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The assessment of aesthetic and perceptual aspects within environmental impact assessment of renewable energy projects in Italy

Michela Tolli [a,*], Fabio Recanatesi [b], Matteo Piccinno [b], Antonio Leone [b]

[a] Department of Architecture and Design (DiAP), Sapienza University of Rome, Via Gramsci 53, 00197 Rome, Italy
[b] Department of Agriculture, Forests, Nature and Energy (D.A.F.N.E.), Tuscia University, Via S. Camillo de Lellis, 01100 Viterbo, Italy

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ABSTRACT

The main aim of this paper is to explore how perceptual and aesthetic impact analyses are considered in Environmental Impact Assessment (EIA), with specific reference to Italian renewable energy projects. To investigate this topic, the paper starts by establishing which factors are linked with perceptual and aesthetic impacts and why it is important to analyze these aspects, which are also related to legislative provisions and procedures in Europe and in Italy. In particular the paper refers to renewable energy projects because environmental policies are encouraging more and more investment in this kind of primary resource. The growing interest in this type of energy is leading to the realization of projects which change the governance of territories, with inevitable effects on the landscape from the aesthetic and perceptual points of view. Legislative references to EIA, including the latest directive regarding this topic show the importance of integrating the assessment of environmental and perceptual impacts, thus there is a need to improve EIA methodological approaches to this purpose. This paper proposes a profile of aesthetic and perceptual impact analysis in EIA for renewable energy projects in Italy, and concludes with recommendations as to how this kind of analysis could be improved.

Contents

1. Introduction

Both the speed and intensity of landscape changes are increasing and in order to assess the impacts of these changes rapid evaluation based on objective scales of measurement are needed. These needs have often resulted in a more detailed assessment of the ecological and environmental aspects at the expense of aesthetic and perceptual aspects (Gobster 1999; Parsons and Daniel, 2002), mainly because of the difficulty in measuring and assessing these aspects rapidly (Kaplan, 1987; Kaplan & Kaplan 1989; Daniel T.C. 2001; Vargues & Loures 2008; Sevenant & Antrop, 2009).

Since the European Landscape Convention (ELC), adopted in 2000 by the Council of Europe, landscape has become a central topic in land management, policy and planning. The definition of landscape given in the ELC puts the focus on the human experience of landscape, highlighting issues of the perception and aesthetic aspects; article 6 letter C of the ELC asserts: "to assess the landscapes thus identified, taking into account the particular values assigned to them by the interested parties and the population concerned". The "Recommendation CM/rec (2008)", stresses the role played by human perception regarding the

* Corresponding author at: Via G. Baldinelli 42c, 00052 Cerveteri, Rome, Italy.
E-mail addresses: michela.tolli@uniroma1.it, michela.tolli@gmail.com (M. Tolli), fabio.rec@unitus.it (F. Recanatesi).

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preservation and enrichment of the population's cultural heritage and it asserts that: "It implies recognition of the rights and responsibilities of populations to play an active role in the processes of acquiring knowledge, taking decisions and managing the quality of the places where they live. Public involvement in decisions to take action, and in the implementation and management of such decisions over time, is regarded not as a formal act but as an integral part of management, protection and planning procedures".

For these reasons, in recent years, a number of scientific studies have shown the importance of considering aesthetic and perceptual aspects in the planning and evaluation of the landscape, but many difficulties in dealing this matter at the implementation stage persist (Daniel and Boster, 1976; Nassauer 1997; Harrison & Burgess, 2000; Luz, 2000; Pinto-Correia et al., 2006; Dupont et al., 2015).

The reasons for these difficulties are mainly due to a lack of methodologies and parameters shared by the entire scientific community. In fact, the professional who faces an EIA adopt shared methodologies only for some aspects concerning aesthetic and perceptual assessment (e.g. visual analysis through viewshed analysis), but the study of these aspects is much more complex, indeed there is a distinction between aesthetic judgment and perceptual judgment of the landscape (Berque, 1994; Gobster 1999; Gobster et al., 2007; Cassatella 2011). Aesthetic judgment is especially linked to visual and sensory perceptions in general (e.g. touch/feel, smells, sounds, form, pattern, texture and colors) while perceptual judgment also includes the intangible values that are associated to a landscape (e.g. cultural value, use value, emotional and evocative value, etc.) (Cassatella 2011; Tudor 2014). All these aspects are dealt with very heterogeneous methodological approaches by professionals and sometimes many of these aspects are completely overlooked.

The two sets of aspects are tightly linked by cross-relationships, therefore we believe that it is useful to analyze them through a single methodology, since both are subjective values and strongly influenced by cultural and social factors. In this regard, many studies have demonstrated that the same landscape may elicit different perceptions from different people (Brabyn, 1996; Conrad et al., 2009; Dupont et al., 2015). The population in this type of evaluation has a central part to play and research concerning the involvement of local people is ongoing. Understanding how to measure and parameterize aspects of perception consistently is therefore an issue that still leaves a lot of confusion, despite the fact that such investigations have already been under way for some time (Leopold 1969; Boster & Daniel, 1972; Daniel & Boster, 1976; Carlson 1977; Bishop & Leahy 1989; Gobster & Chenoweth 1989; Del Furia 2000; Kovacs et al., 2006; Conrad et al., 2009; Sherrouse et al., 2011; Wagtendonk and Vermaat, 2014). In this scenario, therefore, the professional has the daunting task of coordinating and synthesizing heterogeneous and subjective information, including that coming from the people involved, and this is not possible without an adequate and full methodological support.

1.1 Renewable energies and perceptual-aesthetic impacts

European policies on climate change increasingly encourage the use of renewable energy as an alternative to fossil fuels (a policy framework for climate and energy in the period from 2020 to 2030, Brussels, COM, 2014). The growing interest in this type of energy leads to interventions that change the governance of the territory, with inevitable effects on the landscape.

In Europe, landscape transformations produced by large-sized works and having a high potential impact are assessed mainly through the Environmental Impact Assessment (EIA), which, according to European and national level legislation, must also include the assessment of effects on the landscape. Subsequent to the European Landscape Convention (ELC), it is now widely recognized 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, so its values are related both to its ecological functionality and to perceptual and cultural aspects. Despite the fact that the ELC introduced the principle that all aspects of landscape should be considered an integrated manner, and although many scholars have emphasized the importance of including aspects of aesthetic perception in management, planning and evaluation of the landscape (Fry, 2001; Opdam et al., 2002; Tress & Tress, 2001, Tress et al., 2001, 2005, 2007; Dramstad et al., 2006; Gobster et al., 2007; Wissen et al., 2008; Recanatesi et al., 2014; Junge et al., 2015), these aspects have not yet been addressed in the main assessment tools, such as Environmental Impact Assessment. One major cause of the lack of integration of aesthetic perception in the process of evaluating landscape transformation may be the lack of indicators and benchmarks for the evaluation of these aspects (Dramstad et al., 2006; Junge et al., 2015). Ecological aspects of the landscape, in contrast, have been addressed from many points of view, and today there are several indices and indicators available to analyze the ecological impacts that a landscape change could produce (Opdam et al., 2002; Wissen et al., 2008; Fry et al., 2009). Furthermore, ecological indicators are increasingly used in the assessment of impacts on the landscape. An important characteristic of such indicators is that they allow quantification, which makes the evaluation less subjective (Tveit et al., 2006; Sevenant & Antrop, 2009; Sevenant & Antrop, 2010).

Thus, the situation as regards the assessment of ecological aspects is very different from that of aesthetic and perceptive aspects. In fact, the latter have received significantly less attention in Europe (Loures et al., 2008; Ode et al., 2008; Fry et al., 2009). It should be borne in mind that in planning and evaluating landscape, it is not very simple to establish a general definition for these aspects. In Italy, as for others EU Countries, this topic is currently under discussion. Italy has a territory with a very high density of human settlements so in a lot of cases the best choice for a wind farm is driven by climatic conditions, or by the presence/absence of landscape constraints. However, often the main factors taken into consideration are aimed at mitigating visual impact in reference to residential areas.

The main reference document for the assessment of landscape changes, in Europe, is the Landscape Character Assessment (Tudor, 2014) of the United Kingdom. LCA is the process of identifying and describing variations in the character of the landscape. LCA documents identify and explain the unique combination of elements and features that make landscapes distinctive by mapping and describing character types and areas. Such documents also show how the landscape is perceived, experienced and valued by people. The LCA document is designed to be a reference point for planning tools, including the Environmental Impact Assessment (EIA). Nevertheless, aesthetic and perception impacts have not yet been taken into account by the EIA in an integrated manner.

Therefore there is a crying need for research in this field, aimed at developing a method of environmental impact assessment capable of assessing all the impacts that a change can have on the landscape.

1.2 Aims and issues

This paper looks at the status quo on the modalities through which the aesthetic and perceptive impact is analyzed in the procedural requirements of the Environmental Impact Assessment (EIA) in Italy. For this purpose, we identified 44 EIA reports. The category of projects considered is that of renewable source power plants (especially wind, solar, biomass and biogas). European provisions, in particular Directive 2009/28/EC, the 20/20/20 targets and the recent document entitled "A policy framework for climate and energy in the period from 2020 to 2030 — COM, 2014", encourage the use of renewable resources in energy production. The European Union has set itself three targets to be attained by 2020 for greenhouse gas Emissions Reduction (20%), renewable energy share (20%) and energy efficiency improvements (20%). Moreover new targets for 2030 are aimed at achieving a 40% reduction

in greenhouse gas emissions and an increase in the renewable energy share from 20% to 45% (COM, 2014).

To achieve these energy goals, the European Community has asked each of its 28 Member States to produce a National Action Plan (NAP) to identify strategies and internal policies aimed at the achievement of individual national targets for renewable energy. A comparative analysis of national action plans presented by the 28 EU member states, shows that energy from renewable sources is planned to grow at an average of 6% per year from 2005 to 2020. The current trend shows a rapid rise, particularly in wind, photovoltaic and biomass power, for which both the statistics of the past and the predictions of the NAPs identify the fastest growth rates. Although these actions offer a common benefit, as they produce energy through an industrial chain defined as more sustainable than that of fossil fuels, for example. The location of the plant generates a conflict between the general benefit and the localized criticality. This conflict affects the places where the plant is realized, in which local communities feel threatened. Local communities in fact, often oppose this type of project. The participation of the people is something that should not be overlooked, because they are also part of the landscape.

The importance of the integration between environmental assessment, evaluation of the landscape and public participation, has also been highlighted by several important European documents, such as the European Space Development Scheme (ESS, Potsdam, 1999) in which the regional and local authorities are urged to cooperate in the definition of sustainable strategies for planning the landscape and for the evaluation of the ability of the landscape to receive plants from renewable energy sources. To this purpose, the European Landscape Convention (COM, 2000) specifies the need to consider the perception of the local people in all landscape interventions.

Furthermore, the Gothenburg strategy (2001) for sustainability emphasizes the need to address the political, economic, social and environmental, synergistically activating processes of consultation among all stakeholders. Finally, the Directive on Environmental Impact Assessment recognizes that participation has an important role to play in reducing the impact and increasing the efficiency of these processes.

Therefore, in this paper we analyze the ways in which the aesthetic and perception impact is considered in Italy in the documents required for Environmental Impact Assessment. In particular, this work aims to identify critical aspects in carrying out analysis of aesthetic perception in EIA and their possible causes.

1.3 Regulatory framework

In the EU, the assessment of the effects of certain public or private projects on context has been mandatory since 1985 with Directive 85/337/EEC which introduced Environmental Impact Assessment (Commission of the European Communities, 1985). This Directive is now replaced by 2011/92/EU, which includes all changes made by the subsequent directives 97/11/EC, 2003/35/EC and 2009/31/EC. The new EIA Directive defines the environmental impact of a given project as a result of the effects that the project has, not only on ecological aspects (as the word "environmental" might lead people to think), but also on social and cultural aspects. Article 3 of Directive 2014/52/EU, which will be completely implemented on May 2017, but it is possible and it is encouraged an earlier adoption, it defines EIA as a planning tool that identifies, describes and evaluates the direct and indirect effects of a project on humans, fauna, flora, soil, water, air, climate, landscape, material assets, cultural heritage and the interaction between all these factors. This definition clarifies the need to consider more than simply the ecological effects of a transformation, since the other terms listed (including man, landscape and cultural heritage) also contain social, cultural, aesthetic and perceptive aspects. Although this Directive has not yet entered into force, it is important that we start to address EIA according to these principles.

The reference to man and the landscape in the Directives concerning the EIA assumed a more precise meaning after the European Landscape Convention (COM, 2000), in which for the first time at a European level, a definition of a landscape quality purpose was provided in the following terms: "landscape means, for a specific landscape, the formulation by the competent public authorities of the aspirations of the public with regard to the landscape features of their surroundings". The innovation of this definition is mainly in the central role accorded to the perception of the people, which should always be considered in an integrated manner with respect to natural factors. In the latest European Directive on EIA, 2014/52/EU, the European Parliament and the EU Council move from 42 aim points, including:

> "(16). For the protection and promotion of cultural heritage comprising urban historical sites and landscapes, which are an integral part of the cultural diversity that the Union is committed to respecting and promoting in accordance with Article 167(4) TFEU, the definitions and principles developed in relevant Council of Europe Conventions, in particular the European Convention for the Protection of the Archaeological Heritage of 6 May 1969, the Convention for the Protection of the Architectural Heritage of Europe of 3 October 1985, the European Landscape Convention of 20 October 2000, the Framework Convention on the Value of Cultural Heritage for Society of 27 October 2005 can be useful. In order to better preserve historical and cultural heritage and the landscape, it is important to address the visual impact of projects, namely the change in the appearance or view of the built or natural landscape and urban areas, in environmental impact assessments."

Therefore in EIA, when identifying, describing and assessing direct and indirect effects on landscape, it is appropriate to refer to the concept of landscape as defined by the ELC. Moreover, the effects that a project may have on the landscape should be evaluated in terms of landscape quality objectives, identified through a survey on the aspirations of the populations (COM, 2000 art. 1 point C). The European Directives on EIA in Italy have been transposed by Law 152/2006. This Decree defines the environmental impact as:

> "the qualitative and/or quantitative, direct and indirect, short and long-term, permanent and temporary, single and cumulative, positive and negative alteration of the environment as a system of relations between anthropogenic, natural, chemical-physical, climate, landscape, architectural, cultural, agricultural and economic factors, as a result of the implementation on the territory of plans, programs or projects at different stages of their implementation, management and disposal, as well as any malfunctions."

So the Italian legislation completely transposes the indications of the European Directive and defines the meaning of the term "Environmental Impact" (Decree 152/2006 Art.5). In cases in which the proposed project falls, even partially, in areas with landscape regulations, the EIA should be in conjunction with landscape authorization. This type of application is based on the assessment of the compatibility of the intervention through the creation of a landscape report produced by the designer. The landscape report is undoubtedly an important first step towards making landscape management actions active at all levels, but as it is addressed only to restricted areas, it is not yet sufficient to ensure the protection and enhancement of all landscapes, as envisaged by the European Convention.

1.4 EIA reports

According to the national legislation (Decree 152/2006, Title III, Article 19), EIA is carried out through a series of prescribed steps: a) conducting a screening of the project; b) defining the contents of the EIA reports; c) the submission and publication of the project; d) a consultation phase; e) assessment of the EIA reports and the results of

consultations by the Ministry and the Regions; f) the decision; g) information on the decision; h) monitoring. The Ministry of the Environment and the Regions are the governing bodies responsible for the assessment of the documents submitted by the proponent. They assess the suitability of the new intervention through the contents of the EIA reports, which is the document that describes both the characteristics of the environment and landscape at the status quo and the predicted impacts of the project. Article 22 and the annex VII define the contents of EIA reports as follows: a) a description of the project with information about its characteristics, location and size; b) a description of the measures planned to prevent, reduce and offset significant adverse impacts; c) the data required to identify and assess the main impacts on the environment, cultural heritage and landscape, which the project may produce, both during construction and during operation; d) an outline of the main alternatives studied by the applicant, including the zero option, stating the main reasons for the choice; e) a description of the measures provided for monitoring..

Annex VII point 6) emphasizes the need to consider the impacts on the landscape caused by the project, also through the description of any cultural and landscape elements which may be involved.

The legislation, however, does not provide guidance on how to analyze the expected impacts. In case of designated landscapes, EIA must be accompanied by landscape authorization, which follows the Decree 12.12.2005 main features: a) analysis of the current status of the project site; b) details of the project; c) elements for assessing landscape compatibility. In addition, some quality parameters (Diversity, Integrity, Visual, Quality, Rarity, Degradation) and risk parameters (Sensitivity, Visual Absorbency, Stability, Instability) of impact assessment for the latter are also described. However, these parameters do not have prescriptive value, and are only for reference..

2. Review method for EIA reports

A sample of 44 projects was identified, provided on-line from the archive of the Ministry of the Environment (MATTM) and the archives of the Regions. The sample consists of four types of projects related to the production of energy from renewable sources: wind power, photovoltaic ground, biomass and biogas. From 44 projects identified, only 29 had the necessary documentation for the complete analysis. For each of 29 projects, the review focuses on the main document required by the procedure of Environmental Impact Assessment: the EIA report. As shown in Fig. 1, the composition of the sample analyzed includes most of the Italian regions and it is distributed reasonably evenly throughout the national territory.

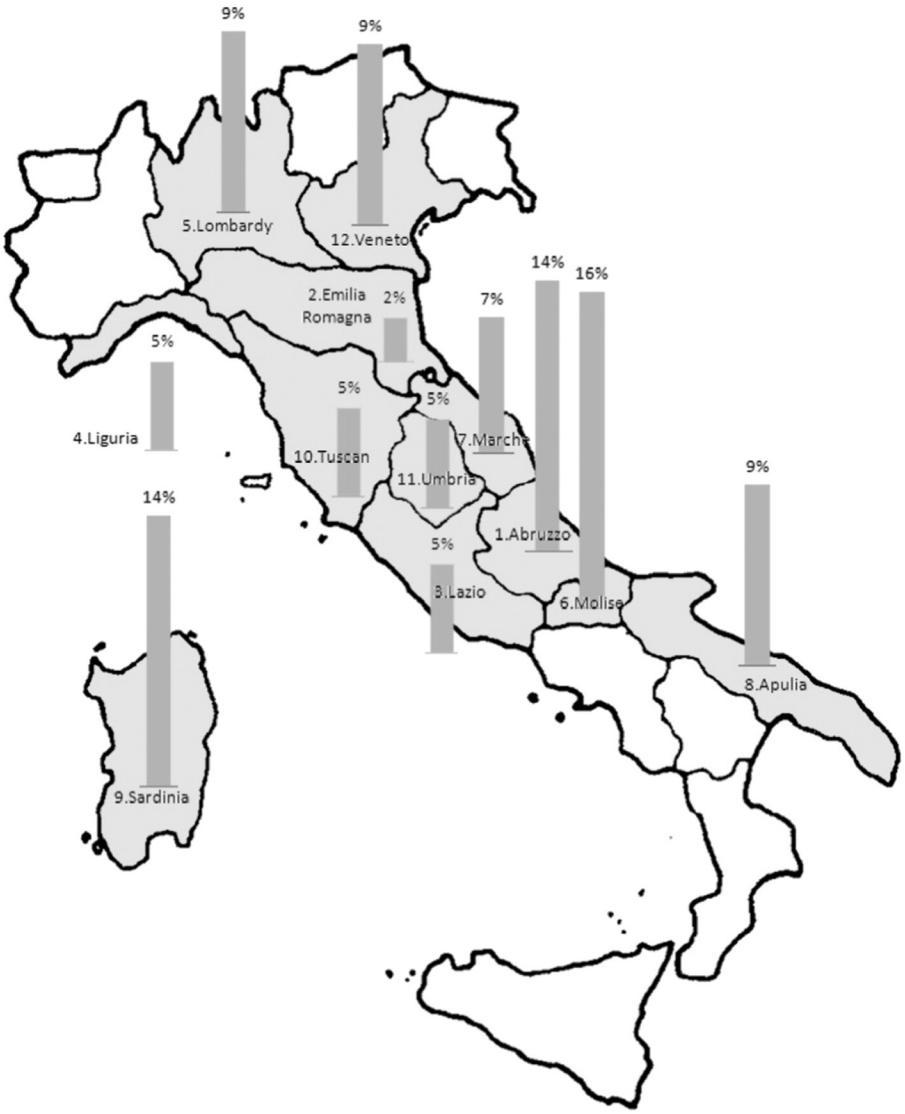

Fig. 1. Regional distribution of studied projects.

The sampling procedure is mainly based on a time criterion. We considered all the available projects assessed after 2000, when the European Landscape Convention changed the concept of landscape and the concept of impact on landscape. The review process was based on the identification of components and methods used to identify aesthetic and perceptual impact in the documentation expected by the EIA. The elements necessary for that evaluation, were identified through the support of reference literature (Tveit et al., 2006; Loures, 2008; Fry et al., 2009; Tudor, 2014). Most of the components that characterize the aesthetic impact of perception, can be identified through the involvement of stakeholders and through surveys and interviews with people, however there are some studies that experiment the possibility of identifying the aesthetic value through indices, indicators and GIS applications (Sevenant & Antrop, 2009, 2010; Schirpke et al., 2013a, 2013b).

In order to identify the components and methods used, an analysis worksheet (Table 1) was designed and applied to the documentation of each project analyzed. The analysis worksheet is divided into two sections: Review Categories and Criteria Review. The Review Categories section refers to the entire documentation of the EIA reports and includes the first three points: 1) documentation mentioning aesthetic perceptual impact; 2) documentation providing a definition of aesthetic perceptual impact; and 3) documentation referring indirectly to aesthetic perceptual impact. This section is useful to understand how the aesthetic and perceptual impact is introduced, in the setting of the study. Instead, the Review Criteria section refers to the part of the documentation that analyzes the impacts of the project. The purpose of the latter section is to determine the types of landscape impact that each EIA report considers.

In the Review Categories section we investigate what types of impact are addressed; in the Review Criteria section how the impacts arising from the effects are analyzed. There are some methods, such as viewshed analysis, that alone are not able to analyze the impact, but only the effect; for the purposes of this work, these are considered as indirect approaches.

The following paragraphs refer to the approach used for the evaluation of the type of impacts considered in the projects; in particular we investigated the presence of a preliminary or parallel involvement of stakeholders and the participatory methods used (interviews, surveys). The last point on the worksheet investigates the use of indices, indicators or specific GIS applications.

The analysis worksheet was structured in Review Criteria and Categories (Cooper & Sheate, 2002; Daini, 2002), which are defined on the basis of the aesthetic and perceptual assessment definition from the main literary and regulatory references, such as the Landscape Character Assessment Guidance for England and Scotland (Tudor, 2014) or the ELC (COM, 2000). However, the Review Criteria include aspects that are not required by law, this choice is due to the lack of a single and clear methodology for the assessment concerning the perceptual and aesthetic impacts adopted at a national scale for EIA procedure. In fact, the examined projects appear very heterogeneous with respect to these issues. Therefore, in order to be able to analyze them, it was necessary first to define how many parameters were possible to be functional to the objective pursued in this work.

Table 1
Analysis worksheet.

Review Categories	Review Criteria
Documentation	Documentation mentions aesthetic perceptual impact
	Documentation provides a definition of aesthetic perceptual impact
	Documentation refers indirectly to aesthetic perceptual impact
	List of the aesthetic perceptual components evaluated
Impact analysis	Documentation considers a preliminary involvement of stakeholders
	Documentation mentions surveys or interview
	Documentation mentions the use of indices, indicators or GIS application

Table 2
Evaluation worksheet results.

Review Categories	Review Criteria	%	No.
Documentation	Documentation mentions aesthetic perceptual impact	7%	2
	Documentation provides a definition of aesthetic perceptual impact	7%	2
	Documentation refers indirectly to aesthetic perceptual impact	100%	29
Impact analysis	Documentation considers a prior involvement of stakeholders	3%	1
	Documentation mentions surveys or interview	0%	0
	Documentation mentions the use of indices, indicators or GIS application	31%	9

3. Results and discussion

Table 4 summarizes the results of this review. From the worksheet applied to all projects selected (Table 2), it appears that only 2 of the 29 projects analyzed, explicitly mention aesthetic and perceptual impact using terms such as:

– "Perceptual quality", defined as the identification of quantitative and qualitative factors of visibility and intervisibility in relation to the structure of the landscapes Biomass power plant ("San Quirico");

–"Study of the phenomenal and perceptive characters", in an aesthetic and cognitive sense, tied to visual knowledge and consideration of visible forms in relation to aesthetic judgments (Wind farm "Gargano South").

Both definitions identify the visibility of the project as a key element in assessing aesthetic and perceptual impact, although they are very different and neither makes any reference to literature on the subject.

Regarding indirect mentioning of the aesthetic impact instead, there is a reference in all the projects analyzed. For the identification of indirect mentioning, we referred to the reference literature, in particular the UK document "Characters Landscape Assessment" (Tudor, 2014) identifies five components to characterize the aesthetic and perceptual aspects of landscape: visual component, sensory component, references, associations and memories. These aspects are the ones most often used by scholars, for the definition of aesthetic and perceptual components of the landscape (Tveit et al., 2006; Loures, 2008). The entire sample analyzed, 29 projects (Table 2), indirectly mentions these components, using terms such as:

–"Overall dimensions view".

–"Concealment of significant visual".

–"Conservation or alteration of the continuity of the relationship between historical and cultural elements or between natural elements".

–"Adoption of constructive types, more or less consistent with those present in the neighborhood, for the same functional destinations".

Table 3
Total list of landscape impacts.

Landscape impact categories	Biomass/Biogas	Wind power	Photovoltaic	%
Morphological	2	1	3	21%
Visual	10	12	7	100%
Symbolic	2	1	1	14%
Social agreement	0	1	0	4%
Limitation to enjoyment	0	0	1	4%
Connotative characters	0	0	1	4%
Chromatic	0	0	1	4%

–"Capacity planning image of relating conveniently with the symbolic values attributed by the local community to the place (the importance of the signs and their meaning)".

The visual component of aesthetic and perceptual impact is the most considered, in fact it is mentioned in all the EIA reports analyzed. As shown in Table 3, other aspects related to aesthetic and perceptual impact were considered, but by a much smaller proportion of the projects than those which considered the visual component. In particular, the morphological component, understood as the consistency of the project with the shape of the landscape, was considered by 6 projects, 21% of

Table 4
Review results.

Projects	Year	Documents	Impacts	Approaches
Wind farm "Vallaurea"	2013	Non-technical summary	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Sant'Angelo Limosano"	2012	EIA report + landscape authorization	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Mercatello sul Metauro"	2010	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Monte delle Danzie"	2011	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "SURITE DEL CUCULO"	2012	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "San. Gavino Monreale"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Pattada"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Nulvi"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "Osilo"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Wind farm "CORTI TURACI E TACQUARA"	2011	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
			Morphological	Documentation considers a preliminary involvement of stakeholders
			Visual	Documentation mentions surveys or interview
			Symbolic	Documentation mentions the use of indices, indicators or GIS application
Wind farm "GARGANO SUD"	2012	EIA report + landscape authorization	Social agreement	
Wind farm "Brindisi"	2013	EIA report + landscape authorization	Visual	Index and GIS applications were used
Biomass power plant "Eridania-Sadam"	2011	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
			Morphological	
			Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biomass power plant "San Quirico"	2011	EIA report	Symbolic	
Biomass power plant "Fiuminata"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biomass power plant "porto Torres"	2012	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
			Morphological	
			Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biomass power plant "Taranto"	2011	EIA report	Symbolic	
Biomass power plant "Bedizzole"	2000	EIA report	Visual	Stakeholders were not involved neither index nor indicators were used GIS applications were not used
Biomass power plant "Voghera"	2000	non-technical summary	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biomass power plant "Assemini"	2008	Non-technical summary	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biogas power plant "Sannazzaro de' Burgondi"	2002	Non-technical summary	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Biogas power plant "Monselice"	2014	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Solar power plant "CAMPOMARINO"	2010	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Solar power plant "TREVI"	2012	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Solar power plant "San Lorenzo in Campo"	2010	Non-technical summary + landscape authorization	Visual Morphological Chromatic	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Solar power plant "Costa di Rovigo"	2011	EIA report	Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used ions
Solar power plant "Castel San Pietro Romano"	2011	EIA report	Visual Morphological Enjoyment limitation Connotative characteristics	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
			Morphological	
			Visual	Stakeholders were not involved; neither index nor indicators were used; GIS applications were not used
Solar power plant "CHIOGGIA 2"	2012	EIA report	Symbolic	
Solar power plant "San Lorenzo in Campo2"	2010	Non-technical summary	Visual	Stakeholders were not involved neither index nor indicators were used GIS applications were not used

the total, and the symbolic component by 4 projects, 14% of the total. The other components were considered only in one project:

–"Social agreement" in Wind farm "Gargano South";

–"Chromatic" in Solar power plant in "San Lorenzo in Campo";

– "Enjoyment limitation" and "Connotative characters" in Solar power plant "Castel San Pietro Romano".

As for the methods through which aesthetic and perceptual impacts were analyzed in the EISs investigated, it was found that only one project, "Gargano South" Wind farm, had involved the stakeholders in the design process, while no project carried out surveys or interviews to understand the viewpoint of the people involved. As regards the use of GIS applications, 8 projects (22% of the total), used indicators to determine the visual impact of the work, through GIS applications (e.g. viewshed analysis). Of the 8 projects, 7 regard wind turbines (Wind farm "Mount of Danzie", Wind farm "Cairo Montenotte", Wind farm "San. Gavino Monreale", Wind farm "Pattada", Wind farm "Nulvi", Wind farm "Osilo", Wind farm "Corte Turaci and Tacquara", Wind farm "Gargano South", Wind farm "Brindisi") and one regards a biomass power plant (biomass power plant "San Quirico").

There is no case in which GIS applications are applied in projects regarding ground level photovoltaic power plants.

The results of this review indicate that the environmental impact assessment of renewable energy plants in Italy continues to be fragmentary. In addition, not all possible impacts are adequately considered, in particular many aspects concerning perception and aesthetic impact are neglected. In fact, 79% of the projects consider this type of impact only in terms of visibility, while only 22% of the projects apply innovative tools and methods, such as indexes or GIS applications, to make the assessment. Moreover, it is particularly significant that the aesthetic and perceptual impact is understood differently in each project. In the sample analyzed, the only two environmental impact studies that directly mention the aesthetic impact of perception, provide two different definitions.

Furthermore, other environmental impact studies that refer indirectly to aesthetic perception, do so in an incomplete way, considering only certain (e.g. visual or chromatic) aspects and completely ignoring others (e.g. preferences, associations, memories). However, a growing trend emerges regarding the use of indices and GIS applications in the most recent projects (2013–2014), especially for wind power.

Another point of interest that emerges is that it is impossible to identify specific differences distinguishing the projects evaluated only through an EIA report from those that were also assessed through a landscape report, even though the reference standard for the latter is much more detailed. The impact analyses conducted as part of the projects for which a landscape report was also carried out (Wind farm "Sant'Angelo Limosano", Wind farm "Gargano South," Wind farm "Brindisi", Solar power plant "San Lorenzo in Campo") do not differ from the others; the only project which stands out for the completeness of its analysis is the Wind farm "Gargano South" project.

In contrast, it is possible to distinguish between the different project types by considering impacts related to aesthetic perception. Although wind power plants are the most numerous project type in the sample analyzed, only one such project is characterized by an analysis of more than one type of impact in addition to the visual impact (Wind farm "Gargano South"), as you can see in Table 3. On the other hand, two of the biomass and biogas projects analyzed take into consideration the effects on the visual, morphological and symbolic components. The type of project which is the most complete from this point of view, however, is that of photovoltaic power plants. Of the seven photovoltaic projects analyzed in the sample, two take into consideration the effects on visual, morphological, symbolic and chromatic components, while another is the only case of the whole sample analyzed which also takes into account impact on enjoyment limitation and connotative characteristics.

3. Conclusions

The review shows an inconsistent and unequal treatment of aesthetic and perceptual aspects in the documents reviewed and highlights the limitations of the methods used to obtain an integrated assessment of all the impacts produced by each project analyzed. A comparison between the requirements of the legislation and the results of the review, stresses that the EIA for renewable energy continues to fail in addressing the question of aesthetics and perception in an exhaustive manner.

For a number of years now, European legislation on EIA and ELC (both ratified by the Italian legal system) has been set up to make evaluation of impacts as holistic as possible. Although the legislation emphasizes the importance of considering all components of the landscape in the process of environmental impact assessment and although there are some regional and ministerial guidelines regarding this issue (Di Bene & Scazzosi 2006; Cassatella 2014; Cassatella and Cinà 2015), the aesthetic and perceptual aspects not are still considered in a comprehensive and coherent manner in renewable energy projects. A very important measure which would contribute to making the environmental impact assessment more holistic, would be to give the aesthetic and perceptual aspects equal weight compared with the other impacts considered in the process of decision-making. This, however, cannot be brought about until there is a uniform, shared, interpretation of the concept of perceptual and aesthetic evaluation in the planning context. The definition of aesthetic and perceptual judgment is not clear, some researchers believe in a non-cognitive perception, stressing various kinds of emotional and feeling-related states and responses as intrinsic perception parameters; by contrast, others contend that cultural codes prevailing, so perceptual parameters change for each society and period.

This heterogeneity along with subjective nature of this kind of evaluation, are the main causes of the deficiency of thoroughly tested and shared parameters for all aesthetic and perceptual components, as is the case, instead, for ecological environmental aspects.

Research is ongoing in this direction, indeed, there are many scholars who are tackling the challenge of assessing the landscape from an aesthetic and perceptual point of view, through the use of innovative methods, and by experimenting indices, parameters and GIS applications. Therefore the authors believe the time is ripe to find a way to ensure that the EIA becomes a real holistic tool for the assessment of landscape transformations. The identification of an operative method for the assessment of the aesthetic and perceptive impacts could represent a very useful and functional tool at different levels of landscape planning. Indeed, the same approach could also be applied for instruments at a larger scale, such as the Strategic Environmental Assessment (SEA) or for landscape planning. For this purpose, in some countries (e.g. France, Italy), landscape plans provide in the identification of suitable or unsuitable areas to the inclusion of renewable energy installations; if the identification of these areas were also supported by an aesthetic and perceptual analysis, more complete results would definitely be obtained.

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