropriate (technical, but also procedural) ability to manage the transformation is required (and in general this is recognised in the case of Trentino). An example concerns ski-lifts and ski-slopes, which are largely seen as part of the contemporary 'mountain (tourism) landscape'.

Similarly, the huge works required by hydropower production were not mentioned as detrimental factors, either in the case of large and visible modification of the landscape (dams, lakes etc.). In recent times, major plants, planned by famous engineers and architects, have

been proposed as interesting places of visit. A controversial attitude emerges in the case of hide-out places, which are not so visible - and therefore not so much protected in the past -, but are important because of their eco-systemic role, and because they well represent a tract of landscape which can be considered a refuge. The sensitivity towards such features has increased in the recent years, as testified by a number of recent initiatives which have valorised gorges, canyons, and hide-out places.

The impacts on naturalness, in particular of protected areas, are crucial, but this does not imply that change cannot be planned, because the concept of 'natural' is largely influenced by the personal and community culture. In any case, by-effects can be important and must be managed. In particular, the oscillation of the water level in reservoirs or the diversion of water from torrents in the case of hydropower plants can impinge not only on the ecosystem but also on leisure activities (fishing, canoeing and rafting, in particular). On the contrary, the artificial abundance of water during specific timetables, downstream some dams, allows the practice of water sports

Cultural landscapes are not seen as static. The collective memory of the traditional cultivation methods is almost lost, and the ongoing change in terms of abandonment of agricultural land (in many cases terraced landscapes) or in specialisation (requiring new field patterns and new equipment) is not perceived as a loss of values. Again, a utilitarian perception emerges, and this leaves space for the installation of RETs.

Also the traditional image of settlements and the historical heritage were not cited as key components of landscapes. Probably the inquiry underestimated such values, but there is certainly space for intervening in the urbanised space with new technologies. In particular, their insertion along major roads and in urban areas has already been done without controversies.

More difficult is consideration of the concepts of coherence/legibility and complexity/mystery, which combine physical perception and cultural aspects. The history of the Alpine landscape reflects the evolution of the perception of nature and the well-known elaboration of the concepts of sublime, horror, and picturesque. What we perceive as coherent, legible, or complex and mysterious depends on our vision of the world, and on our intentions. In this regard, architects are long discussing the way new buildings must be designed to be appropriately inserted in an Alpine landscape, between tradition and innovation; mimetic intervention and dissonance. Also the new energy plants deserve a similar attention to the peculiar landscape values, as well as a better design.

Similar issues raised by the insertion of RETs concern the coherence of the use of the source (in particular water and biomass; to a lesser extent, sun and wind) and the relationship of the technology with the environment, the skyline or the cultural landscape and the built environment. This is the case of wind towers, which need to be placed on elevations, of equipment installed on agricultural land, of PV panels on the roofs of ancient buildings. There are also conflicts between alternative uses of resources or spaces, as in the case of the use of the water of a torrent for hydropower production or for leisure activities or irrigation, or the detrimental effects of technologies on the quality of green areas.

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