Landscape and wind energy: evaluation models

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Key words: landscape, wind energy, evaluation models

Abstract

Considering the landscape as a “tool” to produce the territorial and urban planning has always fascinated and involved experts with very different backgrounds. In this regard, also the Italian lawmaker has issued rules and regulations, in different periods, which have imposed the need to establish urban landscape plans.

The landscape has been interpreted, often for the only goal of protection, through reading keys based upon the “opinion” of experts (government officials, superintendents, planning boards, etc.), resulting from simplistic and often apodictic value judgments. Such an approach cannot be methodologically included in the evaluation processes; it has not produced any progress in the field of territorial and urban planning, rather it has led to a wasteful conflict between “conservationists” and “transformists”.

This paper does not aim at debating the evolution of the landscape concept in urban studies or the legal nature of the rules that have introduced the obligation of landscape planning, since there exists a rich literature on the matter. Instead, it seeks to deal with a much more practical and substantial topic: how to evaluate the landscape transformations caused by the construction of wind farms, since these are emblematic projects for their physical size.

In this respect, the landscape evaluation is based on different stages, which define the general evaluation model.

The first stage is the analysis of the state of fact in which the places and protection levels are geographically described, with the goal of characterizing the intervention area following two main reading keys of the context: on one side the landscape qualities, on the other the landscape, anthropic and environmental risks.

The second stage concerns the description of the project in its engineering and architectural aspects, as well as its application in the intervention area.

In the third stage, the evaluation is carried out through the definition of the evaluation model in relation to the levels of modification and alteration of the landscape quality after the project inclusion.

In the fourth stage the judgment of landscape compatibility is expressed through the identification of the conditions of coherence/conflict between project and environmental context, as well as any measures of mitigation and/or compensation.

Finally, the paper aims especially to address the third stage, the evaluation, which presents proper techniques of qualitative and quantitative assessment of the landscape transformations by comparing the ex ante stage (without the wind farm) with the ex post stage (with the wind farm).

1. INTRODUCTION

In Italy the protection of the landscape is a “value” established by the Italian Constitution, which states “The Republic promotes the development of culture as well as scientific and technical research. It protects the landscape and the historical and artistic heritage of the nation”1. This has engendered a wide legislative production and many interpretations of the concept of landscape “protection”.

This protection is implemented through two prevailing legislative tools: the identification of special areas “under restrictions” from a landscape perspective, in compliance with various regulations, and the production of regional land planning instruments2.

In this context one should remember that not all the landscape is worth being protected, and the landscape itself can never be considered as static, but rather it is in a dynamic condition.

1 Art. 9 of the Italian Constitution.

2 In Italy territorial planning is regional, not national.
The dynamic view of the landscape is also contained in the European Landscape Convention\(^3\), which states that the measures for the management of the landscape shall be addressed to “[...] meets economic and social needs. The management approach must be a dynamic one and seek to improve landscape quality on the basis of the population's expectations [...].”\(^4\)

Therefore, it is possible to define the concept of landscape compatibility, which can be expressed as follows: a transformation is compatible with the landscape if it does not worsen the quality class of the pre-existing landscape.

This paper is not intended to analyze the evolution of the landscape concept or the territorial planning about the landscape or, even less, the legal nature of the landscape itself\(^5\), but rather it will consider the methods and techniques for the evaluation of the landscape transformations, through the case of wind farm projects.

Consequently, it is necessary to introduce evaluation models (Campeol, 2007)\(^6\) able to “measure” the landscape transformations.

2. METHOD

In the literature there are interesting essays that deal with the relationship between land planning and wind farm but few that deal with the evaluation of the landscape in relation to the realization of these technological systems. Certainly face the cultural aspect of how to interpret the wind farms (Pasqualetti, 2000), others how to read the wind farm from an aesthetic point of view (Molina-Ruíz et al., 2011), any others address the issues of social acceptability of these energy plants (Thayer & Freeman, 1987; Chataignier & Jobert, 2003; Bell et al., 2005).

Also interesting are studies that face the aspect of public participation in the decision (Wolsink, 2007 and 2010). However, the multicriteria evaluation experiences of wind farms landscapes are rare (Torres Sibille et al., 2009) and never tackle the multicriteria evaluation of landscape transformations, resulting from the wind farm implementation, by comparing the phases ex ante and ex post.

The goal envisaged is to show that the landscape can be “measured” (Campeol, Carollo & Masotto, 2017)\(^7\) and so it is subject to “environmental evaluation”, a process that goes beyond the general “landscape description”.

This environmental evaluation of the landscape is described in a document, called “Landscape Report”, which is regulated by law in Italy. The report must be laid down in compliance with art. 146, (4) and (5) of the “Code of Cultural Heritage and Landscape” Legislative Decree of 22 January 2004, n. 42 - art. 146 (2) of the Prime Ministerial Decree of 12 December 2005.

The Landscape Report shall generally contain descriptive and especially evaluation aspects, by developing the following topics:

- The current state of the landscape concerned.
- Its valuable landscape elements, as well as the possible presence of cultural heritage protected by the Code, Part II.
- The impacts of the planned transformations on the landscape.
- The necessary mitigation and compensating elements.

Through the evaluation of the impacts produced by a project on the landscape, this Report shall show whether the project is compatible with the values of the landscape, be it under restrictions or not.

This approach, required by law, is considered as a real “assessment” and therefore, like any evaluation typology, it shall respect three fundamental postulates – to be logical, rational and coherent – on the basis of the following definitions:

- logical, since it shall have accurate work stages, from the analysis to the assessment of the transformations and the judgment of landscape compatibility;
- rational, since the value judgments on the landscape quality and its transformations shall be attributed following clear, shared and measurable criteria;
- coherent, since there shall not be contradictions between the analytical system and the value judgments attributed to the transformations.

For measuring landscape transformations it is necessary to use three evaluation models, as here below described:

- The first level: it identifies the area of visual influence through the elaboration of an “intervisibility map” necessary to define at what distance the wind farm project can be seen.
- The second level: it interprets the fields of visual perception represented through photographic optical cones that read the “shot” and “reverse shot”, with a quantitative evaluation of the landscape qualities (ex ante) and the calculation of their variation after the construction of the power farm (ex post). This evaluation is performed with a matrix of “ex ante quality / ex post quality” produced on the visual optical

\(^3\) It is the first international treaty exclusively dedicated to the European landscape as a whole. Officially subscribed on 20 October 2000, by the EU member States, in the Salone dei Cinquecento, Palazzo Vecchio in Florence.

\(^4\) Explanatory Report to the European Landscape Convention, Chapter I – General provisions, Article 1 – Definitions, point 40 (third paragraph).

\(^5\) In this field there is a wide literature on the above.

\(^6\) Reflections developed in 2007, also during the doctoral studies on landscape planning, Faculty of Architecture at the University of Florence.

\(^7\) The above mentioned essay, presented in March 2017 in Conegliano Veneto (Italy) at the “Fifth International Congress on Mountain and Steep Slope Viticulture”, deals with the theoretical-methodological issue of the landscape measurement.
cone. This optical cone is then de-structured into foreground, middleground and background.

- The third level: it represents a qualitative evaluation of the “alterations” (negative impacts) or of the “added values”.

The most important help to the evaluation of landscape transformations, as already said, can be found in the annexes to the Prime Ministerial Decree of 12 December 2005, which outline some important criteria for the interpretation of the landscape, necessary to measure the landscape transformations deriving from the realization of a project (Campeol, Carollo & Masotto, 2016)8.

These criteria can be used to compare the state of the landscape before (ex ante) or after (ex post) the realization of an intervention. The Prime Ministerial Decree of 12 December 2005 articulates them as follows:

- **diversity**: recognition of peculiar and distinctive, natural and anthropic, historical, cultural, symbolic characters/elements;
- **integrity**: permanence of the distinctive characters of natural systems and historical anthropic systems (functional, visual, spatial, symbolic, etc. relations between the components);
- **visual quality**: presence of special scenic, panoramic, etc. qualities;
- **rarity**: presence of characteristic elements, limited in number and/or concentrated in some special sites or areas;
- **degradation**: loss, damage of natural resources and of cultural, historical, visual, morphological, testimonial characters.

For a scientific approach to the landscape evaluation, as for any environmental evaluation models, the judgments of value need to go through a confutation step (Popper, 1969)9.

The various criteria for the landscape evaluation, as identified by the Prime Ministerial Decree of 12 December 2005, are given numerical values from 0 to +5 for the criteria **Diversity, Integrity, Visual Quality, Rarity**, and from 0 to -5 for the criterion **Degradation**.

Based upon solid evaluation experiences, which generally recognize six evaluation levels, the following values are identified:

- 0 in the absence of the criterion;
- 1 when the criterion has a very low level;
- 2 when the criterion has a low level;
- 3 when the criterion has a medium level;
- 4 when the criterion has a high level;
- 5 when the criterion has a very high level.

Therefore, from a methodological viewpoint it is important to assign the numerical values to the various criteria for reading the landscape, following their level of presence in a given geographical area.

In order to apply this evaluation methodology the case of a wind farm project is presented as an emblematic intervention from the landscape perspective because of the large size of the wind turbines.

## 3. A WIND FARM IN BASILICATA REGION

The present case concerns the elaboration of the Study of Environmental Impact and the Landscape Report of a project for a wind farm in Basilicata region (Italy)10. The project has undergone several modifications that have reduced the original dimensions and have produced a “mitigated” version. The mitigated version (Fig. 1), envisaged in the area of Cerreto (Province of Potenza), presents a nominal power of the installation of 20.4 MW and shows the reduction from 30 to 6 wind turbines.

### 3.1 The measurement of the landscape transformations

This paragraph illustrates the evaluation of the optical cone11 from which the power plant can be seen, following the criteria of the above mentioned Prime Ministerial Decree of 12 December 2005.

The definition of the field of visual perception, through the elaboration of the “Map of Theoretical Intervisibility” (Fig. 2), namely the space in which an observer can see a project, is of crucial importance.

As stated above, the technical annex to the Prime Ministerial Decree of 12 December 2005 and the National Guidelines suggest to evaluate the visual interference of the future power farm in relation to the presence of assets under restrictions or protected properties, valuable tourist tracks, etc.

For each optical cone, not only the localization of the shooting angle but also the following are presented:

- the ex ante view before the intervention planned;
- an ex post photo simulation after the realization of the original project;
- an ex post photo simulation after the realization of the mitigated project, with a view to present as clearly as possible the mitigating actions introduced.

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8 The mentioned paper, presented in September 2016 in Innsbruck (Austria) at the “XXVII session of the PECSRL biennial international conference”, envisages a model for the measurement of the landscape transformations for a project of an open-cast mine.

9 Karl Popper defines a method as scientific when it has gone through a confutation process. In fact, Popper (1969) recalls “[…] the criterion of the scientific state of a theory is its falsifiability, refutability, or controllability […].”

10 Studio ALIA (April 2013), Wind farm “Cerreto” and “Monte Poto” in the municipality of Genzano di Lucania (Province of Potenza), project owner Eusebio Energia SpA.

11 The landscape evaluation of this wind farm project has been made through the analysis of twenty optical cones.
In general, the modifications engendered by the realization of the wind farm are mainly interpreted in relation to the visual planes, following the image elaborated (Fig. 3).

### 3.2 Visual planes

To ensure that a landscape evaluation can verify the morphological congruity of the intervention in the reference landscape, it is necessary to destruct the view within the optical cones on the basis of three space planes that define its depth.

- **Foreground**
  
  The foreground enables the interpretation of the typological characteristics of the interventions, which are their architectural form. Following the morphology of the territory, it is approximately 300 m. deep.

- **Midground**
  
  The midground enables the interpretation of the urban characteristics of the interventions, namely their settlement pattern, as well as the prevailing intended use of the territory. Following the morphology of the territory, its depth varies from about 300 m. to a few kilometers.

- **Background (skyline)**
  
  The background permits the interpretation of only the presence or the absence of the interventions as profiles, or their skyline. It is a few kilometers deep, in relation to the weather conditions and the territory morphology.

### 3.3 Morphological congruity

The evaluation of morphological congruity is carried out by verifying the distribution of the intervention in the space in relation to the marks that characterize the main landscape optical cone of this type of interpretation, or when the intervention is sufficiently visible.

If the intervention follows these characterizing marks, it is defined congruous or partially congruous; on the contrary, it is defined incongruous.
3.4 The optical cones

This level of evaluation determines the values of landscape quality of the state of fact (ex ante quality) for each optical cone, and quantifies their variation after the modifications (negative – alterations; positive – added values) produced by the project (ex post quality).

For the evaluation comparative table are elaborated, criterion after criterion, in order to compare the value of...
the ex ante situation with the values identified in the ex post stage.

Among the 20 fields of visual perception analyzed and evaluated in the Landscape Report of the case study, here below is presented, as an evaluation example, the Optical Cone n. 3 – realized from Viale XXIV Maggio in Genzano di Lucania (Fig. 4) –, in which to compare the views between the original and the mitigated projects in the ex ante and ex post stages (Figs. 5, 6 and 7).

### 3.5 Visual planes and morphological congruity

From a methodological viewpoint, through the comparison between the ex ante and the ex post state of the landscape it is also possible to analyze the characteristics of the various visual planes in relation to the localization of the farm power project selected (mitigated). This is done to define the morphologic congruity of the wind farm project (Fig. 8 and Tab. 1).
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Figure 6 - Ex post photo simulation – original

Figure 7 - Ex post photo simulation – mitigated

Figure 8 - Interpretation of visual planes and morphological congruity

Table 1 - Description of the visual planes and morphological congruity

<table>
<thead>
<tr>
<th>Visual planes</th>
<th>In the optical cone a part of the wind farm is visible in the skyline.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphological congruity</td>
<td>The imaginary line that connects the visible wind turbines is coherent with the descriptive marks of the landscape that can be highlighted in the optical cone: in fact, the wind turbines are placed in a harmonious way following a prevalently horizontal line that reproduces the skyline and the underlying hill lines, which present curves stretched horizontally.</td>
</tr>
<tr>
<td>Relations between power plants</td>
<td>Considering the absence of other wind farms in the optical cone, it is not possible to elaborate the evaluation of the relation between power plants.</td>
</tr>
</tbody>
</table>

4. INTERPRETATION OF THE LANDSCAPE QUALITY OF THE SELECTED OPTICAL CONE

Applying the criteria of the Prime Ministerial Decree of 12 December 2005, to which a numerical value is assigned, it is possible to measure the transformations of the landscape from the ex ante to the ex post stage, following the evaluation tables here below presented, composed as follows:

• in the first column the criterion indicated by the above mentioned Ministerial decree;
• in the second column the description of the ex ante state of the landscape placed on the appropriate level among the six identified;
• in the third column the various numerical values related to the six theoretical conditions, highlighting the one derived from the description of the ex ante state of the places;
• in the fourth column the description of the ex post state of the landscape placed on the appropriate level among the six identified;
• in the fifth column the various numerical values related to
the six theoretical conditions, highlighting the one derived from the description of the ex post state of the places. In this way it is possible to measure the variations of the characteristics of the landscape, interpreted through an optical cone following the various criteria, as highlighted in the following tables.

- **Criterion Diversity**
  Presence of peculiar and distinctive, natural and anthropic, historical, cultural, symbolic characters/elements (Tab. 2)

- **Criterion Integrity**
  Presence of distinctive characters of natural systems and historical anthropic systems (Tab. 3).

- **Criterion Visual quality**
  Presence of particular scenic, panoramic, etc. qualities (Tab. 4).

- **Criterion Rarity**
  Presence of characteristic elements, existing in low numbers and/or concentrated in some special sites or areas (Tab. 5).

- **Criterion Degradation**
  Presence of damage of natural resources and cultural, historical, visual, morphological, testimonial characters (Table 6).

### Table 2 - Value of the criterion Diversity

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>ABSENCE</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VERY LOW</td>
<td>+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LOW</td>
<td>+2</td>
<td>The partially visible wind farm DOES NOT change the characteristics of the criterion.</td>
<td>+2</td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>+3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGH</td>
<td>+4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VERY HIGH</td>
<td>+5</td>
<td></td>
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</table>

### Table 3 - Value of the criterion Integrity

<table>
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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Integrity</td>
<td>ABSENCE</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td>VERY LOW</td>
<td>+1</td>
<td></td>
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<tr>
<td></td>
<td>LOW</td>
<td>+2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEDIUM</td>
<td>+3</td>
<td>The partially visible wind farm DOES NOT change the characteristics of the criterion.</td>
<td>+3</td>
</tr>
<tr>
<td></td>
<td>HIGH</td>
<td>+4</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>VERY HIGH</td>
<td>+5</td>
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</table>
Table 4 - Value of the criterion Visual quality

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<tr>
<th></th>
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<tbody>
<tr>
<td>Visual quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ABSENCE</strong></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VERY LOW</strong></td>
<td></td>
<td>+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td></td>
<td>+2</td>
<td></td>
<td>The partially visible wind farm SLIGHTLY MODIFIES the perception of the horizon line.</td>
</tr>
<tr>
<td><strong>MEDIUM</strong></td>
<td></td>
<td>+3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The optical cone is characterized by a good scenic quality thanks to the presence of several visual planes with a vast and open view.</td>
<td></td>
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</tr>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
<td>+4</td>
<td></td>
<td></td>
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<tr>
<td><strong>VERY HIGH</strong></td>
<td></td>
<td>+5</td>
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</table>

Table 5 - Value of the criterion Rarity

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<th></th>
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<tbody>
<tr>
<td>Rarity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ABSENCE</strong></td>
<td></td>
<td>0</td>
<td>The partially visible wind farm DOES NOT change the characteristics of the criterion.</td>
<td>0</td>
</tr>
<tr>
<td>The optical cone does not present elements of rarity.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VERY LOW</strong></td>
<td></td>
<td>+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td></td>
<td>+2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MEDIUM</strong></td>
<td></td>
<td>+3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
<td>+4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VERY HIGH</strong></td>
<td></td>
<td>+5</td>
<td></td>
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Table 6 - Value of the criterion Degradation

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>Degradation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ABSENCE</strong></td>
<td></td>
<td>0</td>
<td>The partially visible wind farm DOES NOT change the characteristics of the criterion.</td>
<td>0</td>
</tr>
<tr>
<td>The optical cone does not present particular phenomena of degradation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VERY LOW</strong></td>
<td></td>
<td>-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td></td>
<td>-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MEDIUM</strong></td>
<td></td>
<td>-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
<td>-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VERY HIGH</strong></td>
<td></td>
<td>-5</td>
<td></td>
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</tbody>
</table>
5. RESULTS

The numerical results obtained from the evaluation of the various optical cones are appropriately aggregated for determining the total landscape quality of the state of fact (ex ante) and of the project (ex post).

An accurate table collects the values attributed to the four criteria (Diversity, Integrity, Visual quality, Rarity) of the landscape quality represented by the positive value assigned to each optical cone. In the case study there are 20 cones.

Similarly a table is elaborated for the criterion Degradation, since it is interpreted with negative values, from 0 to -5.

The numerical results obtained are of particular significance when they are placed and compared in a scale of values (range). Since there are twenty optical cones analyzed in the case study, the possible theoretical range (case of zero landscape quality with maximum degradation and maximum landscape quality with zero degradation) is the following:

• for the degradation from 0 to -100;
• for the quality from 0 to +500.

At this point it is fundamental to transform the numerical result into a qualitative judgment able to define the class of landscape quality of the landscape (territory) investigated. For this, the scale of values is divided into five levels of landscape quality, represented by the positive value (very high, high, medium, low, very low) for the various criteria used (diversity, integrity, visual quality, rarity), and into five levels of degradation, represented by the negative value (very high, high, medium, low, very low).

The total value of the two evaluations is then inserted into the class of the relevant landscape quality/degradation, as shown in the following Table 7.

Therefore, in the case study it is possible to observe that:

• in the ex ante stage
a. the landscape quality is equal to “+153” and is placed in the class Low
b. the landscape degradation is equal to “0” and is placed in the class Very Low

• in the ex post stage
a. the landscape quality is equal to “+148” and is placed in the class Low
b. the landscape degradation is equal to “0” and is placed in the class Very

5.1 Evaluation judgment: landscape compatibility

In line with what expressed in the introductory chapter, the definition of landscape compatibility of an intervention is not derived from the absence of modifications produced in the landscape but from the preservation, where possible, of the existing landscape quality in the ex ante stage.

In the case study, the global evaluation shows that the landscape quality after the realization of the mitigated project (ex post) is in the same class of the ex ante landscape quality and therefore it is compatible with the landscape.

### Table 7 - Total value class of quality and landscape degradation

<table>
<thead>
<tr>
<th>LANDSCAPE QUALITY</th>
<th>RANGE</th>
<th>EX ANTE</th>
<th>EX POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>+20 ÷ +100</td>
<td>+153</td>
<td>+148</td>
</tr>
<tr>
<td>Medium</td>
<td>+101 ÷ +200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>+201 ÷ +300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very high</td>
<td>+301 ÷ +400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape quality</td>
<td>Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low</td>
<td>0 ÷ +100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>+101 ÷ +200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>+201 ÷ +300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>+301 ÷ +400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very high</td>
<td>+401 ÷ +500</td>
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</tbody>
</table>
6. CONCLUSIONS

This landscape evaluation model, which the work team has been applying for many years, shows that the landscape transformations can be measured, and this enables to define the level of landscape compatibility of an intervention in a “scientific” way.

However, the level of the emotion that a landscape produces cannot be measured, since the feeling escapes logical, rational and coherent criteria. This level cannot and must not be used by public authorities to issue a judgment of landscape compatibility of a planned intervention.

References


CAMPEOL G., CAROLLO S. & MASOTTO N. (2016). The “measure” of landscape transformation. Methods and techniques of multi-criteria evaluation in the opencast mining area of Paderno del Grappa (Venetian Pre-Alps, Italy). In “XXVII session of the PECSRL biennial international conference”. Innsbruck (Austria), 5-9 September.


